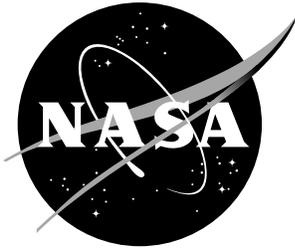


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Pilot Comments From the Boeing High Speed Research Aircraft, Cycle 3, Simulation Study of the Effects of Aeroservoelasticity (LaRC.3)

*Melvin L. Bailey, Editor
Lockheed Martin Engineering & Sciences Company
Hampton, Virginia*

July 2000

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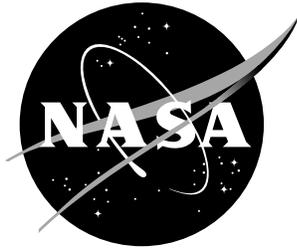
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Abstract

This is a compilation of pilot comments from the Boeing High Speed Research Aircraft, Cycle 3, simulation study of the effects of aeroservoelasticity, conducted from October to December 1997 at NASA Langley Research Center. This simulation study was conducted using the Visual Motion Simulator. The comments are from direct tape transcriptions and have been edited for spelling only. These comments were made on tape following the completion of each flight card, immediately after the pilot was satisfied with his practice and data recording runs. Six pilots were used in the evaluation and they are identified as pilots A through F. Cooper Harper Ratings (CHR) or Handling Qualities Ratings (HQR) are given along with Dynamic AeroServoElastic (DASE) effects for Control Input Ratings (CIR) and Ride Quality Ratings (RQR). Quasi-static Aeroelastic Effects (QSAE) on the Head Up Display (HUD) are also addressed.

Configuration 01, Dynamic aeroelastic effects turned off, qsa0

Exposure 23

DATE: 23Oct97

PILOT: A

TASK: 1001

CARD: Nominal Approach and Landing

Task rating for the straight-in approach; Some comments first of all about the configuration. It seemed very QSAE zero like. I didn't detect any ASE responses in any of the axis from some doublets, -abrupt inputs. Appeared to be seat of the pants very light turbulence. The behavior in close was indicative of maybe a little bit more than that. The up and away approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes -a three. No problems at all. The glideslope deviation that showed adequate was my fault for being late to correct to glideslope and also doing some doublets there. Lateral up and away; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Pretty much all desired's or very close to desired's. Last two were desired's and the first two were just barely out, so we'll say adequate performance was attainable but it was not satisfactory without improvement. We'll rate it a four for borderline desired-adequate although all four of them were ... there were no outliers. They were all four were all right there close to it. Lateral, performance wise it was no problems there. So it was controllable? Yes. Adequate? Yes. Satisfactory? Yes. I am going to go with a four again just for workload in the task but you meet the criteria. The CIR rating; Did not alter my control inputs in any way shape or form. That's going to be a one and the RQR; No DASE influence was apparent to me and the very, what appeared to be looking out the window and seat of the pants, very light turbulence did not impact the quality or I guess I could say the vibrations were perceptible but (not) objectionable. So they were perceptible so let's go with a two for that, the RQR. I had some airspeed excursions with autothrottles up around four knots. The max was up around four and a half knots, I think and averaged around three point five or so. So we are getting a little bit of airspeed variation there but it certainly feels like very light turbulence and no on the aeroelastic display question.

Exposure 23

DATE: 23Oct97

PILOT: A

TASK: 2001

CARD: Lateral Offset Landing

The up and away, approach, no problem at all. Both really nice. It does takes minimal pilot compensation so for both lateral and longitudinal ratings that's going to be a Cooper Harper of three. Pretty easy call there. For the landing phase, this is for the correction turn on down, for the longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? I'm going to say yes. This was probably the nicest configuration for the offset landing that I have seen in all the exposures so far and want to call attention ... I would call that level one. The first time I was just late pulling the power off. That was my error and not the configuration's error and was just kind of brain dumped there and that resulted in slightly long one. But the second one felt real good, real good longitudinal control throughout the turn and a very nice configuration. For the lateral rating; Controllable? Yes. Adequate? Yes. I am also going to give this a three. Satisfactory? Yes, level one. Again this was a superb configuration for the offset approach task which is in itself a fairly difficult task but

it certainly seemed very nice laterally, in the lateral axis. No overshoots, real easy to capture the right bank angle that I wanted. Rolled out well. I didn't have much workload for lineup and had pretty good lineup results. So very nice all the way around. For the CIR; we can stop at number one. I didn't do anything to change my technique based on perceived DASE modes. For the RQR; The motions are virtually undetectable, I will go with a two on that. It's borderline one-two. You don't think about it. You don't feel those motions. So let's caveat that two, just kind of borderline one-two. And let's go with no on the display question.

Exposure 23

DATE: 23Oct97

PILOT: A

TASK: 3001

CARD: Composite Flight Director Tracking Task

Very nice configuration, no real problems at all. For the rating, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three. Certainly does take minimal compensation to complete the task. Lateral; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three also. One of the better lateral performers. First time I was kind of smooth not for any fear of anything. Second time I was very aggressive and had no problems whatsoever with any type of DASE responses. For the CIR; One certainly. Did nothing out of the ordinary to adjust my inputs. And for the ride quality; Based on the dynamic nature of the maneuver, I really could not feel any motions whatsoever. I would rate that a one for this task. And no for the display question.

Exposure 15

DATE : 05NOV97

PILOT: B

TASK : 1001

CARD: Nominal Approach and Landing Task

Exposure fifteen, straight in landing, longitudinal Cooper Harper for approach, I'd say a two. And for the landing, we're between desired and adequate. I think I could give it a three. You think that was more adequate? Call it a four. In order to be desired, all of them have to be desired? And lateral-directional, those were all in the desired range weren't they? Actually I could give it a three for that. On both, approach... And for the DASE influence CIR rating, I guess I could give it a one. And I didn't see very many objectionable vibrations, call it a two. And the answer to the display question, I could say that it was a no.

Exposure 15

DATE : 05NOV97

PILOT: B

TASK : 2001

CARD: Offset Landing Task

Exposure fifteen, the offset approach and landing Cooper Harpers were largely adequate performance. I guess I'll give it a four. Actually, a four for approach and landing. Lateral-directional, the same thing. Four for approach and landing. DASE (control) influence, a

one and ride quality seemed pretty reasonable. I guess I'd have to give it a one and I did not see any aeroelastic display perturbations that impacted me in the task.

Exposure 15

DATE : 05NOV97
PILOT: B
TASK : 3001
CARD: Flight Director Tracking Task

Exposure fifteen flight director tracking. Longitudinal Cooper Harper was; we did get desired performance and I think I'd give it a two. Lateral tracking a three and DASE (control) influence one. Impact on ride quality a two. And no impact on displays.

Exposure 19

DATE: 13Nov97
PILOT: C
TASK: 1001
CARD: Nominal Approach and Landing

Okay, this is configuration nineteen, the offset ILS approach to a straight in approach and landing. I'm not feeling any structural vibrations at all. What I'm feeling, feels very much like baseline. The turbulence is not exciting any structural modes and I can't see any structural modes that I'm exciting through longitudinal or lateral-directional inputs. So what I'm feeling is very much baseline airplane. I'm gonna give that four threes. A three, three, three, and a three with the caveat that the longitudinal on landing is very, very close to level two. It's very close to bumping into level four or to HQR four. In fact I'm gonna give it threes. CIR of one and RQR of one. I'm not feeling anything at all, this feels like a baseline airplane. No display impact. That concludes these comments.

Exposure 19

DATE: 13Nov97
PILOT: C
TASK: 2001
CARD: Lateral Offset Landing

Okay, configuration nineteen, offset approach and landing and the task is clearly task driven. It's not structural vibrations... really have nothing to do with it. For the approach phase, pretty much level one. No major problems with it. Longitudinal, three, lateral-directional three, minimal compensation. For landing, longitudinal is four, moderately compensation for desired performance and lateral-directional is three. So, three, three, four three. The issue is task driven. It's difficult to set yourself up well so I'm fighting the sink rate vs. longitudinal distance battle and generally landing a little bit firm. I think I got 4.1 and 4.6 on those. CIR is one, RQR is one. No display impact. That concludes these comments.

Exposure 19

DATE: 13Nov97
PILOT: C

TASK: 3001
CARD: Composite Flight Director Tracking Task

Exposure nineteen, flight director tracking and capture. Again, baseline aircraft, fairly benign task, fairly easily controllable. Controllable, adequate, satisfactory. Minimal compensation, HQR of threes, both axes. CIR is one, RQR is one. No display impact. That concludes these comments.

Exposure 14

DATE: 18Nov97
PILOT: D
TASK: 1001
CARD: Nominal Approach and Landing

Okay this exposure fourteen nominal approach and landing. This was a puzzle. The approach was fine, it felt good. It didn't feel like a lot of oscillations or anything and it was as precise as I can usually get them. Except for dropping the glideslope out of my cross-check for a moment. It was all fine. Satisfactory without improvement, yes. Three for longitudinal lateral-directional. Landing is a real puzzle to me. I don't what to make of this. I even had one in there that wasn't adequate but I'm gonna say that was an anomaly, unexplained. The majority of the time the adequate performance was attainable. Longitudinally, satisfactory without improvement, no. I've got to give it a five. Consistently long and usually a little hard. The best I could do on that would be a five. I was considerable. The thing that surprised me is feels so solid and everything. To have a performance like that, is a surprise. As far as Lat. Dir. goes, it satisfactory without improvement. Far as I'm concerned, could make that a three. That was not the problem in this straight in approach. For CIR, I think that was a one. I don't remember making any inputs. There was very little bouncing around going on. I'd say two as far as RQR. Yeah, there were some vibrations there but I don't think anybody'd complain about that if that were turbulence. Display perturbations, well, it was different then the other ones that I saw. The other ones tend to have the glideslope marker. Thus, I put the flight path marker on it. That's usually just short of the runway and this look like it was more normal type location. There were no perturbations that effected it. In other words, it wasn't moving around. It was staying where it should be, so I'd have to say no on the display.

Exposure 14

DATE: 18Nov97
PILOT: D
TASK: 2001
CARD: Lateral Offset Landing

Okay, exposure fourteen, offset landing comments. Approach, well it felt smooth. I didn't see any large oscillations or anything. Certainly adequate performance, satisfactory without improvement? For the approach, I'd say yes. I pretty well put it where I felt I wanted it and was confident it would go there. So, another three and three on the longitudinal, lateral-directional. Landing however,... this'll be pitch. Adequate performance satisfactory, no. Another five for just being usually a little long and a little firm. Five for longitudinal. Lat. Dir. I think I'll stick with a four on that. It doesn't have quite the tight feel that I'd like to have, that's for sure. So, it's a little minor annoying, not being quite as connected to the

stick as I'd like. So, five and four for longitudinal (and) Lat. Dir. CIR, again is one, I'd say. Two, just very minor little bumps. (Display perturbations). Oh, and display perturbations not a factor.

Exposure 14

DATE: 18Nov97
PILOT: D
TASK: 3001
CARD: Composite Flight Director Tracking Task

Pilot comments, exposure fourteen, tracking task. Okay, for the director task, in both cases, adequate performance and satisfactory without improvement. Yeah. I'm gonna go with the longitudinal being a four and the Lat. Dir. being a three. I'm sorry, turn that around. The longitudinal being a three and the Lat. Dir. being a four. CIR one, and RQR ... I hardly felt any that time but I guess they were perceptible, two. (No display problems). That's correct, no display problems.

Exposure 4

DATE: 03Dec97
PILOT: E
TASK: 1001
CARD: Nominal Approach and Landing

The date is December 3rd This is the morning session. Pilot E is the pilot. This is Exposure 4, Nominal Approach and Landing. For the intercept I really don't have much to say. I did try a little bit of just some pulses in roll and pitch. I really did not see much, it almost seemed like the basic airplane. The part of the rigid airplane we did yesterday, I would give it a two and a two for the Glideslope and Localizer Intercept. For the approach segment, I guess on this one we go down to 200 feet for the approach segment. Again, I thought it was pretty easy to track. I give it a two and a two for the approach segment. For the landing phase, the only real comment, the big thing I noticed here is that just below 150 feet on all three runs that we did the actual and commanded flight path vector split in the glide path or in gamma. In order to maintain you aim point down to flare initiation you have to compensate and put the power ... to hold your actual flight path where you want it. I guess I probably ... and that happens without any control input, I guess again just from a philosophical standpoint, I have a hard time splitting axis and I also think that half ratings within the boxes except between four and five are probably appropriate. I would probably lean towards a two and a half if we were going to go with full ratings or just integer numbers, I guess just because of the split I don't know ... I guess I would probably go with a three just because of the split. I would probably actually go with two and a half's. So we'll go with a three and a three. On the DASE, on the control inputs I would probably go with a one because I do not think I was really modifying any of my inputs. I would probably go with a one for ride quality too. I didn't really notice much from the rigid airplane we did yesterday and I would probably go with a no for the displays.

Exposure 4

DATE: 02Dec97
PILOT: E
TASK: 2001

CARD: Lateral Offset Landing

Pilot E, Exposure 4, Offset Landing. Okay, the approach phase, first of all I would say is a two and a two. Now, let me back off on that because this one the approach phase goes down to 50 feet. So, okay, I guess first I probably should make a basic comment. I think I got better performance here than I have in the past because I was less aggressive at trying to correct back to the glidepath. That seemed to give me a lot better results. I think it gives me more time to get the alignment taken care of and it also gives me a more predictable flare. So, I think this was a large step in the learning curve here. We did get desired performance on one of the runs. During the approach phase we always got desired. I guess I still think you have to make the right correction the first time, you don't have much to play with mainly because of that 50 foot window on the Bank Angle limit. I'm going to go with a four and a four for both the approach and the landing task. The tracking on the approach is fine. I still think making the offset at 250 feet, making that turn and setting it up has everything to do with making the landing right. So, I am going to go with a four and a four for both. I am going to go with a one and a one for control inputs and ride quality and a no on the display.

Exposure 4

DATE: 03Dec97
PILOT: E
TASK: 3001
CARD: Composite Flight Director Tracking Task

Pilot E, Exposure 4, Flight Director Tracking. I think there are some learning curves between improvements between yesterday and today. The particular tracking profile we flew ... it seemed that both profiles were close to being the same. I still think that in roll, because of the way the flight director is set up, the task is a little bit more difficult making roll or in trying to track the roll command verses tracking the pitch command. I guess I'm having a hard time going between is it satisfactory without improvement between a three and a four for the task. I think this time I am probably going to go with a three and a three. This configuration seems kind of like the rigid body to me almost. Anyways I'm going to go with a three and three. One for control inputs, one for ride quality and a no for display. I guess that's about it. I think there is some learning curve from yesterday to today. Also, I really couldn't attribute anything to the flexibility on this particular one, I guess.

Exposure 5

DATE : 09Dec97
PILOT: F
TASK : 1001
CARD: Nominal Approach and Landing Task

Okay, pilot rating, on my first evaluation on the ninth of December, Pilot F. Let's rate the approach first and just as a comment, it looks like we had no structural modes nor did we have any quasi steady ... well how do I say that. There was no droop in the displays so apparently we had no modes and I could not detect any vibrations in neither. Okay, the pilot ratings for the approach, longitudinal, it's pretty good but let's give it a four just four minor but annoying deficiencies. You know, it's raw data approach. Same thing laterally, a four, same reason. Landing, longitudinal, it's tough to get the H dot and X position again with the visual cues and I finally discovered where the radar altimeter is, I still haven't got it in my scan and I'm relying on the fall outs. But we are forced into a five because of the

performance. So let's give it a five for longitudinal. Lateral, we were definitely desired. And I think for the task the way we saw it there, it's really pretty good for the landing, let's give it a three. Okay, DASE. As far as I could tell there wasn't any. Pilot does not alter control inputs. Okay, so a one. For the ride, a one. And no! (On the displays question.)

Exposure 5

DATE : 09Dec97
PILOT: F
TASK: 2001
CARD: Lateral Offset Landing

Okay, pilot comments on the offset task. And the approach, which is down to fifty feet now isn't it? So the approach longitudinally, is not too bad, I was having a little problem where the touchdown marker was, I got that clarified. But it's still a pretty difficult task, the visual cues aren't real good out there, so let's give it a four for longitudinal. Lateral, let's give it a five cause it's a very difficult task, it's a ... Okay, landing, longitudinal, on my performance I'm into inadequate that I'm going to throw that one out because I was really trying to sort out that runway marking on this series here because it was really the first one where I haven't had the droop of the QSAE. And let's assume that the performance is adequate and longitudinally the landing requires considerable pilot compensation, let's give it a five. And the lateral ... I'm going to ignore that eight point six too. And say that the performance ... I'll have to give it a five at best. Really theoretically I ought to give it a seven but the ... Okay, how about a one, one and an "N".

Exposure 5

DATE : 09Dec97
PILOT: F
TASK: 3001
CARD: Composite Flight Director Tracking Task

Okay, pilot F, comments on the flight director tracking task, exposure five. Okay, pilot comments on the flight director. Again, you know, no flexible body disturbances. It's just plain old rigid body. And both the longitudinal and lateral have some minor but annoying deficiencies. We were obviously getting desired performance. But I would like a Nav display because I would like a little bit of a heads up what's coming next. So it requires quite a bit of compensation to try and figure out what's happening. Let's give them both four's. Four, four. And the DASE is one, one, "N".

Configuration 02, Baseline DASE configuration, base0

Exposure 19

DATE: 22Oct97

PILOT: A

TASK: 1002

CARD: Nominal Approach and Landing

Straight-in approach and landing, longitudinal rating for the approach; Controllable? Yes. Adequate performance? Yes. Satisfactory without improvement? I'm going to say no and rate it a four. There is enough turbulence driven motions that make the task a little bit higher workload than I would like to see for the longitudinal rating. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. I am also going to rate that a four. And again even the light turbulence is enough to excite the aeroelastic modes and make some very substantial motions. This is a pretty bad configuration. Both lateral and longitudinal axis, we have very large amplitude, very lightly damped ASE motions. These are the largest amplitudes that I can recall so far. They appear to be as large as anything I have seen. The rudder also results in ... which we don't see very often, but it results in very large amplitude responses and there are two motions. One is about a second delay after the other about a three second delay and they are both fairly significant responses. So over all a very bad configuration. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. Basically had some borderline desired-adequate approaches but I didn't really feel like I was totally in control. Based on Cooper Harper ratings it looks like this was more towards a five so I'll rate it a five longitudinally but it certainly is not a very good configuration at all. Very very large amplitude and lightly damped motions and especially in the flare when you go to that high gain task. In the flare I was very careful and not abrupt inputs whatsoever to try to not excite any of these motions. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. I'll rate that a ... I met desired criteria, I'll rate that a four. Not real good lateral performance because the lateral axis is also is very active in turbulence and with any kind of motions, I was kind of wandering around the localizer to a certain extent, getting really bounced around a lot and I'm reluctant to put in a lot of corrective inputs. For the CIR, obviously this did influence my inputs so one and two do not apply. Let's look at three and four. Number three, vibrations impact precision. That's true. Vibrations cause occasional involuntary control inputs. I don't think so, we'll look at that carefully again on the offset. We'll go with a three on that. For the RQR, obviously we can skip the first couple because we do have problems here. Let's look at number three, mildly objectionable. That's not true. Four, moderately objectionable. Five highly objectionable. Let's go with five. These are way to large an amplitude. (Five?) Five for the RQR. Even though it's not very lightly damped, it's kind of lightly damped, we're getting about three or four overshoots. The amplitude of the overshoots or the motions is so high that it really makes it requiring improvement. No problems with the displays.

Exposure 19

DATE: 22Oct97

PILOT: A

TASK: 2002

CARD: Lateral Offset Landing

Longitudinal rating for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? No. I am going to rate it a four again for workload and for compensation required which is the motions are making ... you have to work harder than I would like to. And you have to

be very very careful how you put in your corrective inputs not to excite them further. So its a high mental task there. Lateral similarly its the same thing. We'll keep that a four also. both axes are equally poor. For the landing; Controllable? Yes it is. Adequate? Yes. Satisfactory? No. Actually it made good H-dot and slightly long or in the box and a little bit firm H-dot. But I think a lot of that was kind of lucky. When you get in closer, you really can't afford do much to correct for any type of a situation. I really reluctant to do anything to change the attitude once I established the flare attitude. So if I went a little bit long, I didn't feel confident in being able to make a high gain correction -very rapid, abrupt, small amplitude corrections to correct it. So I just held what I got and that's why I tended land long a couple of times or firm. I just didn't feel confident in being able to correct for those things without exciting a bad longitudinal mode. Also for the first time, I noticed some vibration on the approach which made it -I still saw the displays fine but certainly because they are so big on the up front displays, the head up displays but it did start to get a little bit annoying. So that's the first time we've seen that. For the landing there for longitudinally; Controllable? Yes. Adequate? Yes. And we will say adequate performance for a five. Lateral rating; Controllable? Yes. Adequate? Yes. Made the desired performance but the workload was, I think, a little high for that so we will go with a four. And again a lot of lateral motions based on very small inputs from me and also turbulence responses were poor. Okay for the CIR; Obviously it's not one or two. I'm still going to probably go with three. I don't feel like I had any bio-feedback or whatever or any type of confusion that made me put an involuntary input in there. For the RQR; We can go through the first couple. Obviously they don't apply. This is a bad configuration. Looking at four, moderately objectionable - improvement warranted and five, vibrations highly objectionable - improvement required. I never had to abandon the task so the worst I can give it is a five. So we'll go with a three and a five and a no on displays although I will caveat that with at one point on the approach, it did seem like the displays were bouncing around enough where had it stayed like that it would have been a nuisance. So it just was nipping the edge, for me, for the head up displays where we have a problem. So I am going to give this no but you might want to make a notation that we are right on the edge of where we would be in a problem.

Exposure 19

DATE: 22Oct97

PILOT: A

TASK: 3002

CARD: Composite Flight Director Tracking Task

Longitudinal rating; Controllable? Yes. Adequate performance? Yes. Satisfactory without improvement? No. Absolutely not. I going to for longitudinal rate it a four. I had to be very very careful with my inputs just almost hardly any rate at all. Just very very smoothly applied but a very slow rate and try to anticipate and accept errors and smoothly take the inputs out. For the lateral rating; Is it controllable? Yes. Adequate? Yes. Satisfactory? No. Even though I met the desired performance, I'm going to rate that a five. I think just maintaining adequate performance criteria took considerable pilot workload so we'll go with a four and five with that one. CIR; I certainly had to tone down my gains tremendously to not get tremendous motions that would be very disadvantageous for the maneuver so we can skip right through one and two. Look at three, cockpit vibrations impact precision. Certainly that's true. Number four, cockpit vibrations cause occasional involuntary inputs. Again it's difficult for me to believe that's true, so let's go with a three on that. Again a comment here is that it would probably be worth studying the video and also the traces for the inceptor input to see if in fact there is any involuntary input. I don't believe there is and I'm really very firmly planted on the arm rest and I'm gripping the stick very lightly so I

don't transfer any high frequency motions into the stick. But it's ... probably I just can't determine. My opinion is that I'm not. Okay, RQR: We can just go through the first several. It's either going to be improvements are warranted or required. I am going to say, let's go with a five on this one. Basically, I had to so tone down my inputs for the task that it so influenced the way I flew this that, I think, you have to improve this. So I would say improvements are required. No problems with the displays that time, so a no for the display issue. To the best of my recollection that's the worst configuration I've seen so far.

Exposure 9

DATE : 05NOV97
PILOT: B
TASK : 1002
CARD: Nominal Approach and Landing Task

This is exposure what, eight, nine? Exposure nine, Pilot B. Approach and landing straight in. The longitudinal Cooper Harper on the approach; frankly it's not, it doesn't interfere with the performance. It's strictly, let's say a ride control or ride quality problem. With this one it's mostly in the vertical although there's some lateral. Being in the vertical is not quite as bad as having both Lateral and vertical Inputs. It's satisfactory without improvement? Probably no. I'd say we did get moderate, I'd give that probably a three in the approach and a four on the landing. Lateral-directional, had no particular problem with that so I'll give it a ... although there was some motion laterally, I'll give it a three, in both approach and landing for lateral-directional Cooper Harper. The DASE CIR rating; I guess I'll have to give it a two and the ride quality; I guess I'd call it highly objectionable. I'd give it five and a yes on the display.

Exposure 9

DATE : 05NOV97
PILOT: B
TASK : 2002
CARD: Offset Landing Task

Okay, exposure number, what is it nine? Exposure nine, this is the offset landing, approach and landing. Longitudinal Cooper Harper, that ... we had difficulty getting desired performance and I say it is controllable. Adequate performance, tolerable pilot work load, yes I guess it is. Not satisfactory without improvement, however. So we're talking very objectionable I'd give it a six. On the... that would be the landing itself. The approach actually is not all that bad, probably a four. Lateral-directional, one of the features of the lateral-directional is that it excites a very extremely objectionable bouncing in the cockpit. Laterally and vertically also. So any aggressive use of the lateral controls really gets you going. So you're walking a fine line between, in the correction maneuver, between dumping the computer or dumping the motion system. Because the large amount of motion and trying to get the job done is a very fine line there. Lateral-directionally I'd say we're talking ... we do get adequate performance. I'd say it's very objectionable, a six on the approach and also the landing. The DASE CIR ratings, I'm really not able to determine what the involuntary control inputs are. I'm gonna call it a two and the ride is highly objectionable, call it a five. Yes we are seeing impacts on the display.

Exposure 9

DATE : 05NOV97
PILOT: B
TASK : 3002
CARD: Flight Director Tracking Task

Okay, this is exposure nine. Flight Director Tracking and Capture. Longitudinal Cooper Harper, I'd say there's, we really didn't get adequate performance. I guess I'm gonna call it a seven and lateral-directional is an eight. The DASE CIR rating, has to be a two and ride quality, highly objectionable ... well we actually did abandon the task but not necessarily involuntarily. I don't know how you categorize these, well I'll call it a five on the ride quality. Aeroelastic display question is yes.

Exposure 6

DATE: 12Nov97
PILOT: C
TASK: 1002
CARD: Nominal Approach and Landing

Okay, exposure six, the offset ILS to straight in. Very violent oscillations. Relatively low frequency. In light of the frequency you really don't want. Both longitudinal and lateral-directionally, impacted the control on several occasions. Basically the only way to fly this down low and close is to relax inputs on the sticks and kind of make very, very seldom, very small, inputs. I tried a very small lateral doublet, like a quarter of an inch to a half a inch of stick movements and got very violent shaking directionally in the cockpit. So it's really sensitive to control inputs. Also sensitive to turbulence. This is about as bad as I've seen it. It's controllable, barely. This is on the approach now, down to fifty feet. Adequate performance is not attainable with a tolerable work load. The control issues all occurred just prior to fifty feet so I'm gonna give the same ratings in approach and landing. It's driven by the same event, which is the requirement to make inputs leading up to and in the flare. Longitudinally, I'd say considerable compensation required for control. Control is an issue, HQR is eight, both approach and landing. Lateral-directionally there was on one occasion, I had an event which required control issues, or led to control issues I should say, in the lateral-directional axis. So I'm gonna give it an eight there too. CIR, five. There's kind of a big gulf between five and six on this scale. If you didn't abandon ... hang on, let me look at it again. I didn't get sustained involuntary control inputs 'cause I basically didn't allow that to happen. I kept my hand pretty much off the stick unless I absolutely had to make an input. So, I'm gonna give it a five but boy six would be real easy if you grabbed it. RQR, this is the one where there is a big difference between a five and a six. I can't give it a six because I didn't abandon the task but the worst I can give it is a five and that's what I'll give it. I didn't notice, interestingly enough, any display perturbation problems. That surprised me but I didn't notice any impacts of the display this last time. That concludes my comments.

Exposure 6

DATE: 12Nov97
PILOT: C
TASK: 2002
CARD: Lateral Offset Landing

Okay, exposure six offset landing. This one is largely uncontrollable. In close, any sharp inputs at all, and by sharp I mean moderately sharp not even what I would call real aggressive and you're essentially uncontrollable. Very, very difficult to get the airplane in control both lateral-directionally and longitudinally. The predominate oscillation problem is longitudinal initially but it migrates into lateral-directional and there appears to be trading going on. There certainly is trading in terms of work load. So, I can't tell you which axis is uncontrollable it kind of all fell apart at the same time. So during the approach, I'm gonna call it a ten in all four cases. Because although I didn't lose control in the landing, I think you're gonna lose control at some point. You do enough of these and it's a matter of luck as to whether or not you retain control all the way down. So I'm gonna give it a ten in all four blocks. DASE CIR, six and RQR is six. Once again, I didn't notice an impact of the display. I never noticed it vibrating. It may be that the problems go beyond that. It's kind of like when the forest is burning you don't necessarily notice the color of trees. I didn't notice the display being an issue at all this time. Yeah, it could be frequency issue but in any case I didn't notice it. And that concludes my comments.

Exposure 6

DATE: 12Nov97

PILOT: C

TASK: 3002

CARD: Composite Flight Director Tracking Task

Exposure six, flight director task. Cooper Harpers: Basically it's much the same that I've seen before. If you're very, very smooth on the stick, particularly if you don't make back to back opposing inputs of any magnitude at all it's controllable. If you start making back to back opposing inputs you really get some vibration going in both axes and it's relatively low frequencies, so it's objectionable. You've got to relax your hold on the stick. I didn't abandon the task at all. It bombed out on us once so we did three of them so I didn't lose control but you're certainly losing precision. It's controllable. Adequate performance attainable with a tolerable work load, just barely. Both axes are basically the same work load. It's not satisfactory without improvement certainly. I'd say a five in both axes. Considerable pilot compensation for adequate performance. CIR, frequent involuntary inputs, five and five highly objectionable. No display problems at all.

Exposure 16

DATE: 18Nov97

PILOT: D

TASK: 1002

CARD: Nominal Approach and Landing

Okay for approach. (What's the exposure number? Sixteen?) Yeah, exposure sixteen. Pilot D, this the straight in approaches. For the approach: satisfactory without improvement, as far as the ability to fly it precisely and having to work real hard. I'd say that's a three and three. It was uncomfortable as far as the approach went, didn't effect the performance. For landing however, longitudinal, adequate performance attainable? Yes. Satisfactory without improvement? No. Five ... longitudinal would be five on that. What was happening, soon as I flare, I'd kind of get a, ... almost a surprise lifting back up. I thought I might be over controlling it. I decided, it was the airplane doing it and not me after all. I would end up long each time. So five. I did get adequate performance with considerable pilot compensation. Lat. Dir., it was more uncomfortable. A lot of vibration left and right.

Wasn't effecting the performance particularly but it was annoying. I'll say on that one four for the Lat. Dir. CIR definitely two, ... I'd say three. CIR three. RQR, they're more than mildly. Moderately objectionable and improvement warranted. I'd say probably four on that. That might be a little harsh on it but I'll leave it at four. The displays, I'll say yes that time. That has begun to move around a little bit at this level.

Exposure 16

DATE: 18Nov97
PILOT: D
TASK: 2002
CARD: Lateral Offset Landing

Okay, definitely more work all the way around due to the vibrations this time. Satisfactory without improvement? No. Did get desired for the approach however. Rockin' around there. Just due to the pilot compensation, I'm going to make the Lat. Dir. five on that and the longitudinal four. For the approach it's four and five longitudinal, Lat. Dir. The vibrations left and right were causing, ... getting into ... needed some pilot compensation and that's what dragged it down out of the four even though desired performance. Okay for the landing. Adequate performance attainable? Yes. Satisfactory without improvement? No. The longitudinal usually tended to be a little long. Once in a while a little hard. Probably five on the longitudinal that time but six on the Lat. Dir. The left/right oscillations was beginning to be very overwhelming on that. Five and six longitudinal/Lat. Dir. on landing. CIR, definitely three. I think it was still a three. I didn't notice any involuntary control inputs. The vibrations certainly did impact the precision of the voluntary ones. So, three. Boy, that's getting awful close to five. I guess I probably ... Okay I'll go with a four on that for RQR. Very easily could be a five but I'll stick with four I guess. So, three and four for those two ratings. Yes, I think the visual did, moving around did effect the task performance that time. So, display yes.

Exposure 16

DATE: 18Nov97
PILOT: D
TASK: 3002
CARD: Composite Flight Director Tracking Task

Pilot D, exposure sixteen, flight director tracking. Okay, adequate performance? Yeah. Satisfactory without improvement, all those things. I was able to get desired performance all the way through. The compensation was horribly high and it was worse in Lat. Dir., so I think on this one, even though I got the desired performance. The workload is going to drag this down into longitudinal five and lateral-directional six. CIR, this time, I think, I was beginning to get some involuntary control inputs. Some of those particularly left/right oscillations were beginning to couple in I suspect. So four for CIR and that's a five. Improvement is required on that, no way to accept it. The display, I have the same problem I always do, these up and away ones. I'll say display no. For the reasons I've given so many times.

Exposure 17

DATE: 04Dec97
PILOT: E

TASK: 1002
CARD: Nominal Approach and Landing

Basically it looks like we can excite things in both axes. I guess, if anything the pitch seems kind of ... it looks like we can excite things more in roll than we necessarily do in pitch although with smaller inputs ... think that's kind of my perception ... the pitch though my perception is unless you're very slow and smooth there's predictability problem ... it takes a little bit before you really get what you want. We were seeing, during the flare, a split with the actual flight path vector lagging the commanded flight path vector even at a fairly slow rotation rate from the flare. Another thing is, is basically what happens is we're getting on final we're starting for some reason at 150 or 100 feet or so we're starting to drift high and the aim point shifting down the runway. You're getting a split in the cues with the actual cue going above the commanded. And then as you transition to the flare it goes below the commanded. So that's a little bit disconcerting. I guess I would probably tend to be ... I'd say it's not satisfactory without improvement so we're in the four, five, six block. We got desired performance once. We were close a few of the other times. Twice, sorry. Okay. I guess I'm trying to look at the compensation as moderate versus considerable ... I guess, I'll go with a four and a four on this task for the landing. I'll go with a three and a three for the approach. Sorry that's backwards ... I'm giving it to you in the reverse order but ... the CIR I'm going to go with a three. On this task, I didn't see any involuntary control inputs but I could see if I was much more abrupt that that possibly could've hurt and for the ride quality I'm going to go with a four, I guess. My tendency is between a four and a five and I guess I'll go with a four. This one I did notice the display bouncing around a little bit more and it was disconcerting. I think there's some pro and con as I mentioned before on this but, as far as actually impacting task performance, I'm gonna say no.

Exposure 17

DATE: 04Dec97
PILOT: E
TASK: 2002
CARD: Lateral Offset Landing

Okay, it seems like you can excite motion both in pitch and roll. We knocked the motion base off twice during this, the latter two runs after that. I tried to reduce my gains and back off on the inputs some. The first run we did, I didn't really ... I backed off on my gain because of the banging around but I didn't feel as prohibited, I guess, from doing what I wanted to do as I did on the last two runs that we did. The bouncing around and everything is not very comfortable and it would give me a lot of apprehension if I was close to the ground doing that for real. As far as predictability goes, we're getting a split cue in the flare including the latter portion of the flare and on most of the runs that we completed to a landing I ended up having to bunt forward or fake a small nose down pitch fraction in the flare to stop from just ballooning and either maybe starting to climb again or just drift down the runway. It's really hard to compensate with the split cue and I'm not sure that either one of them is exactly what the airplane's doing. Anyways ... I would come up and be in the four, five or six block. We only got adequate performance. I'm going to disregard the compensation to try to stop from knocking the motion base off and so if I disregard that, I think we're probably in the five range. So I would give the approach and landing both five's for longitudinal and five's for lat dirs. So it'd be a five, five, five, five. DASE for control inputs, I think we're bordering on maybe getting some involuntary inputs in there, I'd probably go for like a three and a half. But, I'm going to go ahead and fall out on the side of the four. So, we'll give it a four for control inputs. I'm going to give it a five for

cockpit vibration. That close to the ground, I don't think, I wouldn't be willing to tolerate that. And I'll say no for the displays.

Exposure 17

DATE: 04Dec97
PILOT: E
TASK: 3002
CARD: Composite Flight Director Tracking Task

I guess I really find the lurching objectionable and I think it affects my ability to do the task. I have to back off way, pretty far on my gains and particularly I think its pretty hard to do any kind of a bank angle capture task or fine tracking of a bank angle while making small corrections even in the bank angle without exciting the motion which makes the task more difficult. We got desired performance both times, I believe that it's not satisfactory without improvement so that puts it in the four, five or six range. I guess the question of moderate pilot compensation or rather if I used more and I'm having a hard time answering that ... I'm going to give it a five and a five. The reason is, I think it's probably about moderate pilot compensation, but I think it's more than a minor but annoying deficiency. And I do ... so anyway, I'll go five and five. I do think that it's definitely a four for CIR and a five for ride quality, a no for the display question. I guess just the lurchiness that I saw is kind of, particularly in roll, I would almost be tempted to go for a four in pitch and a five in roll but I'm going to leave it the way it is just a five. That's it I guess.

Exposure 11

DATE : 09Dec97
PILOT: F
TASK : 1002
CARD: Nominal Approach and Landing Task

Okay, exposure eleven, the straight in task, just some general comments; probing it on the straight in, it's really pretty bad, both axes, fairly lightly damped. And I let my hand couple into the longitudinal axis there and we finally kicked the simulator off. But on the subsequent approaches if you make nice smooth inputs to, the longitudinal is not too bad. And for the straight in task the inadvertent lateral inputs didn't seem to be significant so that we ended up with pretty good performance. You know, it's probably a fluke, a little bit, but we had all desired's. Pilot rating for the approach, you know, I'm going to give it a five. It's a little bit bumpy but not too bad. And the ride quality just due to the turbulence is definitely a seven. And the landing, let's give it a five and a seven also. And the DASE is a three, five and yes. And it's both QSAE and DASE. Let's see, what's the question here? Ease of precision. Yeah, just a little bit. The wiggling doesn't really impact the precision too much but a little bit. Okay.

Exposure 11

DATE : 09Dec97
PILOT: F
TASK: 2002
CARD: Lateral Offset Landing

Okay, exposure eleven, the offset task. And just some general comments, it's really pretty bad and the comments I have, I think it's just really marginal, I mean the display is jumping around so much that I almost can't read it well enough to control to. But it's still marginal,

we're still doing it. Just the same impression on both approaches, it was just ditto ditto on the second approach as on the first one. The performance was similar too. Pilot ratings for the approach, longitudinal, not too hard to keep smooth, longitudinal. You can excite it longitudinally if you try but if you're mildly careful ... so let's just give it a five. Laterally, is adequate performance attainable with a tolerable pilot workload? And I would say no. We're, you know, it's like you're just hanging on. It's definitely a seven. Okay, there is a little bit of discrepancy between performance and the workload there. And I realize that. Okay, same for the landing, five and seven. And the DASE is a three, five and yes. And I think on the yes, this time, it's one of the worst I've seen as far as the display whacking around. Worst DASE movement, I think. Or most noticeable, I don't know.

Exposure 11

DATE : 09Dec97

PILOT: F

TASK: 3002

CARD: Composite Flight Director Tracking Task

Okay, pilot rating on exposure eleven, the flight director. Longitudinal, just have to be a little bit gentle and it's not too bad. The lateral again as I have made comment here, I think, it's for this particular task, it seems like I had the hardest time not exciting the lateral. Previous ones, all previous ones just by backing off on the gain it seemed easier. This one, in fact we bombed here on one run. But let's give it a seven. So five, a seven and a three, five and a no.

Configuration 03 Damp1 with CGI DASE perturbations relative to HUD turned off, disp0

Exposure 2

DATE: 20Oct97

PILOT: A

TASK: 1003

CARD: Nominal Approach and Landing

This is for the straight in approach and landing Cooper Harper for the longitudinal approach rating. Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. Three. Obviously ASE effects were very annoying but as far as completing the task longitudinally there was no real problem and gamma-dot-v worked great on the glide slope. Lateral Cooper Harper for the approach, is it controllable? Yes it is. Adequate performance attainable? It sure is. Is it satisfactory without improvement? Yes it is. I was fairly aggressive and even though we got bounced around a bit, it still responded to my aggressive inputs very well. I'll rate it a three. Fair, some mildly unpleasant deficiencies. Basically the ASE effects did not really effect my performance it's more of a ride quality which we will get to later. For the landing, longitudinal rating, controllable? Yes. Adequate? Yes. Satisfactory? Yes. Made two nice landings. That will be a Cooper Harper three. For the lateral-directional; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, also for a three. So the flare cue has made the longitudinal task in the landing easier, more predictable. The lateral task is not that difficult in the straight-in so we are coming in with three's in everything. Obviously the ride is not nearly as nice but it is not adversely effecting the performance. For the CIR rating, the pilot does not alter control inputs as a result of aircraft flexibility. I really didn't because I just wanted to see how bad it could get on the first one but on the second one I marginally did so let's go ahead and rate this a two: Pilot intentionally modifies control inputs to avoid excitation of flexible modes. Certainly three; cockpit vibrations impact precision, I can not rate that, because I had very good ... met the criteria very well. So it's going to come in at a two for CIR. DASE influence on ride quality; cockpit vibrations do not impact ride quality. That's not true. Cockpit vibrations are perceptible but not objectionable, no improvement necessary. That's not true. Cockpit vibrations are mildly objectionable, improvement desired. Let's look at the next one. Cockpit vibrations are moderately objectionable, improvement warranted and number five cockpit vibrations are highly objectionable, improvement required. I'll probably rate that a five. It definitely on all three axis when on rudder doublets, roll doublets and pitch doublets we get pretty hefty ASE responses and that was only in light turbulence. I can only extrapolate the heavier turbulence and see that it would be a much worse situation. Let's go ahead and give that a five. So a CIR of two and an RQR of five. Do the aeroelastic display perturbations impact the ease of precision with which the task is performed. No they do not. No problem with displays.

Exposure 2

DATE: 20Oct97

PILOT: A

TASK: 2003

CARD: Lateral Offset Landing

This is for the approach for the longitudinal rating for the off-set approach. Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes it is. Cooper Harper of three. No real difference from what we saw on the straight in. For the lateral-directional for the approach portion; It was Controllable? Yes it was. Adequate performance attainable? Yes.

Satisfactory without improvement? Yes. Also a Cooper Harper of three, no changes from the previous ratings. For the landing segment. This from the correction, on to touchdown, it's longitudinal rating; Is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? No it's not. For the longitudinal rating, I met the adequate criteria with slightly firm touchdowns on both attempts, with the first one right in the box and the second one slightly long. I would say it'll be a Cooper Harper of five. Moderately objectionable deficiencies and the adequate performance was not as difficult to attain as the write-up for this Cooper Harper five rating but it was clearly adequate performance. The comment here I'll make; I did probably tend to be a little bit less aggressive in the flare because this configuration was more subject to ASE perturbations. I was fairly aggressive. I did not let it bother me in the turn to the correction from 250 feet. I was very aggressive laterally and I had no problems commanding just what I wanted but as I got into the flare, I tended to back off a little bit because it did seem to have a little bit more vertical or longitudinal axis flavor to it that more susceptible to longitudinal stick inputs to excite a mode. So I was more careful in the flare, hence the slightly long touchdown on the second landing. But at any rate, that's five for the longitudinal rating. I've led into the lateral rating for the landing, Is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? I'll say no and rate it a four mainly because the ASE effects do effect performance in that you get uncommanded motions in the aircraft that makes your workload a little bit higher. so it's difficult for me to give it a three for that. So a four for the lateral rating. For the CIR rating, Pilot does not alter control inputs. That's not true. Pilot intently modifies control inputs to avoid excitation. That is true. Let's look at number three; cockpit vibrations impact decision of voluntary control inputs. Not really. I'll say a two on that. And the RQR ride quality, cockpit vibrations do not impact ride quality. That's not true. Cockpit vibrations are perceptible but not objectionable. No that's not true. Cockpit vibrations are mildly objectionable. No, let's keep going. Cockpit vibrations are moderately objectionable. No. I would say again a five. Cockpit vibrations are highly objectionable, improvement required. You can excite these ASE motions with mildly aggressive inputs both laterally and longitudinally. The longitudinal excitation is what seems a little bit more than I was anticipating and it kind of caused me to back off a little bit in the flare and I tried to be very aggressive. I could have made a very high gain low amplitude correction in the flare and chose not to because I didn't want to excite these modes. So it definitely effected my performance. Do aeroelastic display perturbations impact the ease or precision with which the task is performed? No they do not, no problem with displays.

Exposure 2

DATE: 20Oct97

PILOT: A

TASK: 3003

CARD: Composite Flight Director Tracking Task

Ratings; For the longitudinal rating for the flight director tracking task; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I'd say yes. Cooper Harper three. No real problems. Obviously abrupt inputs causing the ASE reaction but not too bad. The task is not that difficult. For the lateral rating; controllable? Yes. Adequate? Yes. Satisfactory without improvement? I am also going to say yes and give it a three. I tell you what, let me take that back. Let me change that and say it is not satisfactory without improvement and say no and rate it a four. I met desired criteria but I did tend to over control the lateral axis more so than the longitudinal axis. The ASE effects are present there and they only slightly effected my technique. Several times I made fairly aggressive inputs and had no problems doing it. In fact it responded very well. I just pretty well lived with

the motions but it did not effect my performance in being able to capture or what have you. You just get bounced around a little bit more. I did tend to think in some of the bouncing, I probably at times was slightly less aggressive and therefore drifted a little bit towards the lateral limits of the desired circle. So my errors were more lateral errors than longitudinal errors, so I want to discriminate between the longitudinal and lateral tasks. So a three and a four. For the DASE influence on pilot's control inputs. Does it alter control inputs as a result of aircraft flexibility? Yes. I'm sorry that's not true. I do alter them. Pilot intentionally modifies control inputs. Yes. Certainly I don't think the vibrations impacted the precision of voluntary control inputs. So it's a two. DASE influence on ride quality? Cockpit vibrations do not impact. That's not true. Cockpit vibrations are perceptible but not objectionable. Not true. Cockpit vibrations are mildly objectionable, improvement desired. Probably a little bit stronger than that. Cockpit vibrations are moderately objectionable, improvement is warranted. A four. Let's kind of stick with that one. So basically I had no trouble doing the tasks, no real trouble. I did have to slightly modify my inputs because of the aeroelastic effects. I think moderately objectionable is the more appropriate one and a four. And for the question, any problem with the displays? Negative, no problem what-so-ever.

Exposure 12

DATE : 05NOV97
PILOT: B
TASK : 1003
CARD: Nominal Approach and Landing Task

Okay this exposure number twelve. The approach and landing straight in, Cooper Harper ratings Longitudinal for the approach, would be, I guess we're getting basically, mostly desired. I guess I'd give it a two for the approach and a three for the landing. And the Cooper Harper on the laterals would probably be a two for the approach and a four for the landing. The DASE influence would be a two, DASE CIR. Ride quality; three and yes, displays are impacted.

Exposure 12

DATE : 05NOV97
PILOT: B
TASK : 2003
CARD: Offset Landing Task

This is exposure twelve and looking at the offset landing task, longitudinal Cooper Harper in both lateral and longitudinal we're getting quite an excitement in the cockpit from the standpoint of motion. With both pitch and lateral inputs. It's causing some difficulties. We're getting long landings. I would say that we're talking the approach, a four and probably a four for the landing. Lateral-directional Cooper Harper, I think I would classify it in the same, four and four. And a two on the DASE CIR rating and the ride quality was moderately objectionable. I think I would call it a four. With a yes on the displays. Lateral-directional, I gave it a four on the approach. I'm assuming the approach ends at fifty feet. So, the disturbances that the lateral step inputs, large step inputs creates, seem to be rather significant and therefore it creates more difficulties in seeing the display properly and subsequent adjustments. So that's why I gave it a four.

Exposure 12

DATE : 05NOV97
PILOT: B
TASK : 3003
CARD: Flight Director Tracking Task

Exposure twelve, we're looking at flight director capture and tracking. Elevator, I'm sorry, longitudinal Cooper Harper and that is in the category of, I think we were getting desired performance, so I'll call it a three. There was some unpleasant deficiency in that we were ... had a lot of cockpit motion. Not so much in longitudinal as in lateral-directional. Lateral-directional, I believe we were also desired performance, I'd give it a three. However, there was an awful lot of cockpit motion associated with large aileron inputs. DASE CIR ratings were a two and the ride quality I would say was five. With a yes on the display question.

Exposure 14

DATE: 12Nov97
PILOT: C
TASK: 1003
CARD: Nominal Approach and Landing

This is configuration or exposure I should say, fourteen on twelve, November. The approach down to fifty feet was pretty much level one. I didn't like the oscillations but they didn't appear to be effecting my performance. So longitudinal, lateral-directional let's give an HQR of three, minimal compensation. For the landing, longitudinal was a bit more difficult than lateral-directional. I was able to get desired but I was working pretty hard for it. So, HQR of four longitudinal, three lateral-directional, four and a three. CIR, the cockpit vibrations are effecting the precision. I didn't notice any involuntary inputs. That's longitudinal, predominately, interestingly enough. CIR of three, RQR of five. I still don't like the oscillations at all, very highly objectionable. No display impact though.

Exposure 14

DATE: 12Nov97
PILOT: C
TASK: 2003
CARD: Lateral Offset Landing

Okay, configuration or exposure fourteen, offset approach and landing. I'm gonna give the same ratings for the approach and the landing because the problems are all occurring from about 70 feet down to the surface. Lateral-directional, controllable, adequate, not satisfactory. HQR of four, desired performance requires moderate pilot compensation. I think that's task driven, predominately. Longitudinal, controllable, adequate, not satisfactory. Adequate performance requires considerable pilot compensation, HQR of five. This is almost a six, this is borderline five but I'm gonna call it a five. So, rating both for the approach and landing are the same. Four, lateral-directional, five longitudinal. CIR a three. Precision is impacted, I didn't notice inadvertent inputs that time and of course RQR of five. Highly objectionable vibrations. No display impact. That concludes these comments.

Exposure 14

DATE: 12Nov97
PILOT: C

TASK: 3003
CARD: Composite Flight Director Tracking Task

Okay this is exposure fourteen, the flight director tracking. I'm at a point where I don't think I can call the compensation minimal for lateral-directional or longitudinal, although they were driven by different things. The longitudinal was probably effected more by the oscillations. The lateral-directional was effected more by the sluggishness in the roll axis. The quickness with which the symbol moves. I think there was some workload trading. I think had the longitudinal been better, the lateral-directional would have been easier as well. In any case I'm gonna give it a four in both axes. So its controllable, adequate, not satisfactory, moderate pilot compensation for desired performance, HQR of four. DASE, the cockpit vibrations effected the precision, three for CIR and RQR is still five. I find those motions highly objectionable. Improvement required, no display impact.

Exposure 19

DATE: 19Nov97
PILOT: D
TASK: 1003
CARD: Nominal Approach and Landing

Pilot D, exposure nineteen, nominal approach and landing. Okay, approach, satisfactory without improvement? Well the turbulence added a little bit of workload to it but I really can't complain too much about that. Satisfactory without improvement, I'll say yes. Three for longitudinal and lateral-directional on the approach. For the landing adequate performance was attainable. Satisfactory? No. Longitudinally, adequate is the best I was ever able to attain and I worked at it at least considerably hard. Probably approaching very objectionable. Not know when the things gonna touch is not good. I think I'll go with a six on that for longitudinal. Lateral-directional, four just because I'm not exercising the Lat. Dir. that much on that I suspect. I didn't really get into it too much. So six and four. On the CIR, two. CIR of two and RQR of four. Displays I think that's right about on the edge, I'll say yes on the display on that one. I could see the movement around and was chasing it a little bit. So I'll say yes, display.

Exposure 19

DATE: 19Nov97
PILOT: D
TASK: 2003
CARD: Lateral Offset Landing

Pilot D, exposure nineteen, offset landing. Approaches, ... boy I had ... seem to have an awful lot of trouble line-up that time. Was getting a fair amount of vibration that was taking my concentration away from just the basic control. I'm gonna have to say that that was ... although I got moderate ... or I got desired, it was more than moderate. Lat. Dir. five and longitudinal a four. Four and five longitudinal/ Lat. Dir. in the approach. For landing, adequate performance? Yes, most of the time. One sneaked out but most of them are consistently adequate. Boy that was a lot of work trying to get that so that was a very poor six. We'll give a six for longitudinal on the landing. The Lat. Dir., even that was sprayed around. Both of them, longitudinal/ lateral-directional were giving me a fair amount of problems but on the Lat. Dir., I'll give that a six also. Six and six on that. CIR three and RQR four. Displays? Yes. Mildly effected it.

Exposure 19

DATE: 19Nov97
PILOT: D
TASK: 3003
CARD: Composite Flight Director Tracking Task

Pilot D, exposure nineteen, flight director tracking. I think I can probably jump up to there. For the longitudinal, got desired performance that wasn't the problem as usual, four. I had to work really hard on that Lat. Dir., and just barely got it in there. I'll be kind to it and give it a five on that. It could easily go to six, that was really tough. CIR, you know this time, I think maybe I could drop that one down to four. I was beginning to really get enough oscillations ... beginning to get back into the controls I think. Right on the edge but I would give that a four. RQR five. Displays? No, and I always repeat, because there's not very good references to see whether it's the display or the airplane motion.

Exposure 6

DATE: 03Dec97
PILOT: E
TASK: 1003
CARD: Nominal Approach and Landing

This is Exposure 6, Nominal Approach and Landing. Okay, the first comment that I would make is that ... I'm having a real hard time deciphering rather if I'm just getting tired or if there is something that I'm not doing, or if I'm missing something or rather if there is a predictability problem with the airplane. Whether it be in the display or the airplane performance or the combination of the two. I guess my point is that basically the best we got on that, although we were very close a couple of times to getting desired, we were like ... I don't know 3/10 of a foot outside the desired box laterally and 1665 ...so just about 165 feet long, I guess, outside the desired box on this last run. The point that I make is twofold: One that I'm having a hard time close in holding aim point. Down around the 200 foot or below range or 150 foot, somewhere around there. I am often getting a split in the cue or even if I don't get a split in the cue I have a hard time holding the aim point I want visually and also the glidepath shows that I'm deviating from the glidepath that I think I'm on or think I have been holding. During the flare I sat the flight path vector where I want it and I expect that good a touch down and then I just tend to either float or drop in early. I characterize both as a predictability problem. The flare more so than the aim point, although the aim point I'm not sure ... well, they're both predictability problems. I guess the bottom line is I can't really decipher exactly what it is that's causing this. I guess for the approach phase down to 200 feet ... oh, the other comment is there is more bouncing around, it appears I can excite things laterally and in pitch. Maybe more so in pitch ... well, I don't know if its more or not. For the approach phase, I would probably go with a three and a three. Well, first of all for the intercept phase I would probably go with a three and a three for the approach phase. Being able to roll out on target or hold my pitch exactly where I want it requires minimal compensation with the bouncing around. That's for the intercept phase. For the approach phase I'd go with a three and a three. For the landing phase we were only getting adequate performance ... this is one of them where I have a real hard time because I don't know if I would say considerable pilot compensation was required just to get adequate performance but we didn't get desired and even if we had of ... because of the consistency, I'd say it would be more than moderate pilot compensation. So, I'm going to

go with a five and a five for the landing phase. For the DASE definitely it effected my voluntary control inputs. I don't think I have any involuntary so I'm going to go with a three for control inputs. For ride quality ... I'm kind of looking at the three and the four ... kind of going with the four for ride quality, especially close to the ground and the bouncing around like that. I'm kind of waffling between the three and the four but I'm going with the four. I'm going to say no ... I'm going to give a caution no for the display perturbations ... I mean for the aeroelastic display perturbations impact on the task. The reason I say that is that a couple times I perceived that we had a change in glidepath before I got the split in the actual commanded cue. Then close in the predictability problem and I'm not sure if there is a display issue here or not. It's really hard for me to break that out. I attribute the predictability to the display verses response of the airplane because like I said, from the display I would have expected the airplane to react a little bit differently than in did a couple times. Its hard for me to say that the display problem or an airplane problem. So, I guess I'm going to give it a caution, No, because I can't pick out anything specific but I'm not sure that that's not influencing the performance here.

Exposure 6

DATE: 03Dec97

PILOT: E

TASK: 2003

CARD: Lateral Offset Landing

Okay, we get two runs for the offset. The first one we got adequate performance, the second one we got desired. We didn't even get desired on the straight in so I think maybe this is somewhat of a fluke, although I will say that there is, at least for me, and I'm sorry, I know something I'm supposed to be able to do is break out the kind of compensation I'm using. I'm having a real difficult time doing that on this particular profile, doing that and we could go back and do some more but based on the straight in stuff, I'm not really sure that I would pick up ... I guess I'm kind of lost. I can't ... there is some learning curve to this. I just can't tell you what the compensation is that I am using except for, I noticed that time, I tended a couple of times, including in the flare, to make a step input instead of dragging the flight path vector where I wanted it, I kind of made a step input and made it. Right in the flare there I thought we were going to touchdown a little bit hard and I made kind of very small step input and then just released the stick and that was enough to cushion it to bring the H dot back to where we wanted it. Anyway, I'm sorry I can't give you more help on that. We are bouncing around. I don't think the predictability, I think the predictability is worse in this configuration than a lot of other ones that we have flown. It is something that I am adapting to somewhat but again I'm not really sure if I'm ... I think maybe what I'm doing, is I'm making an input and then kind of waiting to see what happens and I think I'm having to wait longer then I did in the other configurations. And I think I kind of have to make ... I think maybe I'm learning what kind of initial input needs to be but it's not as consistent as it was between the earlier configurations that we ran. Anyway, enough babbling. We did get desired performance once and we got adequate performance once. Just, I guess, because of the predictability problem that I perceive, it could just be me on this particular configuration, I think I'm going to go with a five and a five for the approach and for the landing because the approach phase goes down to fifty feet on this one. For the DASE control inputs, the cockpit vibrations does impact the precision of my inputs on that. I don't think I saw any involuntary inputs so I'm going to go with a three. For the ride quality, I kind of for this landing task, I guess I'm going to go with a four. You know, and I guess this kind of goes for all of the runs here, you know, if you assume that the pilot knows that the airplane is okay, i.e., that we are not going to fall out of the sky or nothing

fluky is going to happen because of all the turbulence, and you just concentrate on the task and fly through the turbulence, the turbulence effects your ability to do the task. But I guess what I'm getting at is the pucker factor in the real airplane, we are approaching enough bouncing around where I think there would be a lot more concern in a real airplane than there is in the simulator here and your tendency would not be as much to just fly through it. Again with the predictability problem, I'm going to kind of hedge on the display effects. I'm going to give it a no because I can't really break out anything although I'm not convinced that maybe the predictability problem is not attributed in part to the display or a combination of what the display shows and what the airplane is actually doing. Anyway, that's it I guess.

Exposure 6

DATE: 03Dec97
PILOT: E
TASK: 3003
CARD: Composite Flight Director Tracking Task

I'm still, I guess my impression is, is that when I zero out the flight director error, it takes a while for the flight director to wash back to show that the error is zeroed out because if I set twenty degrees of bank, the flight director still shows that I need more bank. But if I just wait, the flight director will come back and zero out the error and I think that's effecting the performance on this task and it's hard to tell how much backing off of a gain compensates for the flight director action if that's what really is happening and out much is compensation for the airplane. In this, I noticed a gallopy kind of motion with an abrupt push over during this tracking task or at least that is what I would characterize it as. Backing off on the gain improves task performance particularly in roll. I think predictability in roll is worse than it is in pitch and going back to the offset landing task, I'm not so sure that the predictability in roll maybe wasn't accounting for a lot of what I saw. Although there were some pitch things that we talked about, aim point in the float, that I don't think that would account for. But anyway, if I go to rate this task, we did get desired performance. I'm having a hard time answering the question, is it satisfactory without improvement? And looking at the descriptors between a three and a four and looking at minimal versus moderate pilot compensation, you know, if you back off on the gain and are pretty patient, it's really minimal compensation but I guess to back off that much, I'm going to go with a four and a four, I think. Again I have a real hard time splitting axis especially at this box. If anything I would ... I'm not going to do it. But if I were going to split the axis, I would have a tendency to go with a three longitudinally and a four in roll but I'm just going to go with a four and a four for the task. For the DASE, I'm going to give it a three and for control inputs. And for ride quality, I'm going to give it a ... I'd be between a three and a four. I'd probably go with a three and a half if we did half ratings. If you guys want an integer rating, I guess I'm probably going to go with a four. I don't like the gallopy motion that I get. I'm going to go with a four for sure, I don't like the gallopy motion that I get with the push over. As far as the displays go, I'm going to say no with the noted comment about the flight director.

Exposure 20

DATE : 10Dec97
PILOT: F
TASK : 1003
CARD: Nominal Approach and Landing Task

Okay, exposure twenty, straight in task. Feeling the thing out on the long straight in, it appeared like it was a kind of intermediate damping on both axes which really makes it not too bad for the straight in task. You just have to back off a little bit on the control, to try to be a little smooth. And it works out all right. Consequently, pilot ratings, for the approach, longitudinally, let's give it a ... eh, shoot. Is adequate performance attainable with a tolerable pilot workload? Yes. Let's give it a six. Having laterally, let's give it a six. For the landing, okay six again and six again. Wow! Consistent anyway. Okay, and DASE control, is a three. I have to back off. And the ride quality, as far as I'm concerned, is a five. And the display, yes but mostly QSAE.

Exposure 20

DATE : 10Dec97
PILOT: F
TASK: 2003
CARD: Lateral Offset Landing

Okay, Pilot F rating the offset for exposure twenty. The apparent intermediate levels of damping on the two really kind of prevented any coupling from lateral into the longitudinal, as you get with the lighter dampings. We did get some lateral banging just from the control activity. And that was the primary problem on this series. Let's go ahead and give it ratings. The approach, longitudinal, let's give it a six. Lateral, this includes the offset, doesn't it? Let's give it a seven. I'm really working pretty hard not to excite that stuff. Landing is a six and a seven. And the DASE is a three, a five and a yes but mostly QSAE. I'm getting used to all those wiggles.

Exposure 20

DATE : 10Dec97
PILOT: F
TASK: 3003
CARD: Composite Flight Director Tracking Task

Pilot F on the flight director task for exposure twenty. Really not too bad with respect to control. We excited ... We had some ride quality problems a couple of times. The longitudinal pilot rating ... we also got some ... I got a longitudinal banging there at least once, I know. Let's give it a five though. It's a pretty easy task, longitudinally. The lateral is the hardest task and with the apparent intermediate damping, let's give it a six. And a three for the DASE control. A five for the DASE ride. And a no more the display.

Configuration 04 1st mode increased to 1.45 Hz; all others by same frequency ratio, stif1

Exposure 12

DATE: 21Oct97
PILOT: A
TASK: 1004
CARD: Nominal Approach and Landing

Straight-in approach and landing; This is clearly, I would say the worst case we've had so far. We had extremely light to no damping, it seems in all three axis. Rudder doublets caused a four or five overshoot large lateral motion. Abrupt lateral motions cause anywhere from up to eight to nine overshoots and similar with longitudinal abrupt motions. Bombed off the motion during a very low amplitude kind of a high rate pitch doublet. Light turbulence triggers continuous annoying motions so it is really very very lightly damped and large amplitude motions. The approach Cooper Harper ratings; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes, basically it's still going to a three Cooper Harper just because the control law works so well even in this motion. Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes based on performance and criteria. For the landing for the straight-in approach. Yea a three and a three. For the landing longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? The two landings I made were very very good landings but I just can not give it a level one. It met desired criteria, I am going to rate it a four and I may even ... I'm actually going to use my pilot-in-command authority and make this a five. I met the desired criteria but I think five sums it up better where just adequate performance required considerable pilot compensation. And so it's going to be a five based on workload for longitudinal. For lateral for landing; Controllable? Yes. Adequate? Yes. Satisfactory? No. Workload again makes that a four. So a three, three, five, four. For the CIR; Does pilot alter control inputs? Yes. Pilot intentionally modifies control inputs to avoid ... ? Yes. Cockpit vibrations impact precision voluntary control inputs? Yes. Three, I just don't think I can give it a four because my arm is just rigidly braced on this arm rest so there is no bio-feedback and it's not really triggering me into making incorrect inputs. So let's go with a three. And for the RQR; They do impact ride quality. Improvement is necessary. Objections certainly moderately ... A five and that's the worst rating I can give it legitimately. Just way way too lightly damped. And no for the display question.

Exposure 12

DATE: 21Oct97
PILOT: A
TASK: 2004
CARD: Lateral Offset Landing

Again this exposure is pretty bad. I was concerned that we would knock off the sim on this one but we didn't. I flew it very very gently and tried to back out of the loop when ever we go into a good motion, so I definitely altered my technique because of the bad ASE motions. For the approach and up and away, let's go with a three and a three. Comments are the same as the straight in for the longitudinal-lateral. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. Basically ended up being a little bit long. I was reluctant to try to make any kind of corrections that would require high gain inputs, for fear of really triggering the lightly damped and large amplitude longitudinal motions that close to the ground. So I pretty much had to accept what I had. This being a difficult task as it is, when ever I came out of

the correction maneuver, lined up on center line, I pretty much accepted the attitude and just held the flare attitude and let it touchdown. So definitely I was aware of the ASE motions and basically it prevented me from making the more subtle corrections that I would like to have made. Anyway for longitudinal; It is controllable. Adequate performance is attainable. It is not satisfactory. It looks like just about adequate performance, we'll go with a five on that. Looking at considerable pilot compensation ... I tell you what, we're going to change that to a six. Let's go to a Cooper Harper six for that one, based on, I think, extensive pilot compensation is more appropriate. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. I met the desired criteria but the workload was high, a four. For the CIR, number one, that's not true. Number two, intentionally modifies control inputs, that's true. Cockpit vibrations impact precision voluntary control, a three. Not a four so we'll go with a three on that one. Basically the vibrations get to the point that if you have excited it then I'm very reluctant to do anything else especially close to the ground. So it's definitely impacting the precision of my voluntary inputs. For the RQR, again we definitely need improvement so we can skip on down to about four. Improvement warranted. Improvement required. Number six, abandonment, that's not true. Five will be the one. So an RQR of five. Clearly this one needs some help and no for the display question.

Exposure 12

DATE: 21Oct97

PILOT: A

TASK: 3004

CARD: Composite Flight Director Tracking Task

Longitudinal; Controllable? Yes it was. Adequate? Yes it was. Satisfactory without improvement? No. I met the desired criteria but I am still going to rate it a five, I think, just to meet the adequate criteria took considerable compensation. so let's go with a five on that. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. For similar reasons, I'm going to rate that a five as well. I met the desired criteria but there is not really a good descriptor that says it takes extensive compensation to meet the desired. So I certainly think it takes considerable to make the adequate. CIR; Do alter my control inputs. Intentionally modify to avoid excitation, that is true. Vibrations impact precision of voluntary control inputs, maybe slightly. I'm going to rate that a three, especially longitudinally. For the RQR, we can just skip right down, we knew had to ... improvement. So it's either going to be a four or five. And we'll go with a five, it's just way too active and too lightly damped and we have no problems with displays.

Exposure 2

DATE : 04NOV97

PILOT: B

TASK : 1004

CARD: Nominal Approach and Landing

This is Pilot B Exposure two. Nominal Approach and landing. Okay, approach Cooper, Longitudinal, Cooper Harper. We did get, what one, what was the first, did we get desired, what did we get on that first landing? We get ... What , we got all desired on the second one, first one, adequate. So, it's controllable. Adequate performance with a tolerable work load probably yes. Is it satisfactory without improvement? I'd say no. I'd have to give it a five I guess on Longitudinal Cooper Harper. Well actually, let me back up a little bit. On the approach its self, I'd give it a three. On the landing I'd give it a five. And on the Lateral-directional Cooper Harper on the approach, I'd ... really didn't have any trouble with that.

A three on the approach and a three for the landing. The DASE CIR rating, I'm not sure that we had very many cases where, we had inadvertent inputs, into the stick. I'd say it's probably a two, because you are aware that your inputs are causing ... you could see directly that your inputs are causing a structural excitation. So, you're natural instinct is to reduce those to a minimum. The ... I'd go to five on the right quality, and do the Aeroelastic display perturbations impact ease of display with which the task is performed? Yes, I think so.

Exposure 2

DATE : 04NOV97
PILOT: B
TASK : 2004
CARD: Offset Landing Task

Okay this is Pilot B Exposure two. offset Landing Task. Okay Longitudinal Cooper Harper on the approach, I guess I would have to give it a ... as far as holding the glide slope, it's not a particular problem at that point. Give it a five. And Cooper Harper on Longitudinal on the landing, we had trouble with getting the flare executed properly. It's also tied in with the lateral motions. The distractions from the lateral, and it's a combination of the total impact on the crew. The work load is to, at least on my part, was to avoid trying to make the touch down within the box and trying to control the airplane to get some kind of reasonable touchdown on the, somewhere on the runway. And the X portion of the task, in terms of distance down the runway, went by the wayside. So that was inadequate and we're going to call that, for that reason we're gonna give it a, Oh it's a seven or an eight. I'd give it a seven. Longitudinal Cooper Harper for the landing. Lateral; Directional, was not a big problem during the approach, except that, actually we did have trouble executing the large lateral inputs required to line up, and that was not really acceptable, not adequate. I'd give that a seven. Because of the motions involved. The landing, there again I think I'd give it a seven. The DASE CIR rating, think I was getting some impact on inputs, especially when I grabbed the stick a little more tightly during the correction. I guess I'd give it a four. And the ride quality would be a five. And do the Aeroelastic display perturbations impact the ease or precision with which a task is performed? Yes it certainly does.

Exposure 2

DATE : 04NOV97
PILOT: B
TASK : 3004
CARD: Flight Director Tracking Task

This is Pilot B, exposure two, the flight director tracking task. Okay, Longitudinal Cooper Harper. Is it controllable and had adequate performance, satisfactory without improvements? I'd say, no, it needs to be improved. It would be somewhere between a four and a five. I'd give it a five. Lateral the same, a five. And I think actually, yeah. DASE CIR rating, not much need in this task to grasp the stick firmly. And it's just occasional inputs required. Therefore, I would definitely ... I'm modifying my inputs. Let's see, I'd give it a two. DASE influence on ride quality, on the verge of abandoning the task because of the large amplitudes. But I'd say it was five and the display perturbations do impact the task. I'd say yes, but it is primarily due to the pilots motion ... physical motion in the seat.

Exposure 12

DATE: 12Nov97

PILOT: C
TASK: 1004
CARD: Nominal Approach and Landing

Exposure twelve, ILS offset approach and straight in landing, straight in approach and landing. Okay, in general, workload increase is predominately longitudinal but there was ringing in both axes and the workload kind of fed into either axis. So from an longitudinal standpoint, really working hard down below a hundred feet so fifty feet being kind of the threshold. Maybe a little bit tougher inside of fifty feet than it was outside of fifty. So for the approach lets give longitudinal a four. Moderate compensation for desired performance and for the landing let's give it a five. Lateral-directional is four for both the approach and landing. CIR, say occasional involuntary inputs, CIR of four and RQR of five, highly objectionable vibrations but no task abandonment. No display perturbations that impacted the precision. That concludes these comments.

Exposure 12

DATE: 12Nov97
PILOT: C
TASK: 2004
CARD: Lateral Offset Landing

Cooper Harpers, this is configuration twelve, offset approach and landing. For the approach segment, very high workload with the vibrations. I'd say longitudinal and lateral-directional , it's controllable. Adequate performance is attainable with a tolerable workload, not satisfactory without improvement. HQR is a six in both axes, extensive pilot compensation, both axes. For the landing, the longitudinal, same thing, a six. Lateral-directional though, the workload was not tolerable in those vibrations. Trying to compensate for vibrations particularly on the last approach. I think I'm fighting for control lateral-directionally. I'm gonna give it an HQR of eight. So six and a eight on the landing phase. CIR, a four. Occasional involuntary control inputs and RQR of five. Highly objectionable vibrations. No display perturbations noted. That concludes my comments.

Exposure 12

DATE: 12Nov97
PILOT: C
TASK: 3004
CARD: Composite Flight Director Tracking Task

Configuration twelve, flight director control task. Very objectionable vibrations. It does not respond well at all to aggressive inputs. It really makes you work. It's controllable and adequate on both axes, not satisfactory without improvement. Say desired performance requires moderate pilot compensation, HQR of four. This is one of those if I could give half ratings I'd give it a 4.5 but I'm gonna lean towards the four this time. CIR, I'm modifying the control inputs, I didn't notice any inadvertent inputs though. Let's call it a little bit worse than that. It does impact the precision, CIR of three and of course RQR of five. No display impact. That concludes my comments.

Exposure 05

DATE: 17Nov97

PILOT: D
TASK: 1004
CARD: Nominal Approach and Landing

Exposure 5, Nominal Approach and Landing, Pilot D. Okay on the approach both longitudinal lateral and directional had a little more work than before and it did come out desired but it was definitely a few or a little compensation to get it there, it would have gotten off real easy without it. So, satisfactory without improvement? I'm going to say no. Four, I think I'll stick ... four and four for longitudinal and lateral-directional on the approach. Now for landings. Longitudinal, adequate performance attainable? Boy, that's getting on the ragged edge there. I had one firm and one that was in there but I'm not sure I would ... boy that's getting real close then on the longitudinal ... I think I may have to turn the corner on that one and say adequate performance wasn't attainable with tolerable pilot workload. It gets into both of them, barely adequate at some times and had to work real hard in any case. I think maybe a seven on the longitudinal on that one. For lateral-directional for that landing, it was adequate performance and satisfactory without improvement, I'm going to say no and I didn't see too much, I think I had it lined up all the time and I didn't feel like I was having a problem with lat/dir., so I'll give that a four. The big noticeable one was the pitch and that was a seven so, seven and four for landing, longitudinal lateral-directional. CIR, this is where we might get in the ... this is right on the border of three and four, I don't think I got any involuntary control inputs in but it was close. It definitely was impacting my precision. Three for CIR and let's see three or mildly improvement desired, that's more than that, moderately objectionable at least ... well, I'll go with a four on that. Improvements warranted? Probably more than, no I'll tell you what I think we're down ... that was highly objectionable. I think we were down in the five with that one. RQR of five. (Displays?) Okay good point because this is the first time that I really notice much really bobbing around and it's a little disconcerting, it just takes a little bit of your concentration away, so this time I would say that the display perturbations had a minor impact if I can use different levels, it wasn't overwhelming but I was beginning to notice it, which I hadn't before.

Exposure 05

DATE: 17Nov97
PILOT: D
TASK: 2004
CARD: Lateral Offset Landing

Exposure 5, Lateral Offset Landing. Okay, for the approach. Adequate performance attainable? Yes. Satisfactory without improvement? No. I think both longitudinal lateral-directional were very objectionable. Adequate performance was extensive for the approach so sixes, six and six longitudinal lateral-directional on the approach. For landing. Longitudinal, adequate performance obtainable? It was but that was ... I don't have a feeling I'm in control enough. I kind of get it in the general direction and then kind of have to accept what I get as long as it looks like I'm going to be anywhere near, I'm no longer fighting to get desired, I'm just happy to get it down and that's intolerable work load as far as I'm concerned so that would be a seven. The lat/dir. was not much better but I was able to get it back. That by itself would ... it was adequate but it certainly wasn't satisfactory without improvement so a six, so I will give it seven for longitudinal, a six for lat/dir. Now the CIR, I was watching pretty closely and I didn't see any involuntary control inputs, so I'm going to give it a CIR of three and the RQR is probably down to five again. Improvement would be required, it was too close to ... I had to back out too much to be allowable as far as I am concerned and the display ... I don't know, just due to so much

maneuvering, I didn't notice that time about the display bothering me that much. It may have, but I didn't notice it. So I'll have to say no on that ... I wasn't looking specifically for it, I didn't see it and I was so busy doing other things that the display was the least of my problems. So I'll have to say no.

Exposure 05

DATE: 17Nov97
PILOT: D
TASK: 3004
CARD: Composite Flight Director Tracking Task

Composite Flight Director Task for Exposure 5. So I got an adequate and a desired, I felt kind of lucky on the desired part. Adequate performance was obtainable. Tolerable pilot workload, well I'll say yes but it was maximum allowable. Is it satisfactory without improvement? No. Actually I think for longitudinal I'll give it a five and lat/dir. I'll give it a six. It's so much more of a lat/dir. problem that that really stands out and the pitch by itself in that case wasn't as bad as the lat/dir., so I'll give those. Pretty much the same thing on the CIRs, three for CIR and RQR, I actually think I could give that a four and it should be improved and in doing that task I could do it but it should be fixed and I didn't see any problem with the display that time, so no.

Exposure 20

DATE: 04Dec97
PILOT: E
TASK: 1004
CARD: Straight In Approach and Landing

Exposure 20, Pilot E and this is the Straight In Approach and Landing. I guess for the lateral and longitudinal, I guess for the intercept and the approach phase I would probably go with a three and a three. For the landing again, the predictability problem, something that I've noted throughout is there is a tendency to go high at around 150 feet or between 150 feet and a 100 feet. Sometimes we're getting splits in the flight path vector cue as far as gamma goes. I think this all effects the landing task and this time I tried to correct for that a little bit but I tried to take the correction out before I really started to flare so even if I was aiming at the wrong place I was kind of back in a nominal flight path. It seemed to me that I had to maybe over flare a little bit more than normal to break the descent rate. Anyway, I had the tendency to over control in the flare and to balloon and float or under control and drop it in short and hard. So, between the two of those I guess I ... for me at least there was a predictability problem. We did get desired one time, we got close to desired but adequate on the other runs we did. A fair amount of motion. The line up task, I paid a lot attention to and it took a lot of focus, you need to get lined up early and make small corrections, if you make too big a correction with the line up task you end up exciting the modes and it becomes more difficult. I'm kind of looking at the four or five block, I guess I think desired performance requires a little bit more than moderate pilot compensation so, I guess I'm going to go with a five. A five and a five for the landing, a three and a three for the approach. For the control inputs, I would probably go for like a three and a half, I guess, I think there were a couple of times when I could get some involuntary inputs with the roll commands so I'm going to go with a four there. I guess I don't like the bouncing around, I'd probably go with a four and a half on the ride quality just because of the bouncing around closer to ground I think I'm going to go with a five and no on the display.

Exposure 20

DATE: 04Dec97
PILOT: E
TASK: 2004
CARD: Lateral Offset Landing

For the offset landing task I guess the thing that probably bothers me the most here is the predictability in pitch, on final we end up with the actual above commanded and then when we flare it goes below commanded and then when we ... at the latter portion of the flare it goes back above commanded and it's really hard to sort everything out and kind of decide what we are going to do and I think we didn't see this as much ... now that's when I'm real aggressive. I do better if I try to smooth things out a little bit like in the first run or two that we did and not be real aggressive about trying to necessarily get in the box. But, if we get aggressive we can see the perturbations and that coupled with the bouncing around that we're doing really makes the task difficult. I don't think we saw this as much with the straight in because we weren't exciting as many modes laterally and also I think it's not quite as tight ... the tracking task is not quite as tight for pitch in the straight in because your established and you really just have to do the flare, you don't have to correct to a nominal glidepath within flare. So we're definitely in the five or six range, I would probably go with a ... I would be leaning towards a five and a half, I guess, but I will probably go with a five and that is because I'm factoring out the fact that ... all the bouncing around. The airplane ... you can still control the airplane fairly well with all the bouncing around ... let me rephrase that. I don't think you can really control it really well because I think there are predictability problems but despite bouncing around like you are you can still fly the plane somewhat to where you want it to go so, I'm going to go with a five and a five for both approach and landing longitudinal, lat/dir. so five, five, five, five. I'm going to go with a four for CIR and a five for RQR, I would probably tend towards a five and a half for the RQR but we'll go with a five and no on the displays. I guess this is just kind of a note, question, comment ... hypothetical question, I don't know, but it seems to me the airplane has a control authority to move the airplane to or to give you the commanding gamma because when I get a split in gamma I could move the actual gamma to where I want it, and so, I'm assuming that it's a function of how much control authority that you give without having a piloted input or something. I'm not sure what it is but I guess my question is or something to think about is: If the airplane has the authority to give you the commanded gamma, do you want to do that? and I realize there's a lot of implications as far as ride quality if you go through a transition the airplane would maintain the commanded gamma it could kind of be abrupt at some times but I'm wondering if there isn't some trade off in here that we need to look at.

Exposure 20

DATE: 04Dec97
PILOT: E
TASK: 3004
CARD: Composite Flight Director Tracking Task

Exposure 20, Pilot E, Tracking Task. We got desired performance although we crashed the motion base on the second run. I'm definitely in the four, five, six block I think though because it's more than minimal pilot compensation. If I go into the four, I'm kind of faced with minor but annoying deficiency but I think it's more than that. I'm not so sure that it's

more than moderate pilot compensation to do the task, I guess I'm going to go with a four and a four. Let me think about these for a second. It's a tough call, I think I'm actually going to change that and go with a five and no ... let's just leave it with a four and a four. The CIR, I'm going to go with a four, the ride quality I'm going to go with a five and no on the display question. I guess for this task I could track in pitch fairly well, there were times when I would make an input and it wasn't quite what I was expecting and I would have to make a bigger input so I think predictability suffers in pitch here also, there were a few times when I kind of got surprised. In roll, it excites the oscillations and I don't like the oscillations and that makes it hard to make some precise inputs and maybe feeds back some involuntary inputs into the stick. For the most part capturing and tracking a roll or bank angle was not great but it probably wasn't as bad as you might think. I mean there was a lot of motion but you could still basically capture and hold a bank angle. Making fine corrections you tended to excite the motion but you could still make some fairly fine corrections. So, anyways.

Exposure 2

DATE : 08Dec97

PILOT: F

TASK : 1004

CARD: Nominal Approach and Landing Task

Pilot F, exposure two, nominal approach and landing. Okay this is exposure two. And the pilot rating coming up, just a couple of general comments first. It's obviously one of the ... compared to my indoctrination this morning, it's obviously close to the worst case, if not the worst case. And in fact, I think, I was having a little more trouble with this one than I was with what I thought was the worst case this morning. In particular, the ride quality was not too too bad, it was not effecting control down to the flare. But in the flare, initially I was getting some big problems with exciting the motion and I wasn't sure it was me so in fact I suspected it was the turbulence. But apparently it was me and we went through some test there to show that it really was. And I did make one approach where I tried to not make any lateral inputs and sure enough the ride didn't degrade during the flare. Okay so let's go ahead and rate it. Pilot rating, longitudinal, for the approach; got desired performance and overall let's ... I guess this is not based on performance, it's based on the overall impression of the airplane. And so, I can give you halves on this, can't I? No. Let's give it a six. Very objectionable but tolerable deficiencies, that's maybe even a little good. The main complaint; bad ride. No control aspects there. Okay lateral, let's do the same thing; six, bad ride. Landing now, okay it looks like I'm all adequate. I didn't get a single one that was desired. So just on performance we are forced into a level two. And let's give it a longitudinal rating first, and how did my last one go? Not too bad. Okay I think with the modified technique where I intentionally backed off on the control during the flare, particularly on the laterally, it's not as bad as it was previously. But it requires conscious, a lot of compensation not to do that. Let's give it a six still. And laterally, I can back out of here, is adequate performance attainable with a tolerable workload? It's attainable but is it a tolerable workload, is the question? Let's give it a seven, deficiencies require improvement laterally, I think. It's just too easy to couple in and everything gets to banging around and it effects the longitudinal and everything else. Okay DASE. DASE influence on pilot control inputs. Okay, I think it's a three. I don't think ... I don't feel like that my arm is banging around and making involuntary inputs so I think it's a three. Okay for the ride quality; let's make it a five. And for the display, all you want is a yes or a no, isn't it huh? It's a little hard for me to sort out the flexible part for me but ... let's give it a yes. I think with a question mark but a yes.

Exposure 2

DATE : 08Dec97
PILOT: F
TASK: 2004
CARD: Lateral Offset Landing

Pilot F, exposure two, lateral offset landing. Okay Pilot F on exposure two, pilot rating for the offset task. Let's do the approach. The longitudinal rating first. I think it's kind of deceptive here, the longitudinal really doesn't seem too bad. It seems to be the lateral that's the biggest problem. So longitudinally, now this is down to fifty feet isn't it? Okay let's go up the out side to make sure. Is adequate performance attainable with a tolerable pilot workload? Yes. Okay I have a little bit of a hard time because for me at least, to separate out the lateral ride quality from the vertical ride quality. I'm giving the rating primarily on that. So for longitudinal for approach, I think it's a six, correction a five. Not too bad but laterally it's ... No, let's give longitudinal a six and the lateral let's give it a seven. It requires improvement, the deficiencies require improvement. We can do it if you play the game and pussyfoot through the thing there, you can get through it but if, like that last one, if you are slightly aggressive at all it just gets really objectionable. Okay, six and seven for the approach. For the landing, I'm going to give it just six and seven as we did for the straight in, for the same reasons. The DASE. The control. I think it's a three again. I don't think I'm getting any wild coupling. The display, correction, the ride is a five. And the display is a yes, I think. Yeah, the display is a yes for sure.

Exposure 2

DATE : 08Dec97
PILOT: F
TASK: 3004
CARD: Composite Flight Director Tracking Task

Pilot F, exposure two, flight director tracking task. Okay, pilot rating, and this is going to be based on workload and ride quality, etc. yeah, because the performance was all desirable, I believe. So longitudinally it's not too bad. You just have to kind of smooth things out a little bit. Is it satisfactory without improvement? No. Deficiencies warrant improvement. Yes it's that fivey-sixey. Let's give it a five here. It's a little bit easier than the landing. And lateral, the workload, the band pass of the workload doesn't seem quite neither. So it's not quite as objectionable. But shoot, it's got to be fixed. You can't build an airplane like that. Yeah the deficiencies require improvement. Let's give it a seven laterally. And DASE. We have got a control one and I think it's a three again. And the ride quality is a five and let's say no here on the display. I didn't ... it really wasn't as bad and the quasi part of course is not a problem. Okay.

Configuration 05 1st mode increased to 1.80 Hz; all others by same frequency ratio, stif2

Exposure 6

DATE: 20Oct97

PILOT: A

TASK: 1005

CARD: Nominal Approach and Landing

The straight in approach and landing task rating, this is the approach segment, longitudinal Cooper Harper; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes, a three. For the approach for the lateral task; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three also. Now some comments on both of them. The worse axis is the lateral axis both rudder doublets and roll doublets resulted in pretty good ASE motions. What's interesting here is the pitch axis seems to be quickened a little bit. So we have kind of a combination of some of the ones we have seen before, at least that's the impression I got so far. For the straight ins, it's really not that much of a problem. For the landing rating, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No and rate it a four. I believe the desired performance is pretty much split there and I'm going to round it to desired performance. The reason it's not going to be a three is because there are enough motions ASE wise that do complicate the task somewhat and just the turbulence is exciting enough motions that it makes it a little bit complex. I don't feel like I have level one control in the longitudinal axis for the landing. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. Also a four and that's due to the ASE motions and the kind of response you get with a lateral input. For the CIR rating; pilot does not alter control inputs as a result of aircraft flexibility. No I'm going to rate it a two. Again it's kind of subtle as a lot of these are but I do have to be a little more cautious because of the ASE characteristics. Ride quality, certainly number one is not true, vibrations are perceptible but not objectionable. That's not true either. Vibrations are mildly objectionable. That's not true. I am going to go with a four. I don't think the lateral motions are that awful but let's go with a two and a four for right now. Display question's not a factor.

Exposure 6

DATE: 20Oct97

PILOT: A

TASK: 2005

CARD: Lateral Offset Landing

The rating for the longitudinal approach segment; Again longitudinal ratings and lateral ratings for up and away for the approach were very similar to the straight in. No problems. Longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. No real problems at all even with the ASE motions on maintaining the glideslope. Lateral; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, a three. No problem maintaining localizer to within required limits. Probably though I would never give anything better than a three on this because minimum pilot compensation is certainly required. The turbulence excites the ASE motions which makes the thing wander so you have to get in to the loop, so they always probably will be no better than three's in my book. Okay, for the landing ratings, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. Pretty much adequate performance so the first time I had a pretty good H-dot, a little bit long. The second time, right in the box but a little bit firm, so we'll have to rate that as a five based on criteria. There is enough combined lateral and longitudinal

motions on this that it does ... and you are trying to not excite them anymore than you have to. So it does make it a little difficult to be real aggressive there in the flare and typically coming out of that last corrective turn, it's a little bit difficult to get the flare out to precisely set. So a little bit of a tough task made a little bit more tougher by the ASE motions and this is true of most of these I have rated. The lateral rating, for the landing; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No and it's going to be desired Cooper Harper four but not level one due to the complications of the task and due to the complications of the ASE effects. For the CIR, I would say I do make very subtly alter my control inputs so a one will not work but a two will work for that rating. However these are real subtle changes, I'm pretty aggressive, especially laterally, I feel like I'm aggressive laterally even though I get banged around a bit. I don't feel it's going to cause me problems. Longitudinally in the flare, I'm reluctant to be real aggressive so it's pretty much a longitudinal reason why this is going to be a two and not a one. The ride quality, One is not true, two, three vibrations are mildly objectionable, no, four. We'll stick with a four on this just because of the magnitude of the vibrations spate out by the lateral inputs. And for the display question again not a factor. The displays are very very easy to read, head up and just to caveat, all my comments are on the head up displays, I'm not looking head down at all.

Exposure 6

DATE: 20Oct97

PILOT: A

TASK: 3005

CARD: Composite Flight Director Tracking Task

Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I'm going to say yes and rate it three longitudinally. Laterally; Controllable? Yes. Adequate? Yes. Satisfactory? No, and a four representing once again that the lateral task seems to be in this task always the harder of the two even though on some of these we've had some annoying longitudinal characteristics. Again this one right here, we had a semi-quick longitudinal and fairly large displacement lateral motions. Okay, going to the CIR ratings for this exposure six. Let's see, pilot does not alter control inputs, I'm going to say a one. I really didn't hold back on anything that time. So it will be a one and for the ride quality, vibrations do not effect, that's not true. Not perceptible, that's not true. Mildly objectionable ... No, I'm going to go with a four. A one and a four again. They probably warrant improvement. And the displays issue, not a factor.

Exposure 3

DATE : 04NOV97

PILOT: B

TASK : 1005

CARD: Nominal Approach and Landing

Okay, Pilot B, exposure three, nominal approach and landing. We are running. Okay, Longitudinal control, approach. Had no particular problem on that, I guess I would give it a three. Longitudinal Control, landing was, as I recall, we landed long and we landed a little hard on one. So I think I would give it a four on that. Lateral-directional Cooper Harper, didn't have too much trouble with that, I'd say a two. And on the approach and the landing, probably a two. DASE CIR rating, I think I would ... It's a little hard to judge when involuntary control inputs are occurring. The intensity of the vibrations and oscillations do increase down in the 50, below 100 feet. In the 50 foot area. I'm not sure, I'm not totally convinced it's because of the stick inputs. I'd give it a two. And the ride quality, was quite,

moderately objectionable. I'd give it a four, on the ride quality. And the elastic display; aeroelastic display perturbations impact the task? I'd say yes they do.

Exposure 3

DATE : 04NOV97
PILOT: B
TASK : 2005
CARD: Lateral Offset Landing

Okay, Pilot B, exposure three, task; Lateral Offset landing. Longitudinal Cooper Harper approach; really not bad, three I'd say. Landing; we kept landing long, and that was quite difficult. It was controllable. We got adequate performance, Yes. Satisfactory, without improvement, I'd say no. Safe to say that's no, needs improvement. Requires considerable ... well I'd give it a five. Longitudinal ... Lateral-directional Cooper Harper really was not a problem. The ride was extremely uncomfortable, but the approach was not a problem, I'd give it a two. The landing its self, we bank angle problems, we're hesitant to use the correction that might have been required because of the excitation that occurs. And so I think I would give it a five. DASE CIR rating, a two. And the ride DASE influence and ride quality, would be a five. Aeroelastic display perturbations, yes it does effect you, the answer is yes.

Exposure 3

DATE : 04NOV97
PILOT: B
TASK : 3005
CARD: Flight Director Tracking Task

Okay, that's the composite flight director tracking task for exposure three pilot B. Longitudinal Cooper Harper, what did we get on the last one? Inadequate. Okay, Longitudinal Cooper Harper, is it controllable? Yes. Adequate performance attainable, I'll vote yes. Satisfactory w/out improvement? Well , I really didn't have much trouble pitch wise, so I'm gonna give it a three. Lateral-directional is where you have the big trouble, and that's reacting to the immediate heading changes. And lateral-directional Cooper Harper, I'd have to give, it's barely adequate. It is controllable, adequate performance is attainable, yeah, I'd probably say so but it would be a very objectionable six. I'd give it a six, for lateral-directional and DASE CIR rating I'd give it a two. And the ride quality would be five. Aeroelastic display perturbations, I'd say yes.

Exposure 20

DATE: 13Nov97
PILOT: C
TASK: 1005
CARD: Nominal Approach and Landing

Okay, exposure twenty, this is the offset ILS straight in approach and landing task. For the approach, both axes controllable, adequate, satisfactory, minimal compensation, HQR of three. There's a lot of vibrations going on and I'm compensating by just not making any inputs. With the gamma dot V system and the P beta system you don't have to make a lot of inputs at that point. So down basically until I get into the flare, there's not much going on in terms of inputs. It's just very disconcerting with all the motion from the vibrations. The landing is little bit of a different story. Lateral-directional again, nothing really going

on there. It's controllable, adequate, sat., minimal compensation, HQR of three. Longitudinal however, I feel like I'm really working. Like, there's an impact from the vibrations into the longitudinal axis. It's kind of borderline between an HQR of four or five. Saying desired performance requires moderate pilot compensation, probably isn't stating it enough. But, saying that adequate requires considerable is over stating it. I'm gonna give it a four in this case. So, we had three, three, four and three. CIR is four. Occasionally I'm getting involuntary control inputs and RQR is five. The display perturbations did impact the ease of precision, predominately lateral vibrations did that, so I'm gonna say yes on that. That concludes these comments.

Exposure 20

DATE: 13Nov97
PILOT: C
TASK: 2005
CARD: Lateral Offset Landing

Exposure twenty, offset approach and landing, clearly level two. Almost into level three in terms of control. I was able to retain control. I don't feel like PIO is an issue as much as just the vibrations get so violent that it's tough to track what's going on so it's not a PIO situation as much as it is just being able to see what's going on. The approach and landing, the problems occur at about 150 feet on down to touchdown, a little bit higher this time. They occurred sooner than I've seen before. So, I'm gonna lump them into one rating, both approach and landing. It's controllable, adequate performance is attainable with a tolerable workload, just barely. From a lateral-directional standpoint, I'm gonna say adequate performance requires considerable pilot compensation, lateral-directional was a five. Longitudinal, adequate performance requires extensive pilot compensation, longitudinal was a six. I'm really fighting to keep the airplane within safe parameters. CIR, frequent involuntary inputs longitudinally. CIR is five and RQR is a very solid five. Very, very highly objectionable. There's no way you'd ever certify anything like this. Display perturbations are noticeable and did impact the ease of precision. Again, predominately lateral-directional. The shaking from side to side is what you notice. That concludes these comments.

Exposure 20

DATE: 13Nov97
PILOT: C
TASK: 3005
CARD: Composite Flight Director Tracking Task

Okay this was exposure twenty, flight director tracking and capture. Very similar to trying to drive an airplane precisely while somebody's grabbing you by the shoulders and shaking as hard as they can. I was able to fly the airplane and get desired performance but there's a lot of distractions going on with all of the vibrations. I found that I couldn't for instance, lean against the seat and tolerate the vibrations. I had to lean forward, away from the seat to minimize the impact on my body from the airplane. It's a little bit tougher lateral-directionally than it is longitudinally but in both cases I think you're really working because of those vibrations. It's controllable, adequate performance is attainable with a tolerable workload. Clearly not satisfactory without improvement though. Give the longitudinal a four and the lateral-directional a five. Most of the violent shaking was in the lateral-directional axis. There were occasional, actually frequent inadvertent inputs. Let's call the

CIR a five on that and RQR again five. Very, very strong five. No display perturbations noted. So in summary, a completely unsatisfactory configuration by probably a multiple factor and that concludes my comments.

Exposure 20

DATE: 19Nov97

PILOT: D

TASK: 1005

CARD: Nominal Approach and Landing

Pilot D, exposure twenty, nominal approach and landing. Okay, on the approach. Certainly the performance was there again. It was uncomfortable due to the oscillations and all. As far as the accuracy of control and how much compensation it took to do the approach, that was satisfactory. So three and three for the approach. It's kind of beating around. I could make a good case for threes or fours on these things. It's right on the borderline would be my guess. For the landing though, adequate performance attainable? Yes. Satisfactory without improvement? Although I got an awful lot of desireds on those, I'm beginning to feel disconnected with the airplane on this. I'm just kind of relying on the displays, and the control laws to take care of this thing because I'm having to do it almost mechanically. There is very little feel to this. If anything the feeling would be in the wrong direction for me to make the proper thing. So I'm kind of just doing it almost open loop. Just following the displays. Holding and hoping it all works out and that time it did several times. Anyway, that makes the workload way too high to even come close to a four as far as I'm concerned. In pitch, I'm gonna go to six on that. Extensive pilot compensation. In Lat. Dir., I really didn't exercise it enough to do much but I would say probably four on that. So six and four for the landing. CIR, I'll say three on the CIR. RQR four. The displays, I could see them moving around. I'm not sure, I'll say no on the displays. If there's an effect on it ... impact on the precision it was very minor so I'll go with no on that.

Exposure 20

DATE: 19Nov97

PILOT: D

TASK: 2005

CARD: Lateral Offset Landing

Pilot D, exposure twenty, offset landing. For the approach. I'm getting a lot of side to side oscillation here and it's even beginning to couple in. It's beginning to effect it very drastically. In fact, although the performance was reasonably good, we're getting on the edge of what won't make sense here. I'd say, probably didn't notice the pitch as much but I'd say a five for longitudinal and six for Lat. Dir. for the approach. For the landing, longitudinally it was adequate each time. The problem is, I'm really feeling disconnected with this when we get into the turbulence like this. The oscillation left and right was taking my concentration away from the longitudinal some. So, best I could do would be five on the ... certainly five on the pitch. The Lat. Dir., I'd say that's getting to the major deficiency. I don't think I'd buy that the way it is. I think I'll give a seven on the Lat. Dir. Particularly on the last approach whether it was resonance or what but I started to get some really serious oscillations left and right that were effecting me badly. So five and seven on that. Four on the CIR. RQR, that would have to be fixed, five. So four and five on those two. Displays? Yes. I'll put that in there.

Exposure 20

DATE: 19Nov97
PILOT: D
TASK: 3005
CARD: Composite Flight Director Tracking Task

Pilot D, exposure twenty, flight director tracking. Satisfactory without improvement in pitch? I'd say yes. Four would be fine for the pitch. As always, Lat. Dir. is the real trouble maker and this time I would have to bring that down probably to a six. I had one adequate and one desired but just overall feeling is that six would describe the Lat. Dir. better. For CIR, it usually feels bigger accelerations up here. So I'll stick with a four on the CIR and five on the RQR. No on the display. I couldn't tell that it was the display perturbations that were impacting anything.

Exposure 19

DATE: 04Dec97
PILOT: E
TASK: 1005
CARD: Nominal Approach and Landing

Exposure 19, Pilot E, This is the approach and landing task. For the capture task we can excite things both in pitch and in roll and I guess I would give the intercept and approach a three and a three. It's not particularly difficult to do but the bouncing around is a little irritating and you do have to back off on your control inputs a little bit and be a little bit patient to try and keep from exciting the modes. For the actual landing itself, predictability is an issue I think because you get the split cue again right in the final portion of the flare and you kind of have to game it a little bit to really get what you want out of it. The line up task I noticed if I was very aggressive about trying to get aligned on the center line I could excite things so I'm going to go with a four and a four for the landing. The CIR, I'm going to go with a three on this task although there were a couple times where it was borderline rather I might be making some involuntary inputs particularly when I tried to be a little more aggressive in making roll corrections. For ride quality I will go with a four and no on the display question.

Exposure 19

DATE: 04Dec97
PILOT: E
TASK: 2005
CARD: Lateral Offset Landing

Okay, the first comment that I would make is the ... especially after we make the cut we get bounced around pretty good both in pitch and roll, trying to make the corrections. Last time I was probably just a little bit smoother and I don't think we got bounced around quite as much as we did on previous runs. My biggest complaint would be predictability in the flare, on the run just before the last run we made, I ended up in the flare with the actual gamma at least what I think I remember, the actual gamma being above the commanded gamma which was causing us to float. This time I was anticipating that, so after I broke the descent rate I set the commanding gamma lower than I would normally, expecting that floating sensation and we ended up not getting it and we pretty much hitting our aim point. I think we did get

some float but not as much, so anyway I guess my biggest complaint is predictability and that was down in the flare. That may be a function of the modes too, I'm not sure. Anyway, I would probably go in here in the Cooper Harpers and give it a five and a five and a five and a five for the approach and landing. For the control inputs I'd probably go in the three and a half range, I'm going to go with a four, I think there were very few times where I actually fed back involuntary input into the control system but I do think there were a few times when I got a little more/a little less than I really wanted to because of the motion and the stick dynamics. For ride quality, I'm going to go with a five. We didn't abandon the task obviously but the motion that we are getting is very ... although, you can control the airplane and get it kind of to do what you want it to do except for the noted predictability problem. I do have to kind of back off on my gains for capturing or when I go to capture center line I can make fairly large inputs but then what I have to do is make inputs early and then let things settle out for a second and then make slow, fine corrections at the end. So there's also a little bit of a predictability problem in roll but not as much, it's not as apparent at least as it is in pitch but if I was bouncing around that much closer to ground I would probably go around and so, the answer on the display is no.

Exposure 19

DATE: 04Dec97
PILOT: E
TASK: 3005
CARD: Composite Flight Director Tracking Task

Lots of motion, I guess I would characterize the motion that we're picking up here as mostly directional, in the Y direction I guess and it does decrease your ability to perform the task. I don't know if I got very many involuntary control inputs but there's definitely that tendency if I didn't and I think we got a few. Despite all the bouncing around and everything you actually can do the task but it's very annoying. I guess if I go up to: Is it satisfactory without improvement? I guess I'd probably say no because I think there is some compensation for all the shaking around, I know I'm sitting here holding on to the arm rest and letting my body shake and trying to keep my head some what stable so I'm going to say no on the ... I guess I'm somewhat tempted to go with a five here simply because the deficiencies are more than minor but annoying. I guess, I would characterize control in pitch being a little bit better than in the lateral/directional axis here. I don't like splitting the axis but I guess I will. I guess I will go with a four in longitudinal and a five in lateral-directional. I don't know, I guess the thing that is so difficult here is there is a roll control unlike some of the other configurations we've seen, the roll control, despite you excite the mode, you still have pretty good control and you ability, except for the shaking around so much, your ability to track a bank angle or to capture a bank angle is really not too bad. I think I'm going to go with a four and a four but I would note that I'm real tempted to give the lat/dir. a five just because it excites the motion. On the CIR I would go with a four and on the ride quality I would go with a five and under display I would say no.

Exposure 10

DATE : 09Dec97
PILOT: F
TASK : 1005
CARD: Nominal Approach and Landing Task

Okay, Pilot F on exposure ten, for the straight in task. This one seems qualitatively kind of like the last one. Not too bad longitudinally but real bad laterally. Maybe a little bit worse

longitudinally than the previous exposure nine. Okay, in any case, we'll try to give it some pilot ratings. It is not effecting the performance on the straight in significantly here. And the ride, longitudinally, is not too bad. Let's give it a five, on longitudinal, for approach. And lateral is definitely a seven and the same for landing. Five and seven. All kind of ride, really. Okay, the DASE control, I don't think I'm making any involuntary inputs so it's a three. What do you do to make it a six? It's not that bad yet. Okay, five. And yes, you know, both. Although, qualitatively again, the wiggling in the display on the straight in is not to much of a factor but you can definitely see it.

Exposure 10

DATE : 09Dec97
PILOT: F
TASK: 2005
CARD: Lateral Offset Landing

Okay, that was the offset task for exposure ten, just some general comments. It's not as bad as I thought it was going to be from all my initial explorations of it during the long straight in. And the lateral is just borderline making it just where you're really going to have a hard time holding on to the control. But I was able to control and able to hold on. It was really getting thrown around a lot but still able to do the task. And longitudinal wasn't too too bad so let's give it, for the approach, let's give it a pilot rating of five. Now lateral, gosh, seems like you ought to be able to give it worse than seven but do you really need to? Major deficiencies require improvement, major deficiencies, that's what it says in all of them. So I'm just going to give it a seven and say with the comment that it was almost to the point of not being able to hold on to the control. Okay, it didn't effect the controls significantly, I had to be very gentle, laterally. But it almost felt like if it got any worse, I would not be able to hold on to the controller to do anything. So it's a five, seven, a five, seven on the ratings. And, almost can't hold on, applies to both the approach and landing lateral. The longitudinal, not too too bad. Okay, DASE is the control this a three, five, yes. And I have a feeling that the wiggling is effecting it on the lateral task.

Exposure 10

DATE : 09Dec97
PILOT: F
TASK: 3005
CARD: Composite Flight Director Tracking Task

Okay, it's kind of like ditto the previous exposure. And longitudinal, I'm going to give it a five. Standby. We're going to give it a five longitudinal. You have to be careful longitudinally. Once I got just a little bit of longitudinal motion going. Laterally it's definitely a seven still. And not as bad as the offset approach as far as it being marginal but it definitely has to be fixed. You can't sell too many tickets that way. The DASE is three, five and no.

Configuration 06 1st mode increased to 2.00 Hz; all others by same frequency ratio, stif3

Exposure 9

DATE: 21Oct97

PILOT: A

TASK: 1006

CARD: Nominal Approach and Landing

Exposure nine, straight-in approach and landing, longitudinal approach, Cooper Harper rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Again gamma-dot-v no matter how bad this ASE work is it almost should be left hands-off. It pretty much flies the approach but with turbulence you do have to stay in the loop and compensate minimally so therefore a three seems to be very descriptive. And it seems to be across the board on all of these. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? Yes also. Similarly the lateral does take a slight amount of compensation a few disturbances from turbulence but not a whole lot of workload. In this configuration, I have a very lightly damped lateral axis with high amplitude motions, once you put an abrupt input in to stimulate it. Similarly the longitudinal axis is also lightly damped with about seven overshoots I counted with medium amplitude, not quite as high an amplitude as the lateral but a little bit higher frequency. Rudder inputs don't seem to do much. For the landing, this is where this configuration is kind of poor. It is not very predictable or consistent, longitudinally especially but laterally if you make lateral inputs you do trigger this undamped motion which is distracting. So for the longitudinal rating for the landing; Controllable? Yes. Adequate? Yes. Satisfactory? No. Basically I either landed short or slightly long and I had mostly firm H-dot's. So we'll have to say it was adequate performance and to get adequate performance it can be done with considerable compensation, no more. So let's go with a five on that. Not much choice on that one. And the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. We'll go with a four on that for workload. It just takes a little bit of work or effort to keep this thing lined up. Also Bruce and I are of the opinion that there is a miscalibration between the visual scene and what is being recorded. It appears that we tend to have about a three to four to five foot error to the right where if we land on centerline it will show us a right error and if we land slightly left it will show us near centerline. If we land further left, it shows us slightly left. So we've got a slight bias to indicate to the right. The CIR; had to alter my inputs. I intentionally modified it. I would say three. I think in the longitudinal axis this undamped motion does tend to cause the aircraft to do things that I'm not really commanding and it does impact the precision of my control inputs. It does not cause involuntary inputs so we'll stop at three. For the RQR; similarly rationale as before and I'm going to skip on down to number five. Because of the fact that it does tend to impact my controllability. I think we have to improve that, so improvement required is the descriptor based solves that. So we are looking at a three and a five. Display is not a factor and this configuration is pretty interesting in that both axes are pretty bad.

Exposure 9

DATE: 21Oct97

PILOT: A

TASK: 2006

CARD: Lateral Offset Landing

Longitudinal approach rating; The same comments as for the straight in apply. Cooper Harper of three. Lateral; same comments apply, Cooper Harper of three. For the landing;

Controllable? Yes. Adequate? Yes. This is longitudinal. Satisfactory? No. It is really borderline desired-adequate. Because of performance we are going to give it a five. It's real borderline four-five, desired-adequate. For the lateral landing rating; Controllable? Yes. Adequate performance is attainable. Satisfactory without improvement? No with a four. The CIR rating, in this case is going to be a two. I didn't really feel like the vibrations impacted precision on my control inputs either longitudinally or laterally. For the ride quality rating; vibrations did impact the quality. They were objectionable. I'm going to stick with a five on that, because of the lightly damped nature where you get these continuing motions after an input, I find fairly objectionable, even though performance wise the off set worked out pretty well. It could be because it is such a high gain lateral task that I don't have a change to get into the longitudinal loop as much. And I pretty much getting fed up and leaving it where I have it. On the straight-in I had much poorer performance, longitudinally, relatively speaking, and I think that was because I was concentrating more on that longitudinal axis and I think that is where our problem is on this one. It is plain to me that we can accept or I can accept for the landings, I can accept a worse lateral problem than longitudinal even though we ... the lateral control laws have improved. I think we are doing a better job with it. The flare has been unpredictable because of DGE all along and I think when we get a screwed up longitudinal axis it makes it a little bit worse. And no problem with the displays.

Exposure 9

DATE: 21Oct97

PILOT: A

TASK: 3006

CARD: Composite Flight Director Tracking Task

Longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I'm going to go with a four on this. And lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No, a four also. This configuration because it was lightly damped in both axes made it just a little bit more difficult than normal. We had some real good motions as far as sustained high amplitude motions at about one and half Hz. The lateral task was difficult but the longitudinal task, you could generate these big motions that made it a harder task. CIR; pilot does not alter control, that's not true. I did modify my control but it did not effect precision, the voluntary control inputs. We'll go ahead and put this a three, CIR. Its borderline two-three. RQR; also a five this time. It's just too lightly damped and No for the display.

Exposure 1

DATE : 04NOV97

PILOT: B

TASK : 1006

CARD: Nominal Approach and Landing Task

This is Pilot B Nov. 4th Exposure one, nominal approach and landing task. Okay, Cooper Harper longitudinal, it was controllable and we did obtain adequate performance and is satisfactory without improvement. Gee I guess from the stand point of aircraft ... you're talking strictly from the arc ..., strictly from the standpoint of aircraft control is that ... separating out the ride quality, for another rating. I would give it , probably a four, because of the ... there is an awful lot of bouncing and the ... you have to be quite the... the visual loop is, seems like the most vulnerable loop in terms of you're physically bouncing around. If you're bouncing so much that your eyeballs are moving, you can't focus on anything and you can't see various turbulence or you can't really read instruments. This is starting

across the threshold of being able to pick out fine nuances in the display in terms of commanded gamma. So for that reason I give it a four. The actual effect on the pilots stick, tactile feel of the stick is not a big problem lateral and longitudinally. Actually, lateral is probably... Longitudinal I'd give a four and lateral didn't seem to be quite as much of a problem, give it a three. The DASE CIR rating, Oh you want to break it out into the approach and the landing. Okay, I'm sorry, let me back up a little bit. Approach segment longitudinal Cooper Harper, I guess I'd have to give it a three. Lateral-directional Cooper Harper maybe a two, and for the landing I'd back down to a three, a four for longitudinal. And Lateral would be a three for the actual landing. Do you want flight director tracking and capture? Got too many you's in your capture there. Okay, DASE CIR rating for approach. I would find it longitudinal, overall, this is a overall for both approach & landing lumped together. Okay, I didn't really see any involuntary inputs. Precision in the inputs is probably effected more by the visual impact, so I guess I give it a three. And the ride quality, I give it a four. Where is that at? What do you mean down here? Plastic. Yeah, I think in the landing flare, especially after the flare started, there is some impact on how easily the flare is initiated. And that is significant, I'd say yes they do impact it.

Exposure 1

DATE : 04NOV97
PILOT: B
TASK : 2006
CARD: Offset Landing Task

Okay this is exposure one for Pilot B the Offset Landing Task. Cooper Harper approach longitudinal, gee a, that part , the approach includes about, stops when you cross the threshold, is that right? 50 feet. Okay. I would give it a four. Longitudinal Cooper Harper for the landing, yeah, I'd have to give it a six, actually I ... we were difficult. We had trouble getting even adequate performance. It might even be a seven. I'd give it a seven. Lateral Cooper Harper rating, I was a little hesitant to, very, sharply put very ... to put in sharp inputs and so the lateral was compromised and ended up in a steep bank on one. One I really didn't want to be that steep, because I was bashful about getting the bank rolled over and so forth because of the way the airplane was reacting. Straight-in approach ... approach I give it a lateral Cooper Harper, a , Oh a six I guess. And landing, a six also. DASE CIR rating, I can't say that there is very many involuntary inputs there, but it's mostly in the visual channel. Actually the problem comes in, in the motion of the body, the eyes being thrown around. So this CIR rating is, maybe should have something in it about the visual channel. Yeah. I'd say it's a three. The ride quality, probably a five. And do Aeroelastic display perturbations impact the ease of precision ... the ease or precision with which the task is performed? I'd say yes.

Exposure 1

DATE : 04NOV97
PILOT: B
TASK : 3006
CARD: Flight Director Tracking Task

Okay this is Pilot B exposure one flight director tracking task. Okay, we had ... let's look at longitudinal Cooper Harper, okay this is flight director, just have one Cooper Harper rating. I'd give it a five. Lateral, I would give it a ... I think most of the cause for going out

was due to lateral problems. For that reason I'd give it a seven. It's not really a control problem, but it's a situation where the pilot is most likely not going to be able to use the controls inputs required because of the cockpit vibration that it induces. The DASE CIR rating, I guess the ... I can't say that there's really involuntary inputs here. Okay I guess it'd fall under the category of a two. And, it's either five or six I'd say. If you take into account, the ... we did abandon the task primarily for cap limitations. I'd give it a five, on the DASE ride quality. And do the Aeroelastic display perturbations impact DASE? I'd say yes they do.

Exposure 4

DATE: 12Nov97
PILOT: C
TASK: 1006
CARD: Nominal Approach and Landing

Okay, pilot C, it's the twelfth of November, exposure four. Basically, it seemed like it was stiffer than before. The frequency was relatively high. It felt just qualitatively like it was approaching two Hz in both axes. Both axes fairly easily excited and both axes rung after excited. The lateral seemed a little bit worse than longitudinal. Okay, Cooper Harper, was controllable, adequate, not satisfactory. This is the approach. Both longitudinal and lateral-directional, no specific difference in the problems, HQR of four. In the landing, controllable, adequate, not satisfactory, HQR of five considerable compensation. DASE CIR, let's give it a four. Occasionally I'm getting involuntary control inputs. Let's see ride quality, a five, highly objectionable, improvement required. No impact on the display this time. That concludes my comments.

Exposure 4

DATE: 12Nov97
PILOT: C
TASK: 2006
CARD: Lateral Offset Landing

Pilot C exposure four on the twelfth of November. A little bit worse than the straight ins. A little bit being an understatement. Really violent shaking, laterally down low. To the point where inadvertent inputs, display motions, and fighting for control, all were issues. Now that was happening prior to fifty feet, so that was during the approach phase. So it's gonna affect the Cooper Harpers in both phases. Okay, for the approach, controllable, not adequate. Controllability was an issue here so I'm gonna say, considerate pilot compensation for control. I'm trying to decide whether that's lateral-directional or longitudinal or both. It felt like the majority of the oscillations were lateral-directional so let's give longitudinal a six and lateral-directional an eight and since that occurred prior to fifty feet and lasted 'til touchdown, I'm gonna give that the same ratings for approach and landing, longitudinal six lateral-directional eight. The DASE CIR is a five. It's really approaching a six here. The only reason it wasn't a six is because I was letting go frequently to keep out of the loop. RQR, DASE RQR, let it go, let it go. Five just 'cause I can't justify a six there but it's pretty bad so I'll give it a five. Yes, display perturbations did impact the precision. There are times when the display was moving and it almost seemed like it was out of phase with the motion in the cockpit to the point where I had to, kind of lose track for a few seconds until it calmed down. Yeah, I know, I understand.

Yeah, I was never trying to look head down that would not have been doable I don't think. Okay, that concludes it.

Exposure 4

DATE: 12Nov97

PILOT: C

TASK: 3006

CARD: Composite Flight Director Tracking Task

Okay this exposure four, the flight director task. Longitudinal wasn't all that bad. I got desired performance I would assume both times. I haven't looked at this one, yeah 85%. Longitudinal wasn't all that bad, annoying predominately. I'd call it moderate compensation, not to keep it under control but to keep it within desired parameters. Lateral-directional was horrendous. There are times where I was tempted to say I was fighting for control. I'm not going to degrade it that much 'cause it was occasionally and it was predominately ride quality not control. So let's say longitudinal was controllable, adequate, not satisfactory, moderate compensation HQR of four. Lateral-directional, controllable, this is one of those where you can't really give it a seven without talking about control 'cause I was able to get adequate performance. I'd say considerable pilot compensation, HQR of five. Yeah. No I don't think I was fighting for control. I think it was extremely objectionable in terms of the motions. And there were times when I let go of the stick to keep from getting in the loop. Well, see the trouble is eight is too stringent. Seven is not true. Let me go back here. Adequate performance is attainable with a tolerable work load, that's true. So I'm really limited to a six. Extensive ... let's give it a six because I was letting go of the stick occasionally. So what did I say for longitudinal again? (A four) Yeah that's good, four and a six. CIR, five. RQR, five. No display perturbation problems, that's a no. That concludes it.

Exposure 1

DATE: 17Nov97

PILOT: D

TASK: 1006

CARD: Nominal Approach and Landing

Okay, this is Pilot D November 17, Exposure 1, Nominal Approach and Landing. Lets do the approach that will be an easy one, longitudinal lateral-directional, were about equally difficult so I can kind of ... they'll likely the same rating. Adequate performance certainly satisfactory without improvement, I'd have to say because I was just pretty well letting the automatic feature take care of it that that's considered satisfactory without improvement and just occasionally had to make a correction due to the yellow segmented flight path marker coming off so three on longitude and lat. dir. as far as the approach part goes. And you want me to do the control inputs then and go right across the approach and then do it on the landing or ...? (Yeah, why don't you do the landing Cooper Harper, and then the .. two ratings are for both approach and landing.) Oh, for both perfect, okay great. Okay for the landing, it certainly is controllable adequate performance attainable, ugh, tolerable pilot workload well, I had two that were not adequate but then the other one was in there and the difference between them was my throttle control, so I suspect so, I think I would say the adequate performance was attainable. And that was a tolerable pilot workload considering that much turbulence. Satisfactory without improvement, no I'd have to come on over here somewhat even though I had two inadequates and a desired so performance is just more

of a gut feeling and I'm saying that it is moderately objectionable I'd say five, adequate performance. I think I could consistently get adequate performance with what I had ... I think I was a little lucky to get the desired last time. And I think that is considerable pilot compensation but certainly well within tolerance with that amount of moving around. Okay and for the CIR, I did alter control inputs a certain amount and by just in ... on the approach especially just backing completely out when I with the exception of when I was in very close and just had no choice I backed out of the loop somewhat, just made smaller inputs, tried not hold the controller real tightly. Potentially modifies to avoid excitation more than a two, precision voluntary, I'd say three also applies because of occasionally involuntary ... I don't think it caused any involuntary at all, I'd give it a three on this the CIR if that's the ... Did you want me to start at the top and go down or bottom go up or you don't care? Top down, okay. On the ride quality, well certainly did impact it, perceptible no, there more than that ... mildly objectionable, yeah ... cockpit vibrations moderately objectionable ... are we at improvement desired or improvement warranted? Yeah, it would be between a three and a four ... huh, that's a little tough I'd say Yes I'm going to go with a four, on RQR here. It's ... I could make a case probably for a three or a four but I'll go with a four. Anything else I need up there? Okay ... Just a question... (You did this display perturbation. That's just a yes, no.) Where are you seeing that? Right here. Oh, No it's down here. Oh yeah. Well to tell you the truth, I'm really locking on to the HUD display more than I am the outside appearances. So at that point I didn't see such huge perturbations that would case me a problem. I'll say no on that. I'll try and keep that in mind on the rest of them. I wasn't thinking of observing that specifically. I'll try to look at that a little closer.

Exposure 1

DATE: 17Nov97

PILOT: D

TASK: 2006

CARD: Lateral Offset Landing

Okay, for the approach, Okay, longitudinal, on the approach, adequate performance attainable tolerable pilot workload, as far as the approach, I'd say yes but boy it's awful high work. I'd give it probably a six for longitudinal and that lat-dir. I wasn't at all happy with the ability to control it around in lat-dir. and I don't know if adequate performance, I think we heard it was okay but that was way more that a tolerable pilot workload and that probably required, I'd say a seven on that, for the lat-dir. approach. Now for the landing, because I was working real hard here the, I was so busy that something was going to get away from me and it usually it was touch down. I tried different throttle techniques and so on, and I didn't get adequate performance either time on the longitudinal and so that would be a seven and lat-dir., boy I was out to the left, but I think I could probably consistently do that. The lat-dir. if I had the adequate performance in the setup then the lat-dir. was okay. So for just the landing part I would move that to a six. So seven for longitudinal Cooper Harper for landing, six for Cooper Harper landing on the lat-dir. Coming down to our CIR I'd say three through the CIR and ... well, it wasn't completely the vibrations that caused all my problems in the lat-dir. Control was getting in there and that just increased the workload where it got to be intolerable. I would go with a four, I think, on the RQR. I don't have a very good base line to work with on that, but I'll say four. And the display? Oh, and the display, I don't think that impacted the ease or precision one way or the other on that. Maybe I'm just getting use to it. (Thank you.)

Exposure 1

DATE: 17Nov97
PILOT: D
TASK: 3006
CARD: Composite Flight Director Tracking Task

Okay, was adequate performance at least. This is longitudinal now for this one, satisfactory without improvement. For that task in the pitch ...well, no I can't -- I wish I could but I can't okay, it wasn't a satisfactory without improvement but this is one work real hard to get as good performance as I did. I'd say a five on longitudinal, but the problem comes in with the lateral-directional, is it controllable? That's even debatable because one time I had to release the stick just to get out of it but I also could call that a big compensation so for the moment I'll just go to turn the corner at the adequate performance, it does require improvement in the lateral-directional. And without considerable pilot compensation I think sooner or later I was going to do something to it structurally but I didn't, I'll give a seven. I'm being very nice to it to give it seven I could make a good case for it being worse but I'll say seven. That was lateral direction, that's the first I've seen the real coupling come in as we'll see when I go down here to the CIR, cause occasional involuntary control inputs - yes. Frequent - No. Four on the CIR. And that's was lateral inputs is what was the problem. Ride quality on that, more than mildly objectionable. Moderately; no, I would say that had to be fixed. Five on RQR. Yeah. (And display and questions?) And the display, I didn't think that was a problem. I mean, I didn't see that impacting. (Okay, great, thanks.)

Exposure 2

DATE: 02Dec97
PILOT: E
TASK: 1006
CARD: Normal Approach and Landing

This is kind of a general comment overall ... on the first landing that we did on here, we ended up being almost eleven feet right, which I was totally surprised by and this time I thought we were tracking pretty good and then when we got down close, I saw that we were to the left and was kind of correcting back towards the center line when we touched down. The second run we did get all desired performance although the page say adequate for H dot but we were right at the limit between desired and adequate for H dot. I could have flared it out a little longer than I did because we ended up touching down a little short of the actual target. Anyway, I really didn't make too many real abrupt inputs on the intercept to the ILS. I did make one abrupt pitch input and the airplane kind of rung. I kind of felt that it appeared to me to get some oscillations in pitch that felt like a bunch of little turbulent belts. For the approach and intercept portion, I would probably be inclined to go with a two and a two for longitudinal and lateral-directional. The intercept portion really is not hard to fly, it's not very tight or very high gain, so it's pretty manageable. I did notice that just because we were bouncing around a little bit more than the last or at least it seems to me a little bit more than the last time, I was a little bit softer on my inputs and a little bit more patient to let things correct back for small errors. I would say it is probably a two as far as control inputs go on the DASE. For ride quality, I would probably, for the intercept and the landing, I'd probably go with a three, I think. It's getting to the point where if I equate back to the non-flexible airplane, to the rigid airplane, and kind of use that as the base line for the turbulence and the turbulence we're getting here is beginning to push what I'd really want to be landing in. I'd be worried if I felt this on a real airplane, wind shear and the airplane falling out from beneath me, landing short or getting hit by gust. It's probably ... I'm still having a hard time between this two and three. I guess part of what's throwing me is it says

cockpit vibrations are mildly objectionable, improvement desired. Yea, I'm going to go with a three, I think improvement is desired. For the landing portion we did get desired performance the second time, we almost got desired the first time. The biggest problem that I'm having is that I'm having a hard time seeing small drifts develop and actually being able to line up the airplane with the runway. I have a lot of aids out here to help me out. I did notice ...we already talked about the first landing ... I was a little bit surprised because I was right and I thought we were pretty close to being on center line. I guess for this I'm kind of hedging between a three and a four but I guess I'm going to go with a three and a three. Yea, for the landing. You guys want the display? You know I guess I'm kind of getting used to the display and I'm not really picking up on any ... I guess I'd have to say no, it wasn't really a factor here. I guess one last comment I have is, unless I try to do some open loop type things to try to look at to see if I get some ringing or something like that, on this particular task, I can't really differentiate between it being a turbulent level or being a control flexibility issue. Although, just because we're bouncing so much, bouncing around so much to begin with I kind of reduced my gain a little bit and I think that's part of it but I think the other tasks, the offset landing and the flight director task we tend to see flexibility in the air frame, or be able to split the two out a little better.

Exposure 2

DATE: 02Dec97

PILOT: E

TASK: 2006

CARD: Lateral Offset Landing

Exposure 2, configuration 6, Lateral Offset Landing. The first thing that I would note, at least my impression is that we are seeing a lot more flexibility in the pitch axis than we are in the lateral direction axis. A couple times I would characterize it as almost galloping on final after we make a few pitch inputs. During the flare portion, if this was a real airplane I would be pretty concerned because my perception is that is kind of pitch rocking or galloping on final, right during the very last portion of the flare. Although, the picture seems fairly stable, you can average things through the picture, if I was feeling that in an airplane I would be very nervous and I think it would lead me to go around. I'm feeling the perturbations of pitch more than I am really seeing them and I am not sure that is really a function of frequency or whatever. The other thing I notice too, on this, which kind of surprises me, it doesn't seem like the display is drooped, the horizon being below the horizon line outside as much as it was in other simulations that we've seen. Given all that, I think that the task itself is leading us into level two flying qualities because of the parameters. Again, one of the hardest controlling parameters for me is the bank angle at 50 feet because I find myself making a correction and I would probably be ten feet lower when I took the correction out but I'm rushing to take the correction out so that I can try to meet the 50 foot parameter. The other thing that is really difficult is still picking up the lineup once I take the heading off to cut for the runway center line, judging the turn and getting every thing to work out so I can make that turn back onto center line. Anyway, we are definitely in the four, five and six block, we're definitely not a six. Adequate performance requires considerable pilot compensation. Again, philosophically I have a hard time breaking up axis for Cooper Harpers but I think I would probably ... definitely go with a five with the lateral-directional. For the longitudinal, I guess I am going to go with a five too. Again, the longitudinal is not that bad and if you turn the motion off I am not so sure what I would think of the longitudinal. Part of it is that the bouncing around is just really distracting down there. I really think it is the lineup task that is driving the rating on this particular maneuver. I go down to DASE for control inputs. I definitely, intentionally

modify my control inputs. Boy, it's really tough here, I have a tendency to want to go towards a three, simply because it is hard to differentiate out the picture and the motion when we get down close to the ground. I do feel ... I think I am going to go with a three here and I am not sure if it's the visual ... I'm not sure if you turn the motion off that I would still see it as a three, but that galloping motion that I perceived down in the flare is why I would go with a three. I feel, and it is more of a feeling than a picture that I saw, but I feel like I have to average things out. I think it's more a function of my perception of motion than it is actually the visual picture that I am seeing. For ride quality, you know, here I am kind of having a hard time between a three and a four and I guess what I am looking at is ... again the picture that I saw is not bad but the galloping and the bouncing around that I feel at final, especially right in the flare from 50 feet on down when I'm trying to not prang on the runway. That's one of my technical terms. I think because of that I'm going to go with a four. The display. I was kind of lumping those two together, that's right. I am really having a hard time breaking out from 250 feet to 50 feet and then from 50 feet on down. The reason is because that transition there between, you know all of our parameters are based on the landing but the parameters are all effected by that above 250 feet to 50 feet, so I am going to go with the same rating of both. I will say no on the display. The approach, I would probably go with a ... you know, I basically can fly down to 200 feet except if it was 250 feet, I basically am flying just about hands off down to 250 feet. As far as taking the first hack at the runway, that's not really a big deal ...I probably hedge two and a half, two and a half on the approach portion. Oh, you don't want half ratings? I'm going to go with a two and a two because on the short final I am just about flying hands off down to that point so I don't think it is a big deal. (Approach is two, landing is five and DASE is three and four and a no.) I've got the tape running, I probably should just note this on the previous runs I think, I know I was under the impression that the break was at 50 feet. The approach segment on the previous rating is probably not indicative of what it should be, it should probably be more in the realm of two and two also. It was the last configuration we did before the break. That's fine with me if you want to change it ... make it a two and a two. The previous run whatever the rating was stands because I guess we have determined that the break is at 50 feet and we will go with what I originally rated this, which was a five and five I think. Again, this is because of breaks at 50 feet and it's hard, in my mind to differentiate what is caused by what I did above 50 feet effecting below 50 feet. Anyway, I guess we'll move on.

Exposure 2

DATE: 02Dec97

PILOT: E

TASK: 3006

CARD: Composite Flight Director Tracking Task

Pilot E, Exposure 2, Configuration 6, Composite Flight Director Tracking Task. Basically, both times we only got adequate performance. Although, we were close to getting desired both times. An adequate would drive us at least to a five and I guess as far as being able to control the airplane, I probably would go with a five. The airplane is bouncing around and that is really distracting and there have been a few times when it has fed into the stick a little bit but that has been minimal. Anyway, the bouncing around is distracting. If I come down to the DASE for the control inputs, I guess I'm going to go with a four, I think there were like two times where ... well, there is probably a few more, where I noted an involuntary input that was caused by the vibrations. I'm keeping a real loose grip on the stick, which in backing off on my gains also stops me from being able to be as precise as I'd like to be. Part of that is to avoid the involuntary inputs. I'm going to go with a four because I guess, I

think it's still in the realm of where I can compensate for it and I wouldn't say that the involuntary inputs are frequent. If I go over to ride quality, I would definitely ... it's definitely a four, I'm kind of thinking about a five. Is it highly objectionable improvement required? Yea, I'm going to go with a five there too. I'm going to say that the display was not a factor. You know ... just an overall general comment; I think there are a lot of issues on the display where it could be a factor and I think with a better visual the display could be a factor for the landing task for some other reasons. As far as the segmented little task that we have here, so far I have to answer all in all, yes.

Exposure 3

DATE : 08Dec97

PILOT: F

TASK : 1006

CARD: Nominal Approach and Landing Task

Okay, Pilot F, exposure three, pilot rating. And we'll rate the approach first. And we'll rate the longitudinal axis first. And my impression is that, that I can make pretty abrupt inputs, longitudinally, that doesn't excite the DASE so it's pretty much a rigid body thing longitudinally maybe degraded a little bit because of the ride. But again the lateral seems the worst. My performance and my feeling is that it is level two. Well wait a moment, we're rating the approach aren't we? Is it satisfactory without improvement? No. Dog gone it, the ride is so hard to sort out. Whether it's vertical or longitudinal for me, vertical or lateral. In any case we're getting desired performance longitudinally on the approach, minor but annoying deficiencies. Desired performance requires moderate pilot compensation. That's not necessarily true. Let's give it a four. And primarily because of the raw data and so forth. I'm not going to degrade it much on account of the DASE or the ride quality. Okay, lateral I'm going to degrade it a little bit because of the DASE. Deficiencies warrant improvement and it's got some moderately objectionable deficiencies, let's make it a five. And moderately objectionable deficiencies, of course, are the ride quality when you make abrupt inputs. Ah, let's make it stronger than that, let's make it a six. Okay, landing, longitudinal, performance is forcing me into a level two and I would put it there anyway, so let's give it a five, longitudinally and a six lateral. Okay, so this is ride. I didn't detect any control problems there in any of those. Okay, so now, that will show up here. So we can rate the DASE and I think it's a two, on the control. The ride is a ... Ah, let's make it a four and the display, yes with the comment that it is QSAE only. Okay.

Exposure 3

DATE : 08Dec97

PILOT: F

TASK: 2006

CARD: Lateral Offset Landing

Okay, Pilot F, that was exposure three and this is the offset ratings. Longitudinally on approach, again not too bad. Even with the lateral offset, not too bad. I'm still going to give it a four. But now laterally it's really crummy. What did we give it straight in? We gave it a six. But it's much worse than that. Deficiencies require improvement, or level three, although we were getting the performance. It's just the ride quality that I'm rating it down. And it's kind of hard to pick a major deficiency although they all say major deficiencies, don't they? But it's almost like an eight. I almost had to back off of the control a little bit. Let's give it an eight on that lateral correction. Well now, is that in the ... lateral coupling with control. Yeah, I can't remember just where that was. Whether it was on approach or landing. It was all pretty bad. Okay, landing (approach), so it that's a four and an eight.

Okay, landing, longitudinal, it's pretty crummy. I can't use the depressed pitch line too accurately. Shoot, this gets awful hard trying to separate the longitudinal and lateral with all that banging going on. Longitudinal for landing, I don't think it's too bad but I can't tell cause everything is banging around so much laterally, I believe it's mostly laterally. Lets kind of assume it is. And that forces us into a level two with moderately objectionable deficiencies. Let's give it a five for longitudinal and lateral let's give it an eight again cause I'm not quite sure where that coupling problem I got ... I think it's kind of both the lateral offset and into the landing and flare. Okay so DASE. Control is ... I don't think I'm getting any involuntary control movements but it's definitely effecting my voluntary ones. Like I almost have to take hands off. Cockpit vibrations impact precision of voluntary control inputs. Let's give it a three. And a ride, and let's give it a five. On the ride. And let's give it a yes on the display. And it's mostly QSAE. I think that there is a little bit of vibration bothering me, mostly QSAE. Okay.

Exposure 3

DATE : 08Dec97

PILOT: F

TASK: 3006

CARD: Composite Flight Director Tracking Task

Pilot F flight director for exposure three. I ... kind of reflects on what we saw on the other evaluations. Longitudinally it's not too bad, laterally it's kind of crummy. So pilot rating longitudinally, I think, obviously deficiencies requires improvement even though my performance is desired. Deficiencies require improvement. There is just no lead on what's going on. And also I'm backing off a little bit on controls so much laterally that it's effecting longitudinal a little bit. So that's a deficiency. Let's give it a five. Okay and lateral it's got deficiencies require improvement. It's got major deficiencies. You have to back off of the control occasionally. And so it's kind of hard as to which one to pick here but let's give it a seven. Could give it an eight but let's give it a seven. Okay the DASE, the control, let's give it a three. And the ride, let's give it a five and the display ... I really didn't notice any effect in the display so no, for the display.

Configuration 07 Modal damping increased to 0.07 for modes 1 & 2, damp1

Exposure 18

DATE: 22Oct97

PILOT: A

TASK: 1007

CARD: Nominal Approach and Landing

Longitudinal rating for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? For the approach, yes with a three. Longitudinally we had large amplitude moderately damped ASE effects. We get three overshoots but they were fairly abrupt ASE reactions and large enough to be certainly annoying. Laterally we have large amplitudes and they were more lightly damped. We were getting up to five or six overshoots. So it was not quite in harmony with the pitch. Rudder, we got some effects. They were damped but moderate effects but damping -it felt one to one and half overshoots. The lateral rating with that preamble; Controllable? Yes. Adequate? Yes. Satisfactory? Yes with a three. Again the task with the tolerances we have established is not difficult to meet. Okay for the landing; Controllable? Yes. This is for the approach landing longitudinal rating. Is it controllable? Yes it is. Adequate? Yes it is. Satisfactory without improvement? No, it's not. It looks like desirable performance is not really consistently really made. Of the three approaches, two of them were adequate. Let's rate it a five. Another that I didn't like about it was that there didn't appear to be an influence from the ASE effects on the aircraft motion and on my inputs. So that will reflect itself on the CIR in a minute. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. We'll rate it a four for just general workload. I'm meeting desired tolerances. Also the lateral inputs, whatever small ones were made, would create some real annoying motions that also influenced the longitudinal task. For the CIR; Yes I do alter control inputs. Intentionally modify control inputs? Yes that's true. Cockpit vibrations impact precision? That's true also. Cockpit vibrations cause occasional involuntary control. That's not true. We'll go with a three for the CIR. For the RQR; We can skip the first couple because we know this is annoying. Number three, vibrations are mildly objectionable? No that's not true. Vibrations are moderately objectionable -Vibrations are highly ... I would say it's a five. Requires improvement. And again some of the things that really key me to go to that five rating are whenever the motions effect my controllability and that was the case here, where I did feel like longitudinally when I made my flare input it did tend to put in excessive motions that I was not commanding. No for the display question.

Exposure 18

DATE: 22Oct97

PILOT: A

TASK: 2007

CARD: Lateral Offset Landing

Longitudinal rating for the approach and lateral rating for the approach; Both of them comments for the straight-in apply, a three longitudinal, a three lateral. Let's go to the landing, for the longitudinal rating; Is it controllable? Yes. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? No. Basically it's fairly - clearly adequate performance. The correction turn didn't seem to be to bad in the longitudinal task. The flare though I feel like I'm still able to excite some longitudinal modes if I'm anything other than absolutely smooth in the flare. And so therefore it's difficult to both set an attitude to get a nice H-dot and to put it into the box. So I'm not able

to fly the airplane to the ability I like to to make the desired performance. Five for the longitudinal rating. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No, I did meet the desired criteria but with a heavy enough workload to rate a four. Interestingly on the initial turn into the corrective turn, I would get a subsequent motion about a second later that tended to overbank me and this happened on both attempts. It was nothing I couldn't really control but it was something I really hadn't seen too much before. The lateral control in close was not bad, it had good desired performance but again a little bit of a workload to keep it there. For the CIR; Number one, I did alter my control inputs. I would still go with a three I think. I believe that in the flare It's kind of borderline two-three but I'm still reluctant to make a high gain input in the flare and I feel like at times if I do excite a longitudinal mode before it damps out in three cycles, I get a high enough amplitude that can effect my precision of voluntary control inputs which would give it a three. I don't think it ever caused any involuntary inputs so the four is not appropriate. For the RCR, just as before we can kind of just skip down here. Certainly anytime that I feel like the ASE motions are effecting my controllability, I think you have to have improvement on that and so we'll go with a five on that one and no for the display question.

Exposure 18

DATE: 22Oct97

PILOT: A

TASK: 3007

CARD: Composite Flight Director Tracking Task

For the longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes with a three based on performance which is in the 90's however I did have to very very carefully fly this. That will reflect in the CIR. For a lateral rating; Controllable? Yes. Adequate performance? Yes. Satisfactory? No. I going to rate that a four, met the desirable criteria quite well but it's just a high workload in the lateral axis. For the CIR; Basically I had to fly that with kid gloves. I was really afraid of exciting some very strong motions. So number one is inappropriate. Number two, I did intentionally modify my controls. Number three, vibrations impact precision. This is borderline two-three. For this task I'll rate that a two. The RQR, we can skip the first two. Vibrations are mildly objectionable? No. Moderately objectionable, for this particular task, that's probably a more appropriate rating so we'll go with a four. And no to the display question.

Exposure 8

DATE : 04NOV97

PILOT: B

TASK : 1007

CARD: Nominal Approach and Landing

Exposure eight. Straight in the approach and landing Longitudinal Cooper Harper. The approach, there's a lot of bouncing going on, on this particular one. It's easy to excite. This mode is a little aileron input and so I'm getting adequate, desired to adequate, mostly desired I guess. I guess I'd give it a two for the approach and a four for the landing in longitudinal Cooper Harper. Lateral-directional, I had no problem getting desired performance, so I'd have to give it a three in both the approach and landing phase. However, rapid inputs and sharp inputs really sets off a structural oscillation. Which causes the pitch control to be degraded. DASE CIR rating, I guess we'll call it two and the ride quality was not real pleasant. I would cause it to be, I'd call it a four with a yes on the displays.

Exposure 8

DATE : 04NOV97
PILOT: B
TASK : 2007
CARD: Offset Landing

This is exposure eight, and this is high step to a landing. The approach Cooper Harper Longitudinal. There's some kind of annoying, moderately objectionable, I would say, features of the pitch damping. I would give it a five for that reason. Actually make that a five for landing and four for approach. The lateral-directional Cooper Harper had kind of an objectionable oscillation step inputs, I'll have to give it a three for approach and a four for landing. A two for the DASE CIR and the ride quality was actually quite objectionable, I'd give it a four and a yes on the displays.

Exposure 8

DATE : 04NOV97
PILOT: B
TASK : 3007
CARD: Flight Director Tracking

Exposure eight, Cooper Harper ratings for the flight director tracking and capture task. Longitudinal, we got desired performance, I'm gonna call it a three. And lateral, although we did get desirable performance, I guess I'll call that a three also, because of that DASE CIR, that's a two. And a five for the ride quality and a yes on the displays.

Exposure 15

DATE: 13Nov97
PILOT: C
TASK: 1007
CARD: Nominal Approach and Landing

This is pilot C, eleven thirteen, exposure fifteen. Basically, level one. The vibrations were there. They were annoying, they didn't effect the task however. I don't think they effect the performance at all. For approach and landing, longitudinal/lateral-directional, HQR of three, minimal compensation. Surprised me, I didn't think it was gonna be level one. In the presence of large inputs in the beginning, the response was fairly violent but I found I didn't need those sharp edge inputs for this task so I never saw it in practice. I'm gonna say a CIR of two. I was being smooth on the stick to avoid exciting what I knew was there. The RQR is between three and four, let's call it four. Moderately objectionable, it's bouncing around quite a bit and I think improvement is warranted. No display impact.

Exposure 15

DATE: 13Nov97
PILOT: C
TASK: 2007
CARD: Lateral Offset Landing

Okay, this is exposure fifteen, the offset approach and landing. For the approach segment, longitudinal and lateral-directional, I'm working pretty hard both axes. Controllable, adequate, not satisfactory, HQR of four on both of those. For the landing, I'm working hard still lateral-directional, but I'm working real hard longitudinal. So I'm gonna give it a five longitudinal, considerable compensation and a four lateral-directional. Moderate compensation for desired. CIR's, I can't swear that I got involuntary inputs so I'm gonna say three. It's real close, and then a five on RQR. Predominately for the region below a hundred feet. I did notice display perturbations and that did effect the precision. That typically occurred as I was intercepting the final course.

Exposure 15

DATE: 13Nov97
PILOT: C
TASK: 3007
CARD: Composite Flight Director Tracking Task

Exposure fifteen, flight director tracking and capture. Longitudinal HQR, three, minimal compensation. Lateral-directional, a four, moderate pilot compensation. Let's just due to a little bit of lag and the vibrations impacted me just a little bit this time. So, CIR of three, RQR of five. No display impact.

Exposure 9

DATE: 18Nov97
PILOT: D
TASK: 1007
CARD: Nominal Approach and Landing

Okay, for the approach...um, the longitudinal was the main problem this time the lat-dir. seemed to be pretty well behaved throughout the approach. So for Cooper Harper longitudinal on the approach was a Four. It was easy enough to keep in the desired but it definitely took some moderate pilot compensation on that one, lat-dir.; however, was satisfactory without improvement. That would be a Three.... so Four and Three for longitudinal lat-dir. on the approach for landing definitely the longitudinal was the problem. If I got a little bit high, and then ducked under and tried to catch it, it started lots of problems and ended up going long. Again, just verifying that longitudinal was the difficult part. Okay, adequate performance was attainable every time I got the power back so I'm going to say yes it was, and that's....well, that's on the boarder but I'll give it a tolerable pilot workload. Is it satisfactory without improvement? No. I'd say that was extensive pilot compensation so Six for longitudinal and landing. Lat-dir. adequate performance no sweat. Satisfactory without improvement? Didn't exercise it very much, in order to tell but from just the straight in simple one like that it probably was satisfactory without improvement. So Three. We'll exercise that more on the offset but for the straight in easy stuff that we just did it was satisfactory without improvement, I think. Okay, now CIRYes I did modify control inputs, Iyeah, I suspect that, I wouldn't call it the vibration but the flexing, the motion there did impact the precision of that. So I'll say a Three for CIR. And RQR, a Three also. There were mildly objectionable but, you know if you can fix them, fine. But they really weren't that bad. Three sounds fine to me. I did notice some perturbation in the, on the display this time that I suspect might have coupled in, especially when I made big changes on the landing. So I'll say yes on the display this time.

Exposure 9

DATE: 18Nov97

PILOT: D

TASK: 2007

CARD: Lateral Offset Landing

Okay, although the offset usually is much tougher lat-dir. task it was longitudinal again that was really messing up the things I saw this time. The longitudinal while I was able to keep it on the glide slope which is not a big deal, as soon as I started moving I could see some big galloping type motions. In other words pitch oscillations and caused some problems that would be almost intolerable at that size. Well, I'll say for the approach it wasn't ... but it wasn't satisfactory without improvement, I'll put a Six on the longitudinal for approach. Lat-dir. I didn't see a big problem, satisfactory without improvement, no it still could use some more control power for one. I didn't see big oscillations that time, just couldn't move as quickly as I like for that task so Four for the lat-dir. on the approach. Now, for the landing in pitch? Adequate performance attainable? Yes it was, but looking a the ... Would I buy that airplane the way it was? I don't know man. I guess, well that's absolute worst case.... It's not satisfactory without improvement, no how, no way, I could get adequate performance in If I felt good that day, I might buy that airplane. I guess a Six is what I would give it in pitch. It wouldn't take much to say that the workload was too bad, but I'll say that's on the edge so I'll give a Six for longitudinal. The lat-dir. on the other hand, adequate performance? No sweat. Satisfactory without improvement? And gee... in the flare and all it's kind of hard because it's working pitch so hard that it kind of let the lat-dir go. I'd better leave it with a Four. Kind of conservative there. CIR ... vibrations impact precision? Definitely. That was getting close to a Four there, on the CIR. I didn't really, I didn't feel involuntary, I'll leave at Three. Mildly objectionable? No, that's got to be fixed. Definitely should be fixed. Four on RQR. This time I saw motion in the display, very much so, yes on the display.

Exposure 9

DATE: 18Nov97

PILOT: D

TASK: 3007

CARD: Composite Flight Director Tracking Task

Okay ... for tracking on longitudinal, I really didn't see much problem there. Surprised me, thought I'd see more. At least what I saw I was able to handle and keep in and to tell you the truth I wasn't working that hard. I was surprised to see it that way. Adequate performance? Yes. Satisfactory? No. I was keeping desired performance and actually in pitch ... the accuracy and how hard I was working was surprisingly at a Four level. In the lat-dir. adequate performance? Yes. Satisfactory without improvement? And I was working way too hard, even though I'd kept desired performance, I was working way too hard for it to be a four. And I'll give that a Five. But, I think when we get down to ride quality we're going to see something ... big time difference here. Okay, CIR... Three. And RQR, this one ... I think that would have to be improved and it wasn't due to my ability to fly it accurately, it was the ride quality is highly objectionable and I think I'd have to go with the improvement required. Yeah, let that one go then. I was thinking I might even go back and change the landing RQR to five also. But, I'll leave it at Four. I'm kind of thinking out loud here. I won't change the landing one but this one was really worse, I'll stick with the

Five RQR on this. The display I don't think bothered me, but I don't have as good a reference of what the display's doing without the background scene other than the clouds.

Exposure 9

DATE: 03Dec97
PILOT: E
TASK: 1007
CARD: Nominal Approach and Landing

Pilot E, Exposure nine, Configuration seven, Nominal Approach and Landing. It appears like we can excite some modes both in pitch and roll here. During the approach portion we could see that with larger more abrupt inputs. For the finer tracking tasks down close to the runway, I'm not so sure we are exciting as much with the smaller inputs. We did this four times and I could not get desired performance in all the parameters. Most notably, I was having trouble getting in the box longitudinally and I am not really sure why, except for it kind of goes back to what we talked about this morning in that the predictability is just not there. If I round out I'm not getting exactly what I expect so I will either float a little bit more and when I try to compensate for that I tend to drop it in a little harder than I want. Although, I kind of felt like it flew better than this and that maybe it was me just trying to get warmed up. We only got adequate performance so that is a five for the landing, I will give it a five and a five, although, I think it is the longitudinal case that's causing us a little bit more problem, actually I guess I will split it here. I'll give it a five for longitudinal and a four on lateral-directional, I guess, for the landing. For the approach and intercept, I think I will go with a three and a three. Simply because you are bouncing around a little bit and again, it almost seems like there is a little bit of a cliff there at least my perception is that if I go and make larger inputs I can kind of excite some. As long as I keep the inputs kind of small and try to make them smoother, I don't really get that much. Going down to the DASE for control inputs, I guess I would kind of be in the two and a half to three range, I'm going to go with a three. For the ride quality, I'm going to go with a four. No on the display impact.

Exposure 9

DATE: 03Dec97
PILOT: E
TASK: 2007
CARD: Lateral Offset Landing

Pilot E, Exposure nine, Configuration seven, Lateral Offset Landing. I guess the first comment I have of, my perception is, that I could excite modes both laterally and longitudinally depending upon how abrupt or aggressive I am at making turns or pitching the airplane. If I get too aggressive at pitching the airplane close to the ground it looked like I could get a couple perturbations which I really didn't like right above the runway. This approach phase is down to fifty feet so it is part of the offset maneuver. We never got desired performance, the best we could do was either be out of the box longitudinally or firm on the touchdown, which automatically puts us five or greater. I think I would probably go with a five for lateral and longitudinal. I guess the type of compensation required is that you just have to make it early and try to smooth the corrections out as much as you can and kind of turn your gain down a little bit. For control inputs, I did not have any involuntary inputs but it certainly did effect the precision of my inputs. It definitely

might be a three, if we were going half ratings, it might even be a three and a half, but we'll call it a three. For ride quality, I might be in the four and a half range if we were doing halves but I think I'm going with a five because in this task I think it's important to be able to have a fairly good range or bandwidth of inputs that you could do without exciting any longitudinal modes. That one time that I kind of got the airplane excited in pitch, I guess I'm going to go with a five. Particularly if this was a real airplane next to a runway, I'd be a little bit nervous. No on the display.

Exposure 9

DATE: 03Dec97
PILOT: E
TASK: 3007
CARD: Composite Flight Director Tracking Task

Pilot E, Exposure nine, Configuration seven, Composite Flight Director Tracking Task. I guess, type of compensation you just have to back off. There were a couple of times I tried to fly in pitch with pressure in roll, tried to find what pressures. There were a couple of times where I really wasn't getting what I wanted. I end up buffing up against the lateral control stops. I'm kind of at the point of answering the question is it satisfactory without improvement and just going in looking at the descriptors; minimal pilot compensation versus moderate; minor but annoying deficiencies; unpleasant deficiencies. I could probably talk myself into going either way here ... I think I am going to go with the four here. I really don't like the bouncing around and it does make predictability suffer. Going down to the CIR rating, there is no involuntary control inputs here, definitely modify the control inputs. I think it impacts the precision with which you can track so I'm going with a three. For the ride quality I'd probably be in the four and a half range again, I guess ...just because, at least for me, the bouncing around reduces the predictability. I will probably go with the five, I guess and I'd say no on the impact to the displays.

Exposure 16

DATE : 10Dec97
PILOT: F
TASK : 1007
CARD: Nominal Approach and Landing Task

Okay, exposure sixteen, the straight in task, both of the modes appeared to be very lightly damped. The lateral, the worst. And so there didn't seem to be any big impact on the control, that time, on the straight in task. I just had to be fairly smooth. Let's give it a pilot rating, longitudinally, for the approach which is down to two hundred fifty feet. So let's give it a five because you want to be smooth. Lateral, again you've got to be smooth, let's give it a five. Landing, even though we got desired performance, I think that's a fluke, the longitudinal, yeah, I think a five just because I have to be smooth. Okay, same on lateral. So that's all five's, wow! Okay, getting in a rut here. For the DASE ratings, it's a two for this task. The ride quality turned out pretty bad. It's either a four or a five. Ah, You gotta fix that, a five. And no big impact but let's give it a yes with QSAE. The wiggling didn't bother.

Exposure 16

DATE : 10Dec97
PILOT: F
TASK: 2007

CARD: Lateral Offset Landing

Okay, for the offset task for exposure sixteen. And it wasn't as bad as I anticipated that it might be laterally. Longitudinally, for the approach, which is down to fifty feet, really didn't have too much of a problem. You have to be a little smooth. Let's give it a five. And the lateral task, it really is whacking the thing around quite a bit, but it's still controllable. Deficiencies warrant improvement. Shoot. Is adequate performance attainable with a tolerable workload? Yes. Deficiencies warrant improvement. Yeah let's give it a six for sure. I could almost make it a seven but it's such a six plus but six. Okay, landing, longitudinal the same, five. You have to be a little careful. And lateral, let's give it a five. Okay, for the DASE, the control is almost a three, isn't it, vertical? And the lateral also. Let's give it a three for control. Offset control. Okay, the ride is a five. And the display is a yes. And a little bit of wiggling there put mostly QSAE. That's correct. A little wiggly.

Exposure 16

DATE : 10Dec97

PILOT: F

TASK: 3007

CARD: Composite Flight Director Tracking Task

Okay, just a general comment there on the flight director task. You know, there was a potential there for the lateral getting involved in the control put didn't really seem to, too much and the main thing I noticed was that we were getting some very poor ride quality which tended to make me back off a little bit. Pilot ratings, longitudinal it's really not too bad of a vehicle. Let's give it a five. You could be smooth. And the lateral, is adequate performance attainable with a tolerable workload? Let's give it a six. And DASE is a three. The ride is a five and a no.

Configuration 08 Modal damping increased to 0.15 for modes 1 & 2, damp2

Exposure 4

DATE: 20Oct97

PILOT: A

TASK: 1008

CARD: Nominal Approach and Landing

Is it controllable for the longitudinal approach rating? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? Yes it is and I'll rate it a three. Cooper Harper three on the approach. One thing I did notice is that is that it seems to be a higher frequency response in the longitudinal axis. The lateral axis is not too bad but the longitudinal axis has a real quick ASE response. It tends to make the airplane more responsive or seem quicker in the longitudinal axis. The lateral rating for the approach; controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. Say three also. So a three and a three for the longitudinal and lateral ratings. For the landing, is it controllable? Yes it is. This is the longitudinal rating. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? I'm going to say no. Rate it a four. And this is really borderline three and four but I do feel that the more jerky response in the longitudinal axis that I attribute to ASE effects make the task just a little bit higher workload so we'll go with a four, for the landing rating in the longitudinal axis. For the lateral rating, landing. Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Didn't really care too much for my lateral performance that time, I'm going to rate that four also. Met the desired criteria but I didn't seem to be quite as nice as I would like. For the CIR rating; Number one, pilot does not alter control inputs. That's not true. Pilot intentionally modifies control inputs avoid ... That is true. A two. And this two is a little bit more of a one than the previous two. On exposures two and three they seem to be worse overall ASE wise than exposure four but never-the-less I did have to alter my control inputs so that gives it a two. For the ride quality; Number one is not true. Vibrations do impact ride quality. Number two they are perceptible but they are objectionable also. Number three vibrations are mildly objectionable improvement desired. Definitely borderline three-four. I'll go ahead and rate it a four right here. The ride quality rating is a four. For the question; Do aeroelastic display perturbations impact ease? It is not a factor, No.

Exposure 4

DATE: 20Oct97

PILOT: A

TASK: 2008

CARD: Lateral Offset Landing

For the approach, longitudinal Cooper Harper; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No, in fact it pretty much looks like I met adequate criteria both for ... well kind of for touchdown and for X distance. So we rate this a Cooper Harper five. You're right and I was rating landing. For the approach; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. Cooper Harper of three. That's for the longitudinal rating. For the lateral rating, similarly no problem. Controllable? Yes. Adequate performance is attainable? Yes it is. Satisfactory without improvement? Yes it is, and that's for a three also. That's for the point up to the correction. Now for the longitudinal Cooper Harper for the landing. Controllable? Yes. Adequate? Yes. Satisfactory? No. Did not meet the desired criteria. Did a pretty good job adequate though so we'll give it a five. It seems like, I commented earlier, on the straight in that this one has

the characteristic that there is ASE effects in both longitudinal and lateral axis. But the longitudinal axis tends to make the airplane quicker and tends to make it have a quick response when you make a longitudinal input. It tends to jerk it a little bit and that is apparently making it a little bit harder for me to control it longitudinally in a fine high gain task of the flare. For the lateral-directional, it looks like I met the, except for one, desired criteria. So for the lateral task, lateral-directional; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. We'll rate it a four for desired performance but not quite level one. For the CIR; Number one, pilot does not alter control inputs. That's not true. Pilot intentionally modifies control inputs to avoid excitation. Yes that is true. I do not have to modify them that much. The way this thing works, lateral response is not that bad. It's definitely an ASE response and longitudinal response is just a real quickened type response, which tends to make you overcontrol things a little bit. But I don't do a whole lot of modification but some. So we'll still give it a two rating. For the ride quality, cockpit vibrations do not impact. That's not true. Perceptionable and objectionable. That's not true. Cockpit vibrations are mildly objectionable, improvement desired. Yes I'll rate that a three, so let's give it a three. For this particular approach, close in like it is, it turns out to be mildly objectionable. So a two and three and the Cooper Harper's are three and three and a five and four. Display question is not a factor, so no.

Exposure 4

DATE: 20Oct97

PILOT: A

TASK: 3008

CARD: Composite Flight Director Tracking Task

For the flight director tracking task rating, longitudinal; Again I'll make some comments ahead of time. The first time I've noticed PIO due to what I think is an ASE effect and it is basically because of the more jerkier, quicker response in the longitudinal axis. Also I'll make a comment ahead of time, the first task I did, the way the random variations were put together made it harder than some and I commented to researchers that this random nature of this flight director task does make some of them, just the way they're grouped together, some of the maneuvers, one following the others, are harder than others. Okay for the rating for longitudinal. Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I met desired criteria and I think it is worthy of desired rating but it will be a four and I did notice an occasional very slight pitch PIO. For the lateral rating, controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I'm also going to rate that a four. In general, the lateral task in this flight director tracking is harder than the longitudinal task. And that was no exception here even though I had the slight longitudinal PIO, I had less trouble keeping it longitudinally aligned than I did laterally. So I'll make that a four and a four. For the CIR; pilot does not alter control inputs as a result. That's not true. Pilot intentionally modifies control inputs to avoid ... that's true too. However it is to a lesser extent than the previous configurations. In other words, this one is not as bad, so this is a better two than the other two so far. For the ride quality, RQR, number one, cockpit vibrations do not ... that's not true. Cockpit vibrations are perceptible but not objectionable. That's not true. Vibrations are mildly objectionable, improvement desired. I would say no. Vibrations are moderately objectionable. I'd say that's true, so that's a four. We got a couple of pretty good lateral modes going there and a couple of good longitudinal ones so it's probably a little bit too active to be mildly objectionable, it would be more like moderately objectionable so we'll go with a four. So an RQR of four. And for the display question; not a factor.

Exposure 20

DATE : 06NOV97
PILOT: B
TASK : 1008
CARD: Nominal Approach and Landing Task

This is exposure twenty, approach and landing straight in. Cooper Harper approach, two. Four for the landing. Lateral-directional Cooper Harper two and two. DASE CIR rating, I'd give it a two. The ride a three and a yes on the displays.

Exposure 20

DATE : 06NOV97
PILOT: B
TASK : 2008
CARD: Offset Landing Task

Okay, so, this is exposure twenty, offset landing. Cooper Harper approach, I'll say a two and the landing, a four. Lateral-directional Cooper Harper a two, and I believe we can call it a two also for landing. A two in the DASE CIR rating and the ride was probably a four. With a yes on the displays. Comment on the landings; There was so much bouncing going on, If you're active, very active on pitch and roll, lining up, you get a lot of pitch activity and split outs, in the actual Vs command of gamma, which can, if you get them going oscillating up and down, alternately provides a generous amount of confusion, as far as which, displays should be tracked and chances are somebody's gonna start tracking the wrong display or be confused and not put the right input in, in pitch. End of comments.

Exposure 20

DATE : 06NOV97
PILOT: B
TASK : 3008
CARD: Flight Director Tracking Task

Okay, exposure twenty, flight director tracking and capture. Cooper Harper Longitudinal, gee, I guess we'd call it a two. The Lateral-directional, a two. DASE CIR rating, two. The ride quality, I'd call it a five, with a yes on the displays.

Exposure 17

DATE: 13Nov97
PILOT: C
TASK: 1008
CARD: Nominal Approach and Landing Task

Exposure seventeen, offset ILS approach to a straight in approach and landing. Very much reminiscent of the baseline configuration. There's some vibration that's moderately damped. Both in terms of excitation from turbulence and in terms of excitations from pilot inputs. It's a fairly benign task. Not many sharp edged inputs. So, borderline level one but I'm gonna give it the benefit of the doubt and give it level one performance. Minimal compensation for desired performance. So, four threes on the approach and landing. The one that's closest to being degraded is the longitudinal on landing. It's close to a four but

I'm gonna give it a benefit of a doubt on this one. It's very reminiscent of the baseline for this task, so we'll give it a three. I don't feel any precision impact of this stuff and I'm not really modifying the control inputs a whole lot. Well, I am being smooth on this, let's give it a two on CIR. I'm not convinced that I'm not trying to be smoother than I might otherwise be. This is another one where I'd like to give a half for rating. Let's say it's moderately objectionable in terms of vibrations. RQR of four, no display impact.

Exposure 17

DATE: 13Nov97
PILOT: C
TASK: 2008
CARD: Lateral Offset Landing

Little bit more of an effect that time. Obviously because of the oscillations and the sharp edge input requirements. Not as bad as before but it's certainly there and it's there from 100 feet on down to touchdown. So, again the landing and approach ratings are the same because of the way we structured the boundary between the two. Both longitudinal and lateral-directional, I'm working hard. I don't think desired performance is an issue here, I think it's more adequate. The vibrations are definitely effecting the precision. I'm gonna give both them five's. So, five, five, five and five, CIR is three. I didn't notice any inadvertent inputs and RQR is five. Very highly objectionable vibrations, particularly just prior to touchdown. No display impact.

Exposure 17

DATE: 13Nov97
PILOT: C
TASK: 3008
CARD: Composite Flight Director Tracking Task

Okay, exposure seventeen, flight director tracking/capture. Similar to what I've seen before. It punishes you when you get high gain on it. In terms of sharp edge inputs, the oscillations impact precision when you do that. The performance is considerably better than desired and I'm probably shooting for something considerably better than desired so I'm not going to degrade the ratings as much as I might otherwise. Longitudinal, it is fairly responsive in the absence of the oscillations. In the presence of the oscillations and sharp edge inputs it's still not too bad. Say minimal compensation, HQR of three. Lateral-directional, moderate compensation, HQR of four, a three and a four. DASE, CIR is three, again, I didn't notice any inadvertent inputs and RQR five, fairly high vibrations. No display impact.

Exposure 11

DATE: 18Nov97
PILOT: D
TASK: 1008
CARD: Nominal Approach and Landing

For the approach ... for the approach part, non events again. Satisfactory without improvement? Yes. Three's for longitudinal lat-dir. for the approach. For the landing for the pitch adequate performance? Yes. Satisfactory without improvement? No. I had two desired across the board and then one that just kind of put me in the ... just barely out. I'll

give them Four for the longitudinal Cooper Harper and Three for the lat-dir. CIR ... certainly no more than ... I'd have to say two, because when I started working it in pitch especially down low, I was having to change inputs quite a bit by what appeared to be some flexing or something. So Two. RQR ... Three and Display? No.

Exposure 11

DATE: 18Nov97
PILOT: D
TASK: 2008
CARD: Lateral Offset Landing

For the approach, adequate performance, I think it's probably ... fairly good. Boy it's real, real sensitive to that where I am when I first start out. On one of them I wasn't as dead on the localizer as I was on the other one and had further to go. That just makes it work a lot harder near the end. As soon as you start to work it, it starts to go to pieces on you so ... I pretty much ... for the approach I'm going to say that Fours, yeah, Fours for longitudinal and lat-dir. For the landing adequate performance? I'll say yes, twice was no problem and once was pretty hard but I'll say adequate, okay? Satisfactory without improvement? No. And that would be for longitudinal then a Five and a lat-dir. of Four, for that one. CIR is Two. RQR, Three. Display? No.

Exposure 11

DATE: 18Nov97
PILOT: D
TASK: 3008
CARD: Composite Flight Director Tracking Task

Adequate performance attainable tolerable pilot workload? Yes. Satisfactory without improvement? I'll have to give it a No. It was just desired but it was desired but particularly in the lat-dir. it was pretty hard work, so I'll say Four for longitudinal, Five for lat-dir. Two for CIR and Four for RQR. It's getting pretty rough ride there. Again, I can't tell on the visuals how much of it is display motion and how much of it is airplane generated so I'll say No.

Exposure 16

DATE: 04Dec97
PILOT: E
TASK: 1008
CARD: Nominal Approach and Landing

Okay, basically just looking at it on the intercept leg, it looks like we can excite things both laterally and directionally. Although, we got desired one time and adequate the other time, the second time we got adequate, I was trying to ... it looked like we were picking up some drift and I was trying to correct that and I kind of lost track of the pitch task, well, I guess I didn't pay as much attention to it as I needed to and made us touch down a little bit firm. I'm sorry, I'm going to go ahead and do the landing first, I'll go back and do the approach after. The ... just because I feel like I have to kind of back off of my control inputs a little bit, I'm going to say it's a little bit more than minimal compensation, so I'm going to say that for four and four for the task. For the approach, I went through the glide slope initially

and just because I wasn't paying attention and went back and captured it and tracking it, the intercept and the tracking is not a problem so I'm going to consider that desired performance and I'm going to basically, I guess call that a three. I did notice several dispersions in gamma out there on the intercept leg and while we were tracking down and some of them with out any pilot input and some of them fairly prolonged from what we've seen in the past. We are getting some dispersion in gamma right at touch down, or in the last 150 feet to touch down. I think on one of the landings we saw that. For the CIR rating, or CIR I guess, I'm going to give it a three. For ride quality, I'm kind of struggling between a four and a five. I'd probably give it a four and a half left to my own device, but I think I'm going to call it a four and no on the display.

Exposure 16

DATE: 04Dec97
PILOT: E
TASK: 2008
CARD: Lateral Offset Landing

Okay, I guess, the first comment that I'll make is getting ... we've gotten split gamma cues down below 150 feet in the flare and I really ... that's distracting and it takes a while for the pilot to process that and the HUD's cluttered when you see that and we are, at least relying a fair amount on the HUD display and the gamma display for this particular task. The last, the second approach that I flew, I was a little bit more aggressive on the roll inputs and I think we excited some of the motion a little bit more and also, when I did get more aggressive on the roll inputs it was harder to be precise and to damp things out and to really get precisely what I wanted. I ended up, I think you can look at the strips, but I think I hit the stop on taking a cut towards the runway and I think I hit the stop coming back towards the runway. In the process of trying to deal with the roll, I let the pitch get, I guess I didn't pay as much attention to it as I should have, and we ended up getting high and I ended up having to make a big correction at the end and had to dive for the box. And then a big correction to try to arrest the sink rate and so the pitch performance was affected by having to pay so much attention to the roll task. Certainly being a little less aggressive here works a little bit better, I guess even though we got desired both times I'm kind of inclined to give it five's. Let me think about this for second ... I guess I am ... I guess I'm going to give it a five and a five because I think the compensation is more than what I would really consider moderate and I'll go ... both of those approaches I ended up getting distracted from one task because I was looking at either the line up task or the pitch task and I let the other one get out of my cross check and also I don't like the split cues. I'm really working pretty hard at the end trying to decide exactly what I need to do or want to do to try and get the results. I'm going to give it a three for CIR. I would be in the four and a half range on the ride quality, I think, I'm kind of stuck between moderately and highly objectionable. I guess I'm going to give it a five just because I don't like, especially on the last one when we got a little bit aggressive, I don't like all that bouncing around right next to the ground and I'm going to say no on the displays.

Exposure 16

DATE: 04Dec97
PILOT: E
TASK: 3008
CARD: Composite Flight Director Tracking Task

Okay, we got desired performance, I'm kind of having a hard time answering is it satisfactory without improvement ... I guess I'm going to give it a three and a three although, I guess I'm just going to note that I have a hard time dividing between those two blocks on this particular one. The reason I went with a three is, if I kind of look through the, I don't like the motions that I'm getting. I can get fairly good performance. But, I don't like the sharp motions that I get and there almost seems to be a little bit of a cliff. If I make a small input and make it somewhat smooth, I kind of get a fairly descent response. But, the minute I put in a more sharper edged input or a larger input then I kind of get a little bit more than I was expecting out of it. I saw that I think more so in pitch than I did in roll although my perception is that I saw that in both axes. I'm going to, again ... I'd probably be in between a three and a half and a four here. I'm tended probably more towards the four on the CIR than I was on the other task. But, I'm going to go ahead with the three on the CIR and I'm going to go ahead with a five on ride quality because like I said, when we get some of those sharper inputs I really didn't like that and no on the display.

Exposure 12

DATE : 09Dec97
PILOT: F
TASK : 1008
CARD: Nominal Approach and Landing Task

Okay, general comments: the modes are obviously not canceled but they seem to be pretty well damped, both axes and consequently smooth control seemed to work pretty nice. Longitudinal, let's give it a five. We have to back off a little bit. Yeah okay for approach. Actually we can give approach a four, I think, for longitudinal. And lateral, is it satisfactory without improvement? No. Okay, yeah, no we really weren't all that bad. Well from a control standpoint, no problem. But shoot, it really whacks around. Let's give it a six, it's not too too bad. Okay, landing let's give it a five, longitudinally. Which I have to do because of the performance anyway. So that makes that easy. Laterally, let's give it a six. Okay and the DASE, let's give it a two and let's give it a four on the ride quality and how about a yes but just QSAE. Okay.

Exposure 12

DATE : 09Dec97
PILOT: F
TASK: 2008
CARD: Lateral Offset Landing

Okay, it's really not ... this is for the offset for the offset. It's really not too bad of a configuration. The control doesn't couple into the structural modes too much. It's definitely there. And the basic ride quality is, you know, it's probably acceptable. Okay, pilot ratings, approach, longitudinal, approach is down to fifty feet now isn't? So approach it's still a four. Not real bad. Lateral, yeah you really have to ... really have to be careful. Let's make it a six. It doesn't have to be a seven yet, yeah let's make it a six. And four and six again. Why did I give it a five above? Huh? Let's take a look at that. Not being consistent because the landing isn't easier. Yeah let's make it a five, you really have to work pretty darn hard to get adequate performance. Okay so now, let's give it a two, four and a yes huh mostly DASE, or QSAE I mean, but mostly QSAE. Yeah, I think, if the QSAE was fixed, you probably would not even notice the wiggling.

Exposure 12

DATE : 09Dec97

PILOT: F

TASK: 3008

CARD: Composite Flight Director Tracking Task

Okay, this one's not too bad. The big problem is that it's just kind of hard to figure out what the thing wants you to do next. If we had a Nav display we'd get better ratings. Longitudinal is easier than lateral. You have a higher band pass on the control system. Let's give it a four longitudinally and laterally let's give it a five despite the fact that we are getting desired performance. It's just moderately objectionable deficiencies. The DASE is not a real big factor. It's probably marginal from a ride quality stand point but not effecting control. And DASE is two. And four and no.

Configuration 09 Modal damping increased to 0.30 for modes 1 & 2, damp3

Exposure 11

DATE: 21Oct97
PILOT: A
TASK: 1009
CARD: Nominal Approach and Landing

Okay this exposure 11 for the straight-in approach and landing. Up and away longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Longitudinally, looked like it was well damped. About one and a half on the overshoots on the aggressive inputs and moderate amplitude and the lateral axis is the same. About one and half overshoots. These were both about one and half to two Hz, maybe one to two Hz. I'd say more like one and half Hz probably. And similar damping, about one and half overshoots. Rudder doublets caused about the same thing, so it's fairly well harmonized as far as these motions are concerned. And believe it or not I seem to prefer that, as far as not having one axis more ... I seem to like well damped and I seem to like this axis to sort of the same as far as exciting the motions. At any rate to make a long story short, the lateral rating similar for approach was; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also. For the landing, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? We had really some pretty good landings there. One slightly firm on the second but the first and third were very good. I think the workload -moderate performed compensation is probably crucial there, so we'll say it is not satisfactory without improvement for workload and go with a four, longitudinally. Laterally; Controllable? Yes. Adequate? Yes. Satisfactory? No. Also a four for workload. It tended ... I noticed this time that I just seemed to notice more that I tended to wander more about the centerline. I was kind of oscillating back and forth around the centerline and I have not noticed that as much in the past and it increased the workload. CIR; Pilot does not alter control inputs as a result of aircraft flexibility. For this task since it's not a real high amplitude task and I didn't notice anything, I'm going to go with a one on this one. I didn't really think that I did anything to alter my inputs. RQR; Vibrations do not impact ride quality. Not true. Vibrations are perceptible but not objectionable. Not true. Mildly objectionable -improvement desired. A three. That best sums it up. And display question? No.

Exposure 11

DATE: 21Oct97
PILOT: A
TASK: 2009
CARD: Lateral Offset Landing

Offset approach and landing for exposure eleven, up and away, same comments as for the straight in approach. No problems either way. Comments apply, A three and a three, same ratings. For the landing for the longitudinal task; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I will rate a ... I kind of like this configuration and I want to give it a four but I just can't because I landed long, so let's go with a five. There was a real tendency for me to float and I'm not sure why. I thought I had good control. I don't know whether there are some ASE responses that were some how getting in there but it would be interesting to look at the data on this one because I liked it but didn't touch down ... good soft H-dots but a little bit long and for unexplained reasons as far as I'm

concerned. Laterally; Controllable? Yes. Adequate? Yes. Satisfactory? No, I'll rate that a four because the task ... it's really hard to give this a Cooper Harper of three because of the task and just the overall, you know the huge inertias of this aircraft and you just can't really go minimal compensation on this but this is a pretty good configuration as far as lateral response. I was very aggressive with it. CIR; Does pilot alter control inputs as a result of aircraft flexibility? No, not really. I did not consciously do that. Ride quality; Vibrations do impact the ride, and they are perceptible and I would say improvement is desired. A three. And not a problem with displays.

Exposure 11

DATE: 21Oct97

PILOT: A

TASK: 3009

CARD: Composite Flight Director Tracking Task

Okay this is the rating for the flight director tracking task for exposure 11. Longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. For lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No for a four, met desired criteria. I was really aggressive that time, more so than I have been on some others and I go into a little bit of Pilot coupling, PIO type stuff in the longitudinal axis due to my aggressiveness. I'm not going to hold that against the configuration because I did fly it very aggressively. The lateral rating is a four because it is just a little bit harder task to keep that flight path marker inside the inner circle because of the, I guess, lag in performance when you make a lateral input. There just seems to be a lag in flight path marker that is difficult to predict. The CIR; One. I was very aggressive, I had absolutely no fear of the configuration and ride quality it will be a three once again. It would just be nice to get rid of some of the vibrations but they aren't too bad. Again, this one had some ASE effects, I considered moderate amplitude, but it was well damped and both axes were similar. They both had the same kind of response and so I actually didn't mind this configuration although certainly past your comfort wise. You probably want to get rid of some of those amplitudes.

Exposure 10

DATE : 05NOV97

PILOT: B

TASK : 1009

CARD: Nominal Approach and Landing Task

Okay, lat-dir rating exposure ten is it? Approach and landing longitudinal Cooper Harper , actually it wasn't too bad. I would say that we're in the two to three range. Let's look at the approach first; I'd call it a two and the ... we lost the interphone system. But ... Well let's give the comments here. The approach; I would call it a two. The landing; probably a three and the lateral-directional was pretty reasonable. I'd say a two. For landing or approach, Cooper Harper for longitudinal, I'd say it was a two. For the landing, I guess I'd give it a three. Lateral-directional; it's not bad, I'd call it a three for approach and landing. DASE CIR rating, probably a one. And ride quality could be a two and I did not see any problems with the displays.

Exposure 10

DATE : 05NOV97

PILOT: B

TASK : 2009
CARD: Offset Landing Task

This is exposure ten, side step landing longitudinal Cooper Harper for the approach; I would say we're looking at a four and for the landing, we had some tendencies verging on a PIO and I'd guess I'd have to call it a six for the actual landing because of the inconsistency and the tendency to enter a PIO and for some reason we seem to be splitting out commanded vs. Actual and there were some bobbling and pitch that perhaps I was getting out of phase with. Quite difficult, visually, to following the, some difficulty following the flare cue. I ended up landing long because I needed more time to settle out the oscillations in pitch so I didn't get a hard landing. Lateral-directional Cooper Harper, there's not any major problems there. I guess I'd call it a three for the approach and a three for the landing. DASE CIR rating, call it a two and for the ride quality, actually it was somewhat, mildly objectionable, I'd call it a three. And a yes on the aeroelastic display perturbation impact.

Exposure 10

DATE : 05NOV97
PILOT: B
TASK : 3009
CARD: Flight Director Tracking Task

This exposure ten is it? Flight director tracking and capture, longitudinal Cooper Harper. Think that I able to capture desired performance, I'll call it a three. Lateral-directional Cooper Harper , it was probably, I guess we were desirable on that also, so call that a three. The DASE CIR rating, I'd call it a two. The ride quality was mildly objectionable, three. And we did see display impact on the displays. Yes.

Exposure 10

DATE: 12Nov97
PILOT: C
TASK: 1009
CARD: Nominal Approach and Landing

Okay, exposure ten, ILS offset straight in landing. This one is borderline level one level two. I think I'm gonna call the lateral-directional level one and longitudinal level one on the approach and level two on the landing. So, for longitudinal in the approach, it's controllable, adequate, satisfactory and minimal pilot compensation for desired performance. That's both longitudinal and lateral-directional, threes. For the landing, lateral-directional, also a three minimal compensation. Longitudinal, I'm gonna bump it up one though. Controllable adequate not satisfactory without improvement. Moderate compensation, desired performance requires moderate compensation, so I'm gonna give it an HQR of four. So three, three, four and three. That's just a little bit of workload in the flare that time. I'm not consciously modifying the control inputs so the CIR is one. Let's say mildly objectionable oscillations. Hang on a second, it's either mildly or moderately. Let's say mildly, RQR of three. No display impact noted. That concludes these comments.

Exposure 10

DATE: 12Nov97

PILOT: C
TASK: 2009
CARD: Lateral Offset Landing

Exposure ten, offset approach and landing. The approach portion down to fifty feet is primarily driven by lateral-directional. Although longitudinal is difficult as well because you're trying to finesse that to right at fifty feet in the right position. I'm gonna give them both fours on that. Controllable, adequate, not satisfactory, desired performance requires moderate pilot compensation. It's primarily task driven, HQR of four. The landings a little bit of a different story. Occasionally you're getting some excitation. A little bit of ringing with the workload that I think degrades the task both longitudinally and lateral-directionally. So for the landing, both axes controllable, adequate, not satisfactory. Adequate performance requires considerable pilot compensation, HQR of five, five and a five. DASE, that one time I had to modify my input a little bit, back off a little bit. So I'm gonna give it a CIR of two. RQR of four, moderately objectionable, improvement is warranted. No display impact. That concludes my comments.

Exposure 10

DATE: 12Nov97
PILOT: C
TASK: 3009
CARD: Composite Flight Director Tracking Task

Okay, exposure ten, flight director control task. Pretty easy really. Minimal compensation. Controllable, adequate, satisfactory, minimal compensation for desired performance both longitudinally and lateral-directionally, HQR's of three. Three on three. CIR, didn't modify my inputs at all that time. CIR of one. Mildly objectionable cockpit vibrations, RQR of three. It's kind of interesting how the ride quality is varying with the task like this, but it certainly is. That was not nearly as objectionable as in the offset landing. No display perturbations noted. That concludes my comments.

Exposure 13

DATE: 18Nov97
PILOT: D
TASK: 1009
CARD: Nominal Approach and Landing

The approach. Adequate performance? Yes. Satisfactory for the approach? Yes, on both of them. Three and Three for approach. For the landing in longitudinal, adequate performance? Yes. Satisfactory without improvement? No. And I consistently got into the adequate stuff and I was working at it near the end too. I couldn't get it any better anyway. So, I'll do, I think, a Six longitudinal, lateral-directional didn't exercise it very much. Didn't have a big problem with anything so I'll say Four. So Six and Four for longitudinal lateral-directional for landing. CIR - Two and Three and visual? No. Or display? No.

Exposure 13

DATE: 18Nov97
PILOT: D
TASK: 2009

CARD: Lateral Offset Landing

Approach, adequate performance? Certainly. Satisfactory without improvement? No, although from the performance, it was all desired and I was working moderately hard on that part, so I guess I can go with a Four for each one for the approach. But, so Four and Four for the approach. For landing, adequate performance attainable? Longitudinally I saw an oscillation in there that as far as I'm concerned, even though I could usually get a ... see I think once I even got desired, usually got adequate but that is, that is an intolerable workload. I saw a pitch oscillation that was very slow frequency one that would be real easy to couple with. I had to very consciously say don't fool with it, let's see what it'll do by itself. So, seven for landing in longitudinal. Lat. dir., there was just a fairly high frequency oscillation. Didn't seem to hurt the lateral-directional performance that much, satisfactory without improvement. I'll say no, but I'll have to do a four on that. It's certainly an annoying deficiency at least. So, seven and four for landing Cooper Harper's. CIR, impact precision, I would say ... CIR of three on that. Due to the pitch and five ... it wasn't a vibration it was an oscillation but that would be required to be improved. I would not buy it the way that that was. Also this time I did notice the display variations and that might have also added to my thought that would be easy to couple with my inputs. (What's that a three and a Five?) And a yes.

Exposure 13

DATE: 18Nov97

PILOT: D

TASK: 3009

CARD: Composite Flight Director Tracking Task

Exposure thirteen, Pilot D, flight director tracking. Adequate performance attainable, tolerable pilot workload. Boy, I saw some nonsense in pitch that time. The first one went very nicely. I didn't get behind. Soon as I got behind it made a quick nose down input. It went shooting out ... so even though the performance wasn't all that horrible, that's a cliff as far as I'm concerned. That would make the pitch a seven on that and the lateral-directional actually wasn't all that bad. I'm gonna make that a five. So a seven and a five for longitudinal and lateral-directional. CIR, I don't think it made me put in any involuntary inputs so I'll say three. That was bad news. Five for an RQR and no on the display.

Exposure 1

DATE: 02Dec97

PILOT: E

TASK: 1009

CARD: Nominal Approach and Landing

Okay, I guess just to make sure that I understand. We are going to break this up and do an approach and then the landing segment. Is that correct? The intercept segment is the approach segment? Okay. The approach segment, initial approach fix, okay. Guess I was trying to look at, ... for the ... oh, here it is. Okay plus or minus five knots. The auto throttle holds that. The deviation plus or minus a half. We got performance on the intercept portion. I would probably go with a two on the intercept portion. It's really not very tasking, it's not real high gain. I don't think there's any deficiencies that I really noted there except for the ride quality. I guess the ride quality, I would equate it, if I didn't know that it was, you know maybe, partly the airplane. Or what ever. I would probably call that

moderate turbulence if I was in an normal airplane shooting an approach. So I will give it a two for both longitudinal and lateral. Again, I have a hard time splitting up the two axis, well the longitudinal from the lateral-directional axis for rating purposes. Anyway, for the influence on pilot control inputs, I guess it's really hard to tell. I would almost be tempted to go with a one. I guess, are you guys using half ratings on these DASE's? One or the other? I guess I'm going to say that it's a two the only hedge that I'll have is, I didn't ... I guess that I didn't perceive a lot of that as anything that I was exciting a structural mode. It just felt like I was in turbulence. Even with a normal airplane, when I'm in turbulence, a lot of time I modify my control inputs a little bit. So I guess I don't know that I was really doing it because of the flexibility of the airplane. But I did modify it just because we were bouncing around so much that it's easier for me to try to track by trying to be a little bit smaller, a little bit smoother with the control inputs. For the quality of ride, I guess I'd probably ... again I don't know. If that was mild turbulence and there was no structural model in there, which I really don't know what kind of structural model we had. I guess I would have kind of equated that, maybe up to moderate turbulence. If it was in mild turbulence and we were getting the reaction in the airplane. I guess I am trying to draw a line between a two and a three here. Certainly the vibration that we got due to the combination of any structural modes and the turbulence that we had was perceptible. Two is, Cockpit vibrations are perceptible but not objectionable, no improvement necessary. I guess if, depending on what the actual turbulence of what you experienced was. I would say, I guess I'm going to go with a two. See, it's really hard here to divide out the perception of what is a structure. That was no whereas bad as what we saw this morning. It's really kind of hard for me to divide out anything structural vs. just turbulence and what's accounting for what there. There were a couple times when I got the flight path vector commanded vs. actual to split. I guess if you assume that it would be mild turbulence that I would equate to being light chop or light turbulence, I guess I am going to change that and say I'm going to go with a three. I guess I would like the ride quality a little better. I do not know, moving on to the landing task. I guess, let's go back and the more I think about the ride quality let's go with a two I guess. The predominate reason why I'm going back to the two I guess, I can't really ... I really could not decipher turbulence verses flexible mode on the task that we did there. Now we may see something different on the other two exercises cause we will have more of a chance to excite a structural mode but I'm going to go with a two. Okay going on to the landing task, I guess I'm trying to draw the line between is it satisfactory without improvement if it's between a three and a four. Minimal pilot compensation required for desired performance, desired performance requires moderate pilot compensation. I guess I'm going to go with a three for the Cooper Harper in the landing task. Both longitudinal and lateral-directional. I guess the only reason I'm going to say that is, if you followed the cues and just go through it you can get desired performance. I don't know that I'd quite say that you would need to use moderate compensation to do it. So I'll go with a three there. I guess I'd stay with ... I guess we said a two and a two on the DASE. The only other comment which I already kind of mentioned was, I noticed that there was a tendency without any control inputs from the pilot. I think it was times when it was not necessarily during the automatic reconfigure where I would see the commanded and the actual flight path cues split in gamma. Which kind of surprised me. Okay.

Exposure 1

DATE: 02Dec97
PILOT: E
TASK: 2009
CARD: Lateral Offset Landing

Okay this is Lateral Offset Landing, exposure one. Okay, basically, it goes against, philosophically, it goes against the grain for me. This is my personal opinion. To split up the different axis and give them separate Cooper Harpers. I think it's somewhat appropriate here and I think I'm going to do it here. That's because the pitch tracking task is really not a problem. Although if it was better then you could spend more time on the lateral-directional task. I guess the bottom line is, here's my point. The biggest problem that I'm having with this particular task is trying to meet all the lateral parameters. I think part of the reason is ... I'm going to do something else next time 'cause I vaguely remembered this from previous runs, and that's using the waterline. I'm having a hard time seeing the line-up when I turn back to run the airplane down the runway. So, once I start the correction and I get my angle off in the runway to correct the center line. I'm having a hard time dragging my butt down the centerline of the runway and getting in line and being able to see that. I think part of that is ... I believe that read this, the gamma's really where the center of gravity's going. Not necessarily where I'm pointed at. I think there may be some display issues in that too. As far as the turbulence goes and the flexibility of the airplane, I think it degrades the task some here. I think that I'm backing off and trying to be a little bit smoother and backing off of my gains just a little bit more. I'm not so sure that it's really impacting the task that much. So I am going to go with a four longitudinally and a five laterally. So we are just doing one thing for the landing here right, because it would be the same intercept? Okay, I understand and I will try to go along with it. I guess I have a hard time doing that because the task is effected so much by what you do on the offset, the last fifty feet is. The last fifty feet, really flying the touchdown is not very difficult. Longitudinally, I would probably say that ... in the last fifty feet, although I'm not getting desired performance it's not because of a longitudinal problem. I guess I'm just going to go with a four and five for both phases. I guess the reason I'm doing that, I have a hard time dividing up the two. The last fifty feet the flare part is really not that difficult. It's not that difficult to hold what ever heading you have. It's just if you've screwed up the part prior to getting down to fifty feet then you're having a hard time correcting for it in the last part. If that makes sense. Anyway I'll just go with a four and a five and a four and a five. For the DASE, I guess I'm going to go with a two and a two. Again I would say it's mildly objectionable. A real airplane bouncing around this much close to the ground I wouldn't be real comfortable so I'm real tempted to go with a, I think I am, for the control inputs, I'm going to go with a two because I really don't think we're at the point where it's affecting my voluntary control inputs, although I'm modifying my inputs some. I think I'm going to go ahead and push it over and say a three because in the turbulence here, in a real airplane I would've been okay landing with a straight end of a task and this offset task with the bouncing around that we're getting, it's affecting it enough that it would probably coax me to go around or I'd be real close to going around if I was doing this offset task and getting bounced around or getting the response that we are. Again, I am really waffling between the two and a three on the ride quality but I guess I'll go with a three. You know this display question, I'm going to say no. With the same qualification I said before, I think there's some other issues but I don't think I particularly really noticed it there.

Exposure 1

DATE: 02Dec97

PILOT: E

TASK: 3009

CARD: Composite Flight Director Tracking Task

First of all, it is a random task and I varied my technique throughout a couple times there. The last time we got fairly good performance and I think the reason is, I backed off on my gain and for the roll inputs, I just allowed the cue to be out for a while until it slowly came back in. First of all, I'm not sure if this is true but it looks like if I hit the target bank, if the cue shows me to turn left and I start rolling in to left bank, in order to quickly center up the cue, I think I actually have to overshoot the bank and then come back to the desired bank. If I'm just patient and go to about 20 degrees and kind of let it do it's thing and let it slowly catch up to itself, I think I get a little better performance that way. The other thing ... I wasn't intentionally doing that not to bomb the motion base, the first tracking task, I was probably not as patient as I was on the last tracking task. The two times that I bombed the motion, I had tried to tighten up my gain a little bit more and be more aggressive and not only did that bomb the motion base, but it also gave me less consistent performance. So that's why I tried backing off the gain. The other thing is that I think your ratings are going to vary depending on the randomness how the profiles flow together. I think if I did like two profiles and then two different profiles and if it's just all random or if you have a set number of different profiles, but some of them, as they flow from one segment to the other that can influence the task. The other thing I noted, too is there was one maneuver on that last one where I noticed that I waited until the cue moved a little bit and I was pretty sure that it was turning and I tried aggressively. I went to full stop on the roll command to follow the cue and at full roll deflection, I could not keep up with, satisfy the roll cue, and I guess my point there is that I think that if you flew it perfectly, I'm not so sure that with all the transitions you could always stay, if you have control authority to stay, you probably do if you flew it perfectly, and you knew in what direction you were going to go you probably could have the control authority to keep the cue centered. But, by the time I know for sure that it's turning left or right, even if I go to the stop, I can not catch up to the cue immediately. I guess what I'm saying is, by the time that I know it's going left, if I go to the left stop all I'm doing is chasing the cue, I can not catch up to it and then back off on my roll command. The point is once I know which way it's going I have to go set a Bank Angle and then wait for everything to catch up and then go from there. I guess the motion is distracting in this although, I'm not so sure how much the motion really, the flexibility or the turbulence, really affected the ability to do the task. I guess I'm kind of looking at it as it's satisfactory without improvement that question again. I don't think ...well, let me go down into the level two flying qualities block if you will. I don't think adequate performance requires considerable pilot compensation so it's definitely not a five. Four says desired performance requires moderate pilot compensation and I'd really kind of tend to go in that direction simply because there is a compensation that I can use like I did on the last one where I think we get pretty good results. Although it took me a couple of tries to really kind of fare it out that kind of compensation. A three says minimal pilot compensation required to get desired performance and really the last run that I did, I would really consider that was minimal pilot compensation. It just took me a while to figure that out. I'm going to hedge back and forth here a little bit, I think I'm going to. The other thing is that I really don't like breaking up the axis, but I will say that I think that it's harder in roll than it is in pitch and I think part of that is maybe a function of the flight director, but that as it is I going to give it a three longitudinally and a four lateral-directional, I guess. For the influence and the control inputs, I'm going to go with a two and for cockpit vibrations perceptibly ... you know this isn't close to the ground and you know, I could live with this, I guess. Again, I find myself between a two and a three for this tracking task ... I'm going to go with a three and the display question, you could take the outside visual away and do this same thing so I'm going to say no.

Exposure 14

DATE : 10Dec97
PILOT: F
TASK : 1009
CARD: Nominal Approach and Landing Task

Okay, straight in. The configuration felt not a whole lot different from the previous one. There's really not much impact on control, just feeling it out there, a little bit, on the long straight in. It seems like the damping on the lateral DASE may be a little less but, particularly for the straight in task here, there's not much difference. So I'm pretty much going to give it the same ratings, a four, four, for the approach. And for the landing, again let's give it a five, four. And two for the control on the DASE. And again it's marginal three, four, but let's give it a three on the ride. And a yes on the display due to QSAE.

Exposure 14

DATE : 10Dec97
PILOT: F
TASK: 2009
CARD: Lateral Offset Landing

Okay, general comments on exposure fourteen, for the offset task. My impression that there might have been a little bit of potential problem laterally, wasn't born out there. Really there was no problem, it was very very similar to the previous configuration to my feeling and so I'm going to rate it just essentially the same. Which was for the approach, the longitudinal, we'll give it a five because of the sag in the display, laterally because of the difficulty. And the landing is definitely a five, longitudinally and let's give that four again. Same as I gave it last time. Yeah. And two, three and yes. And QSAE on the yes.

Exposure 14

DATE : 10Dec97
PILOT: F
TASK: 3009
CARD: Composite Flight Director Tracking Task

Okay, this was the flight director task for exposure fourteen than it was a little bit surprising, not surprising, but interesting in that the lateral banging wasn't as bad as I anticipated it was going to be and I actually got very good performance at least on the last one. The pilot ratings, longitudinally, there's really no problem. And so let's give that a four, as last time. And lateral, I think I'm still going to give it a five. Yeah, it's still a five. Just the fact that you really know what's coming up next and you just have to sit there really on the edge of the chair. So it's four, five, same as last time. But there was no banging tendency, for not as much banging tendency as exposure thirteen. Okay, now back down to the DASE. It's kind of a two minus on the control and the ride is a three, you can still feel it of course and the display, no.

Configuration 10 Modal damping increased to 0.30 for mode 1, damp4

Exposure 15

DATE: 22Oct97

PILOT: A

TASK: 1010

CARD: Nominal Approach and Landing

Straight-in approach and landing, longitudinal Cooper Harper for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also. Again it's really hard to ... on purely Cooper Harper performance criteria and task it's difficult to give these things other than three's. There is some unpleasant motions due to turbulence but basically the control laws hold right on glide slope and a little bit of effort on localizer and a little bit on glide slope and you get knocked out by turbulence but it certainly level one and minimal compensation so it can't be anything above a three for the most part so these are all going to come in at three's. For the up and away, I did some maneuvering, this is one of those that has poor aeroelastic harmony, is the way I'll term it, is minimally damped in the lateral axis. With abrupt inputs, you basically ... I was counting as much as nine overshoots of a large amplitude. The longitudinal axis is well damped. You get moderate amplitude responses to an abrupt input but it's very well damped. But the very lightly damped lateral axis is leaving all these motions in there that just makes everything harder. The rudder direction inputs is moderate amplitude but it is fairly well damped and it is very low frequency. I was getting about one and a half to two overshoots for very large rudder inputs so not a whole lot of coupling or a whole lot of excitation by the rudder inputs. For the landings, straight-in; Controllable? Yes. Adequate? Yes. Satisfactory? I'll say it's not satisfactory. The question is whether it's desired or adequate performance. The last of four landings was a very nice landing however I don't think I was totally in control so I think that was some learning curve with this configuration and some luck. I'm going to go ahead and give it the benefit of the doubt for adequate. Moderately objectionable deficiencies and adequate performance requires considerable compensation. The lateral modes, the lateral movements back and forth is distracting. And longitudinally I guess I didn't feel as confident as I should have since it was a well damped configuration. But when you get so much motion going on from the lateral it's kind of difficult to be precise in longitudinal. It's just enough of a distraction is more of what it is. So we are going to go with a five for the longitudinal. For the lateral rating for the landing; Controllable? Yes. Adequate? Yes. Satisfactory? No. I think I met desired criteria but with a lot of effort. I'll rate it a four. It's kind of a borderline four-five. CIR rating; I did alter my control inputs. Pilot intentionally modifies ... That's true. Cockpit vibrations impact precision? To a degree yes. I'm going to go with a three on that. What happens is interesting, on that one the lateral motions are effecting my longitudinal task and it effects the precision with which I can control the aircraft in the flare. Just the motions created by lateral inputs or turbulence was distracting. For the RQR, certainly the first couple of two are not applying. The third one, moderately objectionable? No. Warranted? No. Improvement required. Let's go with a five on that. It's just that the damping is way too light in the lateral axis. And no for the display question.

Exposure 15

DATE: 22Oct97

PILOT: A

TASK: 2010
CARD: Lateral Offset Landing

For the approach, longitudinal and lateral; I met the desired criteria on both of those. We'll go with a three and a four this time which is a departure and I'll explain that. The longitudinal rating; glide slope control is still level one. The tracking for the localizer, the workload is increased a little bit to the point where I don't want to say minimal compensation anymore and this is because of the very lightly damped lateral axis. I was having to work harder to tightly control the localizer and so the workload has pushed us to a four. For the landing ratings; Controllable? Yes. This is longitudinal. Adequate? Yes. Satisfactory? No. It looks like clearly adequate performance. Difficult to get it down into the box. I'm a little bit reluctant to abrupt movements and even though the longitudinal axis is not as difficult for me because of the large kind of undamped lateral motions it's making me to be a little bit tentative in all of the control. I was very smooth in the lateral inputs rolling into the turn and rolling out of the turn and it just worked out pretty well on line up. However if you look at the Y dispersions they weren't consistent and I was really having to work a little bit on line up. So the overall task is complicated by the lightly damped lateral axis. At any rate for longitudinal, we said it's not satisfactory and it's going to be a Cooper Harper five for adequate performance. For the lateral rating; Similar. Controllable? Yes. Adequate? Yes. Satisfactory? No. I am also going to give a five for workload. Basically it's borderline four-five but I had to alter my technique enough and I just didn't feel like I could really control it tightly in close in the flare and we were 13.9 Y, that's pretty bad, so we'll give it a five on that. For the CIR; I did alter my inputs so number one's out. Number two applies. Number three is more applicable longitudinally because all the lateral induced motions did effect my longitudinal control. At least the precision of it. The RQR; again the first several don't apply we're looking at a three and four. Improvement desired. No it's more to at least ... I'm going to go with a five on this. I don't like the fact that any kind of motion can effect my ability for precise control. So generally if you see a CIR of three you're going to see at least around a five or so, RQR, because of the fact that when you start effecting my ability to precisely control a task then that definitely is something I think needs to be corrected. And the display answer is no.

Exposure 15

DATE: 22Oct97
PILOT: A
TASK: 3010
CARD: Composite Flight Director Tracking Task

Longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Again, if you make an abrupt input, you get that ASE interaction but you can make a fairly large input, you just have to smoothly bring it on. You can even bring it on a fairly rapid rate, you just can't be abrupt. You just have to start out smooth and kind of taper in your input at a gradually increasing rate without making an abrupt step input. Stay away from step inputs and it's all right. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. I'm going to go with a four on that. Again the lateral workload is high plus all those extra motions that you initiate with the lateral responses are not much fun. Actually they're kind of fun but they're not very good. CIR; I would say two is probably more appropriate in lateral this time. Longitudinally I was very aggressive. I didn't feel like I needed to do anything. Laterally I did try to be a little bit smooth, so that would be a two. For the RQR; It's kind of a four based on this task. This is a fairly aggressive task, you wouldn't

normally do in every day flying and so I think based on this task alone, I'd say a four on that. And the display question is a no.

Exposure 6

DATE : 04NOV97
PILOT: B
TASK : 1010
CARD: Nominal Approach and Landing

Okay, Exposure number , what is it, six. Pilot B straight-in ILS and the approach, Cooper Harper, seemed to be right up there. I think, longitudinal, I'd say, three. Landing, probably a four. And lateral-directional Cooper Harper has quite a large, actually I think I'll give that a ... actually performance wise it wasn't bad, so I give it a three on the approach, and a four on the landing. The DASE CIR ratings, they kept, what's that? Okay, I give it a two, and DASE ride quality, say it was moderately not highly objectionable. Let me give it four on the ride quality. And yes there was some impacts on the display perturbations.

Exposure 6

DATE : 04NOV97
PILOT: B
TASK : 2010
CARD: Offset Landing

Exposure six, Pilot B approach side step landing. Cooper Harper longitudinal; well on the approach not all that bad, I'd give it a three. On the landing I'd have to give it a five and lateral Cooper Harper on the approach, probably a four. And on the landing, actually, let me back up on that. The lateral for the approach, and if include the side step maneuver, we had some inadequacies there, I'd have to give it a seven. Well let's see, maybe a six for the approach and seven for the landing. And the DASE CIR rating, I don't know what involuntary input I've got, so I'm gonna call it a two. The ... I'm sure that the intense, most likely the intensified oscillations are because I'm grasping the stick harder. But, the cockpit vibrations are highly objectionable. We didn't abandon the task, so I'd give it a five and yes on the displays.

Exposure 6

DATE : 04NOV97
PILOT: B
TASK : 3010
CARD: Flight Director Tracking

Exposure Six, Pilot B, flight director tracking. Longitudinal Cooper Harper; we got desired performance, well, I'd give it a three I guess. Later directional; probably a five. And DASE CIR rating, be a two. The ride quality is highly objectionable, that's a five and a yes on the displays.

Exposure 1

DATE: 10Nov97
PILOT: C

TASK: 1010
CARD: Nominal Approach and Landing

Okay this is Pilot C, November 10th, exposure number one nominal approach and landing. Okay, in general, the issue was the Lateral oscillation. Longitudinal was objectionable but in terms of control difficulty it was the lateral-directional, predominately directional that was the problem. The oscillations were fairly extreme. Throwing me around the cockpit a bit. You could not hold on to the stick. Okay, during the approach, longitudinal HQR, controllable adequate... from a control standpoint, satisfactory. Minimal compensation HQR three longitudinally. Lateral-directionally, same thing, three. Okay, DIC laterally? I'd say a four. Cockpit vibrations cause occasional involuntary control inputs during the approach segment. That's both ... let me see ... let me hold off. Let's call the longitudinal a three, you don't ask for them individually do you? Okay, let's give it a four then overall. That's for the CIR. I'm giving it to you in the order that you ask for it here. RQR, during the approach, call it moderately objectionable with a four. Kind of surprised me when we got down low. When we got down below 500 feet and we got that ringing laterally, directionally rather, that I didn't see before. So, I'm going to lump that into the landing phase. Longitudinal Cooper Harper on landing was controllable, longitudinally. Adequate performance was obtainable longitudinally. I'd say adequate performance requires considerable pilot compensation HQR of five. This isn't pleasant. Then lateral-directional it's controllable. Adequate performance, I'd say is not obtainable and that's because controllability is in the question here. I can attain the performance, but the issue is controllability. I believe that considerable pilot compensation is required for control. See the trouble is, none of these words match what I saw. Adequate performance is obtainable but controllability is in question. Let's give it a ..do you care about half ratings? Preferably integers. Okay, let's give it an eight then, lateral-directional. CIR, during the landing phase, five. Frequent involuntary control inputs. If I were to have held on to the stick at any phase I think that would have migrated rapidly into a six. But we're gonna call it a five since I didn't. RQR is also a five, again due predominately to directional. Yeah, as near as I can tell. I'm not sure I can tell ... but as near as I can tell they don't. In this one it was the aerodynamics, not the display that was causing the problem. But again, I have a hard time separating the display from the airplane. Okay, that concludes this one.

Exposure 1

DATE: 10Nov97
PILOT: C
TASK: 2010
CARD: Lateral Offset Landing

Okay, Pilot C, lateral offset landing task, exposure one. Okay, very much the same deficiencies that I saw before. Just the different task change the work load a little bit. Longitudinal rating on the approach, controllable? yes. Adequate, obtainable? yes. It's not satisfactory, Adequate performance requires considerable pilot compensation, HQR of five longitudinally. Lateral-directionally, same thing. I'm working in both axes on this. It's not satisfactory without improvement considerable compensation required for adequate, HQR of five. On the landing, very much the same thing. The work load associated with the approach phase is predominately in line up and offset correction and maintaining a proper glide slope for the maneuver. The sight picture that I'm used to seeing, that is. For the landing, it's of course trying to marry up sink rate and longitudinal position. But the result is very much the same. Longitudinal and lateral-directional is controllable, adequate, not satisfactory. Adequate performance requires considerable pilot compensation, HQR... well

hang on a second. The issue is control again. I'm able to get adequate performance but lateral-directionally, I'm fighting for control. The problem is that I'm not entering the loop in that frequency. What I'm basically doing is relaxing my gains. Waiting for the inputs to die out. But control is an issue. I'm actually reducing gains to maintain control of the aircraft. So I guess on the landing phase I can't really call it a five anymore. Let me rethink that. I'm gonna keep that on longitudinal HQR of five. Lateral-directional, compensation for control is an issue, so I'm gonna have to, again, give it an eight. Since controllability is in question. So, longitudinal five, lateral-directional eight for the landing task. Let's see, the CIR, I didn't abandon it. Although I sure am seeing a lot of ... well, I not seeing a lot of involuntary control inputs 'cause I'm releasing the control. So let's call it a five, and RQR, very, very near six here. I'm gonna call it a five but it's very near six. That time I did notice a little bit of display perturbations. So I'm gonna say yes to that question on the bottom. And that concludes my comments this time.

Exposure 1

DATE: 10Nov97

PILOT: C

TASK: 3010

CARD: Composite Flight Director Tracking Task

Okay this is Pilot C, exposure one, flight director tracking task. Okay, Cooper Harper, longitudinally, it's controllable, adequate and I think compensation is more than minimal. As for desire, I'm gonna give an HQR four. Moderate compensation for longitudinal. Lateral-directional, controllable ... now the issue again here is control. I am able to pretty much ... you can't really let go of the stick on this one 'cause the flight director forces you be in the loop. I wasn't.. I didn't loose control. I didn't feel like I was imminently gonna loose control. So I'll say it's adequate. Clearly not satisfactory and I think it's saying that desired, requires moderate is not severe enough. I'd call the compensation considerable, HQR of five. I'm not sure why the difference between the landing task and this one, but I didn't feel like control was an issue here as much as I did in the landing task. CIR's gonna be low here that is high numbers, low ratings. A five on CIR. Frequent involuntary inputs. The ride quality was horrible but I didn't abandon the task. So, the worst I can give it is a five again and I'm gonna do that. The aeroelastic display perturbations did not impact ease or precision, so that's a no. That concludes comments at this time.

Exposure 10

DATE: 18Nov97

PILOT: D

TASK: 1010

CARD: Nominal Approach and Landing

For the approach while we were getting beat around so much, it wasn't really hurting my accuracy all that much, it was uncomfortable but it didn't require a super high workload on it. So, satisfactory without improvement? For the approach ... Yeah, they where mildly unpleasant and minimal pilot compensation and keeps me in the desired so I'll go with the Three with both longitudinal and lateral-directional on that. For landing, adequate performance attainable? Yes. Same problem with that. Satisfactory without improvement? No, not really. And two out three time I got the desired, the other time I didn't get it flared. In both lat-dir. and longitudinal that was more than moderate pilot compensation so I'll say both Five's for the landing. On the CIR? Two, did modify it but I felt that it didn't

effect the precision horribly. RQR ... Three, would do that. This time I didn't see the display affecting me. On these displays, I don't know if I've said it, the fact that's offset from where the real aim would point would be as far as on the visual, I'm kind crossing that off, just mainly concentrating on the HUD itself. Using that as truth data, and when I say it affects me it's only as its moving around and oscillating, not in it offset position. I'm not trying to rate that. So ... you might wonder why some are yes an some are no, it's because if I don't see an oscillation than just the fact that's offset I'm not down grading it for it.

Exposure 10

DATE: 18Nov97

PILOT: D

TASK: 2010

CARD: Lateral Offset Landing

For the approach, on several of these there is a big difference. If I'm just off a little bit wide, I'm still in the diamond even, but a little bit wide it's making enough bigger one enough bigger correction that it's I can see the workload go considerably higher. On all of them, if I'm going to be off the glide slope I'm trying to shade it toward being low on the glide slope. Still within desired limits but if anything low, not high so I don't have an extra big one in the pitch to effect. For the approach longitudinal lateral-directional, there were no big problems they were, I can't say that I'm pleased with them enough to be satisfactory without improvement but I would could get them over where I wanted them well enough to be Fours. So, longitudinal and lat-dir. on the approach, Fours. On the landing adequate performance, yeah, on either one of them, that was satisfactory without improvement, I don't think so. Both times I was getting adequate for being long and hard I'm probably always going to do that on that particular task on that configuration. So ... to do that, it was certainly considerable. I guess this time I'm going to make them Five's. But this time it was more on the performance last time as I recall, I had a five in there but that was due to the large compensation, this time it was more due to the actual performance being long and a little bit hard and I would say considerable pilot compensation, so Five. CIR ... Two and Three for RQR and display. No.

Exposure 10

DATE: 18Nov97

PILOT: D

TASK: 3010

CARD: Composite Flight Director Tracking Task

Well the performance worked out fine. Satisfactory without improvement? With the amount of workload, no. I'm going to say No and give ... I think actually both of them four -- no, I take that back, I'm going to split this one. Satisfactory without improvement in pitch? Yes, a Three. In lat-dir. No, and I'd swing over to a Four. So Three and Four for the Cooper Harper's on that. CIR ... it was at least a Three on the CIR and I didn't notice involuntary control input but the big thing, every time I did a reversal why it would be the oscillation was really large. I was purposely trying to find involuntary and I didn't see any so I'll leave it at Three. But the ride quality one is really bad, yeah I think that would be a Five. I think that would have to be fixed. Five for that task and displays? No.

Exposure 3

DATE: 02Dec97
PILOT: E
TASK: 1010
CARD: Nominal Approach and Landing

Pilot E, Exposure 3, Configuration 10, Nominal Approach and Landing. All right, for the intercept, again, I don't think there is any real problem with the intercept and you can see the difference between the two airplanes but for the intercept of the Localizer and Glideslope, it's really not a high gain task. I guess I'm going to go with a two and a two. Do you want DASE for those? Okay. Now, the two and the twos for the Glides are the Localizer and Glideslope Intercept. Are we still doing the approach down to 200 feet for this one? OK, so the approach down to 200 feet, tracking down there is definitely between a two and a three. Again I would have a tendency to go with a two and a half and a two and a half but if you don't want half ratings I guess, then I would probably still go with the twos for tracking down to the 200 foot point. Below the 200 foot point though it gets interesting. This one, no it could be maybe I'm getting a little bit tired because we were close to getting desired under all the parameters but we did three landings, one with the auto throttles off. In each time I've had a parameter or two that was adequate. I think the first one was just adequate and the rest were all desired. That would by definition make it a five, so I am going to give it a five but I guess I have some reservation about it. Initially on the first run I had a tendency not to want to correct laterally because again, my perception is that the airplane kind of rings laterally with the roll inputs. I kind of could get perturbations going in both axes here that I don't really like. I really think I probably could get desired performance if I did it a couple more times but I think we would still end up with like a four at least. I think the five was just fine, so we'll go with that. Yea, in here it truly ... the axis tend to blend together for me a little bit more because it seems like the inputs that I get, I can excite the roll or excite the lateral motion with the roll and I can excite the longitudinal motion with the pitch. If anything I would say that the pitch is probably a little bit better and I might have a tendency to want to go with a four or five here but I'm just going to go with a five. It's tied in enough that I don't really want to break it out. For the DASE, I'm probably going to ... I don't know if I really saw that many times where I got involuntary inputs but there were a couple times that I probably did, I am using a lot of compensation to try not to let any motion couple into the stick. So I guess I'm going to go with a three for the control inputs. For the ride quality, it's definitely between a four and a five for me. I'm going to say it is highly objectionable. I'm going to go with a five. I'm going to say no on the display. Again, just isolating it to this particular task.

Exposure 3

DATE: 02Dec97
PILOT: E
TASK: 2010
CARD: Lateral Offset Landing

Pilot E, Exposure 3, Configuration 10, Lateral Offset Landing. Okay, in the interest of time here we probably could have done another run. We're getting mostly desired and adequate performance. This time we have gone through 50 feet. We had a little bit, on the second run we had a little too much bank, that was right at the 50 foot point. That was simply because I wasn't aggressive or had not gotten the lineup quite right. I really ... I believe if we did this again we would definitely be in the adequate range. I am going to take that leap of faith I guess and put us in the four, five and six block, where it would definitely be five or six. I guess I would probably again, philosophically, I don't have a problem with half

ratings as long as it's not between the major blocks and it is not between four and five. I would have a tendency to go five and a half on this but since we are not doing half ratings, I guess I am going to the six. I think it is more a function of, we are getting enough motion and enough turbulence level that it is uncomfortable for me in the cockpit. I think that has more to do with the degradation and performance and also with going for the six than anything else. The airplane actually is fairly controllable. Both times though, I'm not really sure what caused it, I had the tendency to balloon a little bit or bring the nose up a little bit more than I really wanted to with the roll inputs. I don't know if maybe I'm inducing something, I don't think so. Anyway, my point is the airplane is plenty controllable but I won't say plenty. The airplane is controllable, it's the environment that I think is causing more, or causing the degraded performance. By going to the Control Input, there were times there where I did get involuntary inputs. I think they were occasional rather than frequent so I'm going to go with a four. For the ride quality, we're definitely in the range where I would be real concerned about trying to land the airplane here. I think a landing is doable but I think it is highly objectionable and improvements required. If this was something like a real metal ... well you know, I won't even go there. I guess for an all up and operating airplane I think it's highly objectionable and improvements required so I'm going to say it's a five. I don't think the display is a factor here. I'm going to use the same ratings for the approach here too since we divide this task at fifty feet. Because it is hard for me, like on the last run breaking the Bank Angle at fifty feet having a degrees was a function of what I did above fifty feet not below fifty feet.

Exposure 3

DATE: 02Dec97

PILOT: E

TASK: 3010

CARD: Composite Flight Director Tracking Task

Pilot E, Exposure 3, Configuration 10, Flight Director Tracking Task. I guess the first comment I have is that I'm really surprised that this was not as bad as I thought it was going to be, based on what I saw in the Lateral Offset Task. Maybe I'm just getting a little tired and I'm more abrupt than I needed to be on the Lateral Offset Landing Task, I don't know. I guess my point is we got adequate on one run and desired on the other. As long as I kept my gains down and kept everything backed off. As long as I kept my gains fairly low and was patient with trying to put the flight path vector into the flight director it wasn't too bad. It wasn't as bad as it was in the landing task. Anyway, I guess we did get desired once and adequate once. I don't think that I would go with a three so that definitely puts us into the four, five and six areas. Based on the last run I guess I am going to go with a four. I guess I'm kind of hedging on whether I should say a four longitudinal and a five laterally directionally or just go with a four and a four. I think I am. I just, I don't know, I guess it's more of a function of the flight director and predictably as I talked about before but I am going to go with a four longitudinally and a five laterally/directionally. If I come down and look at the control inputs, I'm kind of looking at the two, three and four. It's definitely not a four, again, I would have a tendency kind of to go two and a half here but I am going to go three. For the ride quality, I guess I'm going to go for a four on the ride quality and No on the display. Again, I may be getting tired, and may not have been as aggressive on the offset landing task or maybe I wasn't as aggressive here because of that or maybe I was getting use to the turbulence level but I was really surprised because I was expecting this to be a lot worse based on the Offset Landing Task, than it was. I'm sure that has influenced my rating a little bit. Anyway, that's it.

Exposure 9

DATE : 09Dec97
PILOT: F
TASK : 1010
CARD: Nominal Approach and Landing Task

Okay, straight in task. Just comments first. The aircraft is very lightly damped laterally and it looks like it's going to be a real hand full on the offsets but for the straight in, as long as you don't make any inputs, it's not too bad. The turbulence, you know, doesn't seem to be too too bad but any kind of control input at all seems to really set it off laterally. Longitudinally, it's pretty lightly damped but by just using normal smooth inputs, I didn't have any problem, longitudinally as far as control. Okay, the pilot ratings for the approach, will let's give it a five based on ride and let's give it a seven, based on ride, laterally. And I think the same for landing too, five and seven. Although my performance on the longitudinal landing required a five. I got that one, short and firm. The old problem of trying to get in this Box here. Okay, for the DASE. I think it's a three, just really have to be so very careful, hardly even touching the stick laterally to keep from exciting it. Longitudinal, it's not too bad. Okay, ride, it's a five and it's lateral. And the display, yes, there is some effect. The QSAE, I didn't see any wiggling that was really impacting the control task there. Mostly QSAE for the yes on display.

Exposure 9

DATE : 09Dec97
PILOT: F
TASK: 2010
CARD: Lateral Offset Landing

Okay, pilot ratings for the approach. And the longitudinal as in the straight is not too too bad. Let's give it a five for the approach. The lateral has got to be at least a seven. Let's just give it a seven, I don't know what ... And it's ride. It just whacks you too much. And then the same on the longitudinal. Okay and for the landing, same thing, five and seven. And with the comment on the lateral is that it's severe enough that you really have to lower your band pass. And so, like on that first one, I didn't put enough bank angle in initially and that really shot me down, so I ended up touching down way off of the centerline of the runway. Just don't have ... Didn't dare get into the control system enough to get it back closer. So it really does force you to back off. Okay DASE ratings, don't really feel that I'm getting any involuntary control inputs. Let's just give it a three. Maybe you guys can show me that I am later but I don't feel like it. Okay, ride quality is definitely a five and the display is definitely a yes. And it's everything. It's wiggling and it's off steady state.

Exposure 9

DATE : 09Dec97
PILOT: F
TASK: 3010
CARD: Composite Flight Director Tracking Task

Okay, it's pretty easy to get the desired performance so you can just kind of back off on the frequency inputs to keep the thing from banging too much. And so again, longitudinally, it's not too bad. I'm not even sure that the ride quality is all that bad. Let's give it a four for

this one. And lateral, it's definitely still got a problem. Let's make it a seven and that's a ride on the seven. Okay, the DASE is, control, is a three. Ride is five. And display is ... it didn't bother me. You would see it moving a little bit but not much.

Configuration 11 Modal damping increased to 0.30 for mode 2, damp5

Exposure 8

DATE: 21Oct97
PILOT: A
TASK: 1011
CARD: Nominal Approach and Landing

Okay this is the exposure number eight, straight in approach and landing, longitudinal Cooper Harper rating, for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Again the approach task with the gamma-dot-v is not a difficult task even with these bad configurations. The longitudinal axis is characterized by a very very lightly damped ASE response. If you make an input ... I counted up to seven overshoots. So basically you're getting longitudinal low vibration all the way down the approach just from the turbulence exciting it. It is very very lightly damped. The lateral axis by contrast, is a slower response, you make an input and there is a noticeable delay before you get the response. It's well damped it appears and it is about moderate amplitude and that's the same for the rudder inputs too. For the lateral approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. I know this kind of like a mono-tone but basically with these control laws the task does meet desired criteria but there is minimal compensation required. Okay for the landing, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? No. Because it's so lightly damped, the ASE response is so lightly damped, it's a little bit unpredictable on the flare. I am reluctant to make aggressive inputs to correct for something. I pretty much try to set a good flare rate and just see what happens. We met the desired criteria on the last one with a nice approach but I don't know how repeatable that would have been. The first two were not that good. We'll go ahead and rate that a five. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. It pretty much is desired criteria. Workload is a little much for giving it level one. And basically it just tends to with a turbulence input, you will tend to get a drift and you are having to constantly work to correct for localizer and for line up. For the CIR; pilot does not alter control inputs as a result ... That's not true. Pilot intentionally modifies control inputs. That is true. And cockpit vibrations impact precision of voluntary control inputs. Laterally no not at all. Longitudinally possibly, so I will err with a three on this one. This is real borderline two-three. And it is probably more of a two in the previous configuration seven, if we are trying to rate these things or trying to order them cardinally. This is not quite as bad in the longitudinal axis. For the RQR; Vibrations do (not) impact. That's not true. Perceptible but not objectionable. Not true. Improvement desired. Not true. It is at least; vibrations are moderately objectionable and improvement warranted. I'm going to go with a five again because of the lightly damped nature of the longitudinal response. I perceive that to be a real problem and I think that would have to be corrected for this to be an acceptable vehicle. And no for the display.

Exposure 8

DATE: 21Oct97
PILOT: A
TASK: 2011
CARD: Lateral Offset Landing

The lightly damped longitudinal axis made it a little bit inconsistent in the flare, I had one terrific landing and then two that were slightly long and I didn't feel like I had real good

control over being able to place the airplane in the desired box. Longitudinally; Controllable? Yes. Adequate? Yes. Satisfactory? No. The performance indicates that it is borderline four-five. I'm going to go with a five on this. And this is for the landing rating, we'll go back to the approach rating in just a second. So a five for the landing rating longitudinally. I felt that the flare was a little bit unpredictable because of the very lightly damped longitudinal motions. For a lateral landing rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. No, let's say satisfactory? No, because of the workload and we'll make it four. For performance, I met the desired criteria. A little bit of effort but the task is kind of difficult laterally and however it was not as difficult as I thought it was going to be. I felt pretty good with the lateral handling qualities so this almost kind of a borderline three-four, borderline level one. For the approach ratings similar to the straight-in, up to 250 feet, no problems at all. Let's give it a three and a three on that. The CIR; pilot does not alter inputs. That's not true. Number two; pilot intentionally modifies; that is true. Number three, cockpit vibrations impact precision, I would say that's true also, longitudinally, not true, laterally. So let's go with a three for the longitudinal reasons. RQR; vibrations do impact. They are objectionable. Improvement is desired. Moderately objectionable-improvement warranted? This is borderline four-five. I'm going to say a four on this one. No, let me keep it a five. Five for the RQR and the main reason; for the loss of predictability in the longitudinal axis during the flare. I think that is something we would require improvement on. And no, for the display question.

Exposure 8

DATE: 21Oct97

PILOT: A

TASK: 3011

CARD: Composite Flight Director Tracking Task

Okay for the longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also based on performance. Now the first time we did this it bombed and that was interesting, the exact maneuver repeated itself the second time. And the first time there is no pause between the level, descend, and the level right turn and then a pull up and there is no pause and I overcontrolled that correction to keep it within the inner circle. It set up an undamped response and I think maybe the increasing or the undamped motions back and forth exceeded its capability of the motion base. I don't think I put in an abrupt enough maneuver on its own to cause the motion to go off. So I'm going to kind of disregard that as an aberration and look at the last two which were basically averaged out to be 95% in the inner circle, which gives it the high ratings. However if we go to the ride quality ratings, CIR first; Number one is not true. Number two; intentionally modifies control inputs that is true for a two, that's correct. Impacts voluntary control inputs, No. I'd say a two. So a CIR of two. For the ride quality; vibrations do impact. They are perceptible and objectionable. They are more than mildly objectionable. For this task it's going to be a four. Improvement will be warranted but for this particular task you don't get into a situation where I feel like they are highly objectionable. This task is not exposed to the high gain flare maneuvers where you want to have predictable response. And No, for the display question.

Exposure 11

DATE : 05NOV97

PILOT: B

TASK : 1011
CARD: Nominal Approach and Landing Task

Reading exposure eleven, is it? Yeah, this is the straight in landing ILS approach longitudinal Cooper Harper, gee I guess we were getting desired to adequate performance. I have to give it, probably a two for the approach and a four for the actual landing. The Lateral-directional Cooper Harper, did not appear this maneuver was not extremely demanding lateral-directional. So, I'd have to give it probably a two for both the approach and the landing. The DASE CIR rating, I had to modify inputs in pitch anyway to keep from getting ... exciting structural modes, so, I'll call it a two and the DASE ride qualities; I would deem them moderately objectionable, a four. Yes we saw impacts on the display from the aeroelastics.

Exposure 11

DATE : 05NOV97
PILOT: B
TASK : 2011
CARD: Offset Landing Task

Exposure 11, side step approach, longitudinal Cooper Harper . We were not quite in all the desired boxes. We're landing a little long because of the bouncing and the vertical bouncing, primarily. I'll give the approach a three and a four for the landing. Lateral-directional Cooper Harper did not seem to produce major problems. I guess I would give it a three for the approach and landing. It did introduce some oscillations when you're aggressively using the lateral control to correct. So otherwise I would have rated it a little higher. I'd give it a DASE CIR rating of two and a ride quality of, probably four. Yes the displays were impacted.

Exposure 11

DATE : 05NOV97
PILOT: B
TASK : 3011
CARD: Flight Director Tracking Task

Exposure eleven, flight director tracking/capture, longitudinal Cooper Harper; I'd guess I'd have to say, it's probably a two and for the lateral-directional a three. We did get desired performance. The unpleasant deficiency is the large amount of oscillations you induce when you are aggressive on the lateral controls. The DASE CIR rating is a two and the ride quality would be a four. And the answer on the aeroelastic display perturbations; Yes.

Exposure 13

DATE: 12Nov97
PILOT: C
TASK: 1011
CARD: Nominal Approach and Landing

Okay this is exposure thirteen. Vibrations are predominately longitudinal in nature. The lateral-directional axes were well damped. Longitudinal was easily excited and relatively undamped. That predominately effected workload in the flare and touchdown. Didn't seem

to effect me a whole lot in the approach in terms of performance. We'll get into ride quality here in a second. So for the approach longitudinal, controllable, adequate, satisfactory, minimal pilot compensation, HQR of three. For the landing, for the approach rather, lateral-directional controllable, adequate, satisfactory. Same thing, HQR of three. For the landing, controllable, adequate, not satisfactory in terms of the longitudinal axis. Let's call it moderate pilot compensation, HQR of four. Lateral-directional was again level one. Controllable, adequate, satisfactory, minimal compensation, HQR of three. So let's see what did I say? Three, three, four, three. CIR, occasional involuntary inputs, longitudinal, CIR of four. Highly objectionable oscillations in the longitudinal axis, RQR of five. I think the fact that it's in one axis and not in the other really doesn't mitigate it. It's still highly objectionable. I didn't notice any display anomalies or perturbations. There may be a learning curve on this 'cause I was seeing this kind of stuff before and I'm not now. So may be that you accommodate to it. That concludes these comments.

Exposure 13

DATE: 12Nov97
PILOT: C
TASK: 2011
CARD: Lateral Offset Landing

Exposure 13, offset approach and landing. My difficulties occurred right around the area between 100 feet and touchdown. So I'm gonna give the same ratings for both approach and landing on this one. Longitudinal was a problem. It's controllable, adequate, not satisfactory. Considerable compensation for adequate performance, HQR of five. Lateral-directional, controllable, adequate, not satisfactory. Moderate pilot compensation, HQR of four. I figure the four as being task driven on lateral-directional. The five is being driven by the oscillations. I'm having to back off deliberately to keep from entering the loop of this thing. PIO is definitely an issue here. Occasional (in)voluntary inputs, CIR of four. Those are longitudinal in nature. Highly objectionable oscillations, RQR of five. No display impact. That concludes these comments.

Exposure 13

DATE: 12Nov97
PILOT: C
TASK: 3011
CARD: Composite Flight Director Tracking Task

Configuration thirteen, flight director tracking task. Longitudinal, controllable, adequate, not satisfactory, moderate compensation, HQR of four. Lateral-directional, controllable, adequate, is satisfactory, minimal compensation, HQR of three. Just working hard longitudinally because of the oscillations and that was driven by the oscillations. It's a fairly easy task. CIR, three. Didn't notice any involuntary inputs but it did impact the precision and RQR of five. Highly objectionable oscillations. No display impact. That concludes these comments.

Exposure 07

DATE: 17Nov97
PILOT: D
TASK: 1011

CARD: Nominal Approach and Landing

These are pilot comments for Exposure 7, Nominal Approach. Okay on the approach: Longitudinal, no. It kept the desired performance but the ... most of the problem again was in longitudinal and four for the longitudinal on the approach. Satisfactory without improvement for lat/dir.? I'd say yes and a three. So four and three on the approach for longitudinal lateral-directional. For landing part: Longitudinal adequate performance obtainable? Yes. Satisfactory without improvement? No. I made a couple of really good saves there but I tell you there's a little disconnected feeling that's very troubling on that one and at least a couple of them were long, one of them was a little firm and so on. I think five is about the best I can give one that had that much of a problem in pitch. On the other hand the lat/dir.: Satisfactory without improvement? Four and I was working hard enough in pitch that I let the lat/dir. get off and yet when I wanted to get back I could get it back in to the desired when we were fairly close to the ground. Most of the problem ...well the difficulty was in pitch primarily. Okay, CIR: Vibrations impacting precision? Probably not but I sure was changing especially in pitch so CIR of two and RQR of three or four and mildly objectionable. No it was more than that ... four, RQR four and display no, didn't consciously notice anything.

Exposure 07

DATE: 17Nov97
PILOT: D
TASK: 2011
CARD: Composite Flight Director Tracking Task

These are comments on the offset landing for exposure 7. Okay for the approach, two of the three worked out well, in the last run I think I was a little hesitant getting over there, I don't think the handling qualities changed as much as the technique that I was using when I started so ... actually though I ended up getting where I wanted and didn't have a lot of coupling and much of a problem, I give both fours. Longitudinal and lateral-directional, four for the approach. Longitudinal for landing: Adequate performance? Yes. Satisfactory without improvement? No and all of them I think were a little firm and a little bit long. When I get down in there I'm kind of surprised, I'm getting quite a feel as though I'm having quite a spread. Sometimes I hurry to touchdown a little bit and that's where part of the firmness is coming. I'm kind of surprised when the wheels touch, even now and I know what it should look like when we get turbulence going like this, I'm sometimes surprised at it. Longitudinal then, five. Lat/dir., I think was in there every time, I can probably give the lat/dir. a four on that, yeah. And CIR, I'd say two on the CIR and three on the RQR and display, no.

Exposure 07

DATE: 17Nov97
PILOT: D
TASK: 3011
CARD: Composite Flight Director Tracking Task

Okay, comments on the flight director task for exposure 7. Okay, longitudinal, adequate performance? Certainly. Satisfactory without improvement? From just the control point of view ... well, I can't bring myself to do better than a four on that. Four for longitudinal. Although I got adequate in lat/dir. the work load was probably more than considerable on

that, so that's one of those that's, you know, it's tough to get desired and would be easy to get adequate so I'm going to give it a five just because it was pretty bad. An aside and it will probably come out down here in ride quality, it's hard to judge just the flying qualities because the ride control is just terrible. So, even though I am getting the performance out of it and actually it is not that difficult to get the performance because I'm being beat around I'm having a hard time really giving it good grades because I don't like the way it rides or feels. What that does is gives you a little more anxiety, almost you expect it to be worse then it really shows up to be. So it kind of contaminates your opinion of it, certainly. Okay ... CIR ... two but when we get to RQR over here that would have to be improved. I'm going to give it five on RQR on that ... that was awful. Yeah, I did see them move around. Its kind of hard for me to tell if I see that ... when you're close to the ground you can see when it's the display versus the airplane. When it's up against the sky its kind of hard to tell whether that's the airplane moving or the display not following. So its a little harder to see up there. I did see it move around, what I suspect was moving around but as far as whether it hurt my ability to fly precisely I'd have to say no but that's a tough call on that particular one. It's easy to tell when you are down close to the ground, on the one up, in a way it's tough.

Exposure 8

DATE: 03Dec97

PILOT: E

TASK: 1011

CARD: Nominal Approach and Landing

This is Exposure 8, Nominal Approach and Landing. I guess a first comment that I would make is that still at around 150 feet there is a tendency to start drifting high and shifting the aim point down the runway, naturally, if I touch nothing and the flight path vector stays on the three degree gamma line. The other thing is if I think as I pick up more things from the display here, it does bother me a little bit as I'm tracking in that my gamma, even though it does not change, it stays at three degrees, it shifts along the ground. That was a little bit distracting. I've seen this before on other runs, I don't know why it was more distracting. I'm just starting to pick up more things on the HUD as I'm getting more used to it on this particular display. Anyway, the other thing I was going to mention, this may have affected the last couple of runs but I notice that the flare cue that comes up is very useful. I notice on the first run that I did, I had a tendency and it may be because close in I'm trying to correct for at least my perception of us starting to balloon or go high at about 150 feet. I start making corrections and maybe I wasn't picking things up and I had a real tendency to start flaring early and I notice that because I was flaring before the third cue really got to me. In the second run I was very ... I made a point to wait until the flare cue got up to me before I started flaring. When I did that I got the results that I was expecting to get. It may have something to do with carrying energy through the flare maneuver in the difference when you start flaring a little bit high or whatever. Anyway, I think that might have influenced the last couple runs for me and maybe that is what I was not picking up. For the intercept and the approach phase, I don't like the bouncing around but I don't know that it requires moderate pilot compensation. Got desired performance, I'm going to go three and a three. For the landing task we did get desired performance the second time around. With all the bouncing around and everything, I'm going to go with a four and a four. For the CIR, I'm going to ... again, I don't think I got any involuntary inputs that time but it certainly did effect the precision and I really don't like the galloping kind of motion that we get going down finals sometimes so, I'm going to go with a three. For the ride quality, I would be at a the four and a half I think but if we're going to insist on an integer rating here,

I think I'm going to go with a five. I don't think that the display impacts the ability to do the task here but there are things about the display that I don't like and that I think could present a problem operationally and there are things like the flight path vector when its set at a given gamma drifting along the ground rather than showing the impact point that you would hit if you continued down that glide path. Anyway, I'm going to say no for that.

Exposure 8

DATE: 03Dec97
PILOT: E
TASK: 2011
CARD: Lateral Offset Landing

This is Exposure 8, Lateral Offset Landing. I guess one thing that I ... this is a perception but it appears that how aggressive I am in taking a cut in roll, after a certain point there appears to be a little bit of a cliff that you really start getting banged around. When you start getting banged around that starts reducing the predictability some. We did get desired performance on the third run that we did ... I definitely guess it was in the four to five range. I guess the question is, was it more than moderate pilot compensation and was it annoying verses an objectionable deficiency? I guess I'm going to go with a five here, simply because the predictability that the task requires ... I don't know. I'm having a real hard time here in ... I know you guys want integer readings but I also don't believe in splitting between four and five or doing a half rating there because there is a difference between desired and adequate performance. I guess the problem that I'm having is that it is very dependent on the initial cut and if I reduce my gain a fair amount and I make the cut right the first time then things work out pretty well. If I take in ... mess up that initial cut then I have to use more aggressive inputs, I end up not getting the performance that I want. Anyway, I'm going to go with a five and a five for the approach and landing, I guess and with the noted comments. As far as the CIR goes, I don't think there were any involuntary inputs so I'm going to go with a three. For the ride quality, especially close to the ground, I'm kind of in the four and half range again and I think I'm going to go with the five, just because if I go over that little perceived cliff that I was talking about I don't like it. I also don't like the galloping motion that we get on final sometimes. As far as the display goes, I'm going to say no with the same noted previous comments.

Exposure 8

DATE: 03Dec97
PILOT: E
TASK: 3011
CARD: Composite Flight Director Tracking Task

Pilot E, Exposure eight, Configuration eleven, Flight Director Tracking Task. Okay, I guess my first comment would be we can excite some modes and really kind of get it banging with some smaller but abrupt pitch inputs that makes predictability suffer in the task when we did that. We still got desired performance, it's definitely annoying. So, I guess I would go with a four and a four, for longitudinal and lateral. I don't think I got any involuntary inputs although, it's real close to it. If we were going to do half ratings, I would probably be in the three and a half for the control inputs. I guess I'm going to go with a three. For ride quality for this task again, I think I might be in the four and a half range but I'm going to go with a five here simply because for this task I think the ride quality is not acceptable and the inputs that we are getting, or the perturbations we are getting in pitch are ... would

need to be improved. Then with the same caveats before that we talked about on the display, I'm going to say no effect.

Exposure 19

DATE : 10Dec97
PILOT: F
TASK : 1011
CARD: Nominal Approach and Landing Task

Okay, Pilot F on exposure nineteen the straight in task. It was very lightly damped in pitch. Laterally it had quite a bit of damping even though the ride quality is really not acceptable longitudinally. Pilot ratings though, for the approach, ah shoot, longitudinal approach, I think deficiencies require improvement. Let's give it a seven. Okay, laterally for the approach, for the straight in task in particular, there's really not much to do, let's give it a four. For the landing, longitudinally, it's very bad so it's at least a seven. That's an easy call there. Because I even had to back out of control on the flare. Lateral, let's give it a four, again. Okay, then we've got this DASE rating too, Randy. Have you seen that yet? Yep. So I'm going to give it a DASE control rating first. And it's a three, you know, in all this stuff I haven't felt anything that's a four, you know, that occasionally gives me involuntary control inputs at least that I'm aware of, Randy, but had a lot of three's and I would call this one a three on the control. And for the ride quality, I would say it's a five. And for the display, they just want a yes or a no. I'm going to say yes and then I usually write down QSAE. There are two effects on the display, there's this sag, you know, that I pointed out and then there's the fact that it bounces. And so it's the QSAE mostly that I'm giving the yes. The little bit of bouncing doesn't bother me too much. I've gotten use to it.

Exposure 19

DATE : 10Dec97
PILOT: F
TASK: 2011
CARD: Lateral Offset Landing

Okay, Pilot F on the offset task, for exposure nineteen. We had just two runs there. The first run, I didn't seem to get much inadvertent coupling from lateral into pitch as I expected whereas on the second run I did. So the thing is pretty much as I expected it to be after having tested the vehicle on the long straight in. Pilot ratings, approach, let's give it a seven and now the lateral includes the offset and ... Gosh all mighty, what do I do now. I've got to back off on the lateral, to not hurt the longitudinal. Do I do the lateral or the longitudinal? Okay, laterally I've got a ... let's give it a six. You really have to be pretty careful laterally. The longitudinal is impacting the lateral. I don't know how to rate that. In any case we'll give it a six due to the coupling. Into the longitudinal, okay landing is definitely a seven, longitudinal. Lateral is not too bad as long as I'm set up. Yeah but no, no, no. For the landing here because I'm usually not set up well enough, let's down rate it, let's give it a six too because I'm still working. Okay, the ratings, let's give it a three for the control. The ride is a five and the display is a yes but mostly QSAE. Okay.

Exposure 19

DATE : 10Dec97
PILOT: F

TASK: 3011

CARD: Composite Flight Director Tracking Task

Okay, Pilot F, pilot ratings on the flight director task. And again the task is ... your performance is kind of tied to how well you guess what's coming next. But with the fairly high damping in the lateral modes, the task is really not too tough. Longitudinally, let's give it a, you know the dog gone ride isn't all that bad there, didn't seem like, did it? Nay, its still whacking around, let's give it a seven, longitudinally. No, I wasn't working that hard. Is adequate performance attainable with tolerable pilot workload? Yes, let's give it a six here. Okay, laterally, it's a pretty tough task. You know, the band pass of that thing is just a little bit more than the airplane's got, if you want to keep it in the little circle. Let's make it a six. And the DASE ratings are, control is a three, a five and no. Copy, Bruce, six, six, three, five, no.

Configuration 12 Modal damping increased to 0.07 for modes 1 - 4, damp6

Exposure 7

DATE: 21Oct97

PILOT: A

TASK: 1012

CARD: Nominal Approach and Landing

We'll look at the approach, longitudinal Cooper Harper rating. Was the task controllable? Yes it was. Adequate performance was attainable. Satisfactory without improvement? Yes, for a Cooper Harper of three. The longitudinal axis is very susceptible to ASE motions if you make any time of abrupt, low to medium amplitude input with the side arm controller, you get a pretty significant ASE motion of a couple of Hz and the first time we did a little doublet on the first approach, we put the motion base out of whack. So it definitely is pretty active in the longitudinal axis. Similarly the lateral axis also with any type of a side arm controller input of a moderately abrupt nature will cause about a one to two oscillation, about one to two Hz response in the ... ASE response which is pretty abrupt also. However if you do rudder doublets, it's not nearly as abrupt. So it's more of a flaperon type input, either longitudinal or lateral that causes problems. For the lateral rating for the approach; It was controllable, yes it was. Adequate performance was attainable. Satisfactory without improvement? Yes for a three. The landing rating for the longitudinal; Controllable? Yes. Adequate performance was attainable? Yes. Satisfactory without improvement? No, a Cooper Harper of four. Met desired criteria but with a little bit of workload and borderline desired-adequate performance. And this is partly due to ... I'm a little reluctant to make fairly abrupt inputs longitudinally and also when you do make inputs it does tend to kind of overshoot the desired input. If you excite the aeroelastic frequencies, it will tend to kind of exacerbate the input. So you have to be very gentle with the inputs. Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I'll make that a four also. Similarly I am reluctant to make aggressive inputs laterally. For the CIR rating; Pilot does not alter control inputs. That's not true. Pilot intentionally modifies control inputs to avoid excitation. That is true. Cockpit vibrations impact precision of voluntary control inputs. I would say yes and give this a three. This is, I think, the worst configuration I have seen because of both axes, it's bad. And we've seen some that were bad in the longitudinal axis or the lateral axis but this has dual badness. (Do you agree with the statement that vibrations in the cockpit effect precision?) Yea, and I think in the flare that's true. I think a couple of times it would tend to over ... I would make an input that I want, a small subtle input and it would over do it. If I made especially an abrupt even though a small amplitude input, the ASE motions would tend to make a larger amplitude than I had asked for. I have not seen that so far. RQR, vibrations do not impact ride qualities, not true. Vibrations perceptible but not objectionable, not true. Vibrations are mildly objectionable, not true. Vibrations are moderately objectionable, improvement warranted. No, I am going to go with five; vibrations are highly objectionable, improvement required and the reason being, this to me is first configuration that I've seen that basically, I feel like if I make a motion this configuration will tend to over do it. So that I don't feel like I'm in total ... I don't have the total ability to make very subtle corrections. Before if I could make a very small amplitude input, I didn't seem to feel like it would over control it but this time I feel like the configuration is doing extra things, I'm not asking for. So we'll go a five on that. And my feeling is that this is the worst configuration I have seen to date. No problems with display perturbations.

Exposure 7

DATE: 21Oct97
PILOT: A
TASK: 2012
CARD: Lateral Offset Landing

Okay longitudinal Cooper Harper rating for the approach; No real differences in the comments made for the straight in. So we'll go ahead and dispense with the time ... Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Similarly for the lateral; no comments any different than for the straight in and this is for the point up to the correction. Is it controllable? Yes. Adequate? Yes. Satisfactory? Yes. Three. So a three and three. For the landing, both for the longitudinal and lateral axis are again the ASE modes are excited with inputs in either one of those axis. I was fairly aggressive laterally and just went ahead and accepted the motions. I was more reluctant longitudinally to do anything too aggressive. For the longitudinal rating; It was controllable? Yes it was. Adequate performance attainable? That's true. Satisfactory without improvement? No. Basically met the adequate criteria for the landing and the workload was; minor objectionable. That's true. Considerable compensation. That's true also. Let's give it a five for longitudinal. For the lateral landing rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. We will rate that a four, desired but barely and workload was a factor. For the CIR; Pilot does not alter control inputs. That's not true. Intentionally modifies control inputs to avoid excitation. That is true. Cockpit vibrations impact precision of voluntary control inputs. I'll say a three. This is kind of borderline two-three as I rated it on the straight in approach configuration but I think in a subtle way especially longitudinally it tends to effect my precision in that I'm both reluctant to make an aggressive input and if I do make an input, sometimes it is unpredictable in how much response I'll get. So I think that tends to make it kind of a three in this rating. For the ride quality; Number one, that's not true. Number two, vibrations are perceptible but not objectionable, not true. Mildly objectionable, not true. We are going to four, vibrations are moderately objectionable, improvement warranted. I am going to go with five. We really need to improve this one. This would be unacceptable as far as I can tell because it does tend to influence the controllability of the aircraft and again this configuration is the first one where it really felt it did tend to influence my controllability. And the display question, not a factor.

Exposure 7

DATE: 21Oct97
PILOT: A
TASK: 3012
CARD: Composite Flight Director Tracking Task

Okay this is the Cooper Harper's for the flight director tracking assignment, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes for a three. This task for me across all the configurations is easier longitudinally than laterally. A couple of points here, on this last one, I noticed at times there is pause, a distinct pause, between say a level flight turn input and then a pure pitch input. At other times there is no pause, and so I think that you might want to double check these different random configurations you put in there. Some of them are truly harder to fly than others and it would be nice if they were all the same level of difficulty. At any rate, longitudinally, even though we had this bad longitudinal configuration, it's just not a difficult longitudinal task.

To me it is much more difficult laterally. Part of the problem is, it's difficult to actually command a lateral rate. The lateral axis controller is much better than it was but it still seems like it's difficult to purely command a lateral rate either because it's difficult to command a bank angle or commanding a lateral rate is harder than a pure pitch rate. At any rate, for the lateral Cooper Harper; Controllable? Yes. Adequate? Yes. Satisfactory? No. I did meet the desired criteria pretty handily so I can't give it anything worse than a four. But, it will be a four and I did have to modify my inputs to be a little bit less aggressive to avoid exciting some bad modes. CIR; I would rate this a two this time. I didn't seem to have the problem in the flare. This task, even though it is high gain, it is not quite as high gain as the flare task and therefore I did not feel that the vibrations impacted the precision of my controls. Let's go with a two for CIR. And for RQR, I would rate this a four, improvements warranted but for this task, I really don't think that improvement would be required. This would fall more into lines with the previous configurations which I thought were kind of bad. In this particular task it didn't show up as bad on the RQR. And display question, not a factor.

Exposure 17

DATE : 05NOV97
PILOT: B
TASK : 1012
CARD: Nominal Approach and Landing Task

This is exposure number seventeen, straight in landing approach. Longitudinal Cooper Harper is generally adequate I guess. I'd say we're talking, during the approach, actually it was desired during the approach wasn't it? (Yes). Probably a three during the approach and a five during the touchdown. The Lateral-directional was a two during the approach. Those were all in desired limits were they? Okay, we'll give it a three for lateral-directional landing. The DASE CIR rating, definitely a ... I believe a three. And a five for the ride quality and a yes for the displays.

Exposure 17

DATE : 05NOV97
PILOT: B
TASK : 2012
CARD: Offset Landing Task

Exposure seventeen, the side step approach. Cooper Harper ratings, longitudinal, the approach was generally adequate. The approach desired, okay. Guess we'd have to call it a three then. Adequate landing, I guess a five. Lateral-directional Cooper Harper, that was adequate approach or desired approach? (Desired). Desired approach, a two. Cooper Harper for the landing was also, basically, is that desired or... (One was just outside and one was inside.) Call it a four. Four for landing. Lateral. DASE CIR rating, a three and ride quality, definitely a five. A yes on the last question.

Exposure 17

DATE : 05NOV97
PILOT: B
TASK : 3012
CARD: Flight Director Tracking Task

Exposure seventeen, flight director tracking and capturing. Longitudinal Cooper Harper actually was not a big problem, that was desired. I'd guess I'd call that a two and the lateral-directional a three. DASE CIR ratings, believe we'll call that a three and the ride quality a five. And yes the visual displays were impacted.

Exposure 18

DATE: 13Nov97
PILOT: C
TASK: 1012
CARD: Nominal Approach and Landing

This is Pilot C, exposure number eighteen. Okay, ILS offset approach to a straight in landing. Vibrations were slightly objectionable. Didn't overly impact performance. I would like to see the number on that though, on that last one. It may be too late. I'm gonna assume that it might have been a little bit long but the rest of them were desired. On the approach, clearly level one. Controllable, adequate, satisfactory, minimal compensation both axes. Let's give it a three and a three for approach. For landing, the lateral-directional axis was the same thing. Minimal compensation, not much of a problem with line-up. Longitudinal though, again, I'm working a little bit and there may be some interplay with the vibrations, so I'm gonna give that a four. So for landing it's a four and a three. CIR is two in that I'm deliberately modifying the control inputs down low to avoid exciting the vibration. RQR is five down low. Highly objectionable vibrations. No display impact. That concludes these comments.

Exposure 18

DATE: 13Nov97
PILOT: C
TASK: 2012
CARD: Lateral Offset Landing

Okay, this is exposure eighteen, this is the offset approach and landing. Very, very difficult task with the vibrations. Again, the approach and landing I kind of merge into phase 'cause the problems start at 100 feet and pretty much last 'til touchdown. Difficulties both in lateral-directional and longitudinal. The longitudinal was a little bit more difficult but I'm gonna give them basically the ratings. Clearly level two, it's controllable, adequate performance is attainable with a tolerable workload. However, requires considerable pilot compensation for adequate performance. So, let's give it a five, a five, a five, and a five. CIR, occasional involuntary inputs, CIR of four. Highly objectionable vibrations, RQR of five and I did get a display impact that time. The display was moving around as well and that impacted the ease of precision in the task, so that's a yes. That concludes these comments.

Exposure 18

DATE: 13Nov97
PILOT: C
TASK: 3012
CARD: Composite Flight Director Tracking Task

Okay, exposure eighteen, flight director tracking and capture. Clearly level one longitudinally, very responsive despite the oscillations. Although there were occasional inadvertent inputs and a slight degradation of precision, nothing that bumped me out of desired. Lateral-directional was challenging as it has been. Primarily just to the amount of time it takes to get the flight director sluing to the left or right and the rate at which the flight director starts moving. So, I'm gonna give it a three in longitudinal. Minimal compensation and a level one performance and a four in lateral-directional. Moderately compensation for desired performance. DASE, occasional involuntary inputs. Let's give it a four with the very aggressive inputs anyway. Vibrations, RQR of five. No display impact. That concludes these comments.

Exposure 17

DATE: 18Nov97

PILOT: D

TASK: 1012

CARD: Nominal Approach and Landing

The date is November 18th, '97. The pilot is Pilot D. This is a continuation of comments for today. This is tape number two for this day. Pilot D, exposure seventeen, nominal approach and landing. Okay, approach is .., there's a lot more of what felt like turbulence throughout the whole thing. Satisfactory without improvement. For the pitch I'll have to say no and commend four. It took definitely, moderately pilot compensation to keep that in the desired. Even, it sneaked out once or twice so it was at least moderate when I took my attention away from it for a moment. Lat Dir., is a three. So four and three for approach, longitudinal Lat. Dir. For the landing, adequate performance was attainable on all but one. In fact, the thing that's happening, I'm a little hesitant to make any large pitch change close to the ground. And if I'm not flared, I know that if I catch it then it's even gonna hit harder. So I kind of accept a harder than normal landing. Definitely not satisfactory without improvement. Having a spread of adequate, inadequate and desired throughout there just shows, I can't consistently do the desired for sure. At best I could do would be a six on the pitch. On the Lat. Dir. for that one I was even out on that one. I feel kind of bad about it. I did have only adequate on line-up on one of them because I was working so hard in pitch. I'll leave it with a five. So six and five for longitudinal and Lat. Dir. in the landing. On the CIR, I'll say three. RQR four. Displays I'll say no. I could see it moving around but I don't think that it effected the precision.

Exposure 17

DATE: 18Nov97

PILOT: D

TASK: 2012

CARD: Lateral Offset Landing

Pilot D, exposure seventeen, offset landing. Okay, for the approach. Well these are all looking pretty similar. Satisfactory without improvement? I'd say no. I'm sure it's desired on all of them. Put it pretty much where I wanted. Four for the approach and longitudinal and Lat. Dir., both four. For the landing. Adequate performance attainable? Yes. Satisfactory without improvement? No. I'm gonna turn it over and the best I could consistently do would be adequate performance. I guess I'll go with considerable pilot

compensation in longitudinal that time. Lat. Dir. the same, five and five on the landing part. For CIR, three. RQR four. Display? No.

Exposure 17

DATE: 18Nov97

PILOT: D

TASK: 3012

CARD: Composite Flight Director Tracking Task

Pilot D, exposure seventeen, flight director tracking. Okay, well, the accuracy and ability to fly precisely is certainly there. Very uncomfortable, but certainly could do well into desired. As far as the accuracy and all go, it's there but it's taking at least moderate pilot compensation, particularly in roll. So, that would be a four. In pitch, I'll give it a four there also. So four and four for longitudinal/ lateral-directional. Three for CIR. RQR, I think we're getting up to improvement required. I think I'm gonna have to go with a five. We were getting some really strong shaking left and right. When I put in the inputs necessary to keep the really high desired performance. Displays, no.

Exposure 7

DATE: 03Dec97

PILOT: E

TASK: 1012

CARD: Nominal Approach and Landing

Okay, again in the flare, I am having a hard time with predictability of the touchdown point. I tried a different couple of techniques including ones where we've broken the decent rate pulling power back. For some reason, I'm still having a hard time with predictability of touchdown point. It could be a function of the configuration or it could be a function of some technique that I've picked up here that I am not aware of. I'm not sure which. It doesn't seem that hard to fly. I'm just not getting it to do exactly what I want it to do as far as touchdown dispersion goes. I did have to back off on my gains some as far as lateral tracking goes here. I have a tendency to put in small inputs. We are seeing split flight path vector cue in gamma, on final around one hundred fifty feet. We got adequate performance which will, well first of all for the intercept and approach phase, I'm going to say it's a three and a three. You do have to back off on your gains a little bit otherwise you do kind of excite some modes and get bounced around a little bit more. And my perception is that I can excite it in pitch and roll here. For the landing phase, I'm going to go with a five and a five. Actually for this particular task, it's slightly more difficult in predictability as far as longitudinal control goes but I felt like I had to back off on my gain more laterally than I did in pitch. Going down to control inceptors, I don't think I got any involuntary control inputs so I'm going to give it a three. And for ride quality, I might be between a four and a five. I really don't like that gallopy motion that we get on final. I would probably go with a four and a half, if I could do a half rating but if I have to pick one I'm going to go with a four, I guess. And I'm going to go ... Again the predictability problem leads me to kind of hedge on the display issue but I can't put my finger on it and I'm not so sure that it's not a technique that I've picked up in the last couple of runs here. So I'm going to say no for the display.

Exposure 7

DATE: 03Dec97
PILOT: E
TASK: 2012
CARD: Lateral Offset Landing

This is Exposure 7, The Lateral Offset Landing. A couple comments first off, one is when we get the split in gamma down near the flare I think that is affecting us, first of all I think there is a lag in that indication. I think there is some breakout before that occurs where you do have a difference between the two. I don't know what that value is but I think all of that may be effecting the predictability and the flare. The other thing is when you get a split in gamma it takes a little bit of time for the pilot to recognize the split and determine what he needs to do because of that split. The recognition time there is a little bit longer than normal. The other thing is if you took the flight path vector away and ... you know ... this offset landing task and the tracking task are a lot like a video game. I guess my point is that I can see myself in trying to get all the parameters in the box using the flight path vector a lot and if I just flew the airplane with a basic airspeed altitude, pitch and power kind of display, even though it's backside, I'm not so sure ... I guess my point is that without the flight path vector and the other cues around the display and the cueing that we have here with the visual, I'm not sure what kind of results we would get. That's just a side comment. Looking at the approach and landing task here, we did get adequate performance a couple times there. The last try I tried turning up my gain a lot and that didn't work very well. We got bounced around pretty good and predictability suffered a lot. I guess for the other runs though, I guess I would probably put it in the five range. So, lets go five and five for longitudinal and lateral direction for both approach and landing. For the CIR, I guess ...we're on the verge of, I think, this time getting some involuntary inputs but I'm still going with the three because I'm not sure that we got any involuntary inputs but it certainly impacts the precision and particularly I'm quite ginger in roll and I don't like the galloping that develops in pitch. For the ride quality, I would probably be in the 4 and a half range, for the offset landing task, I guess I'm going with a five here for the offset landing task. I really don't like some of the bouncing around that we get. Predictability really does seem to suffer, for me at least with the motion that we are getting. For the display I'm going to say no. I'm going to make a caveat on that note for the display in that related to the comment I made about this being like a video game and we really have all these parameters set up that we're doing and without the flight path vector and everything else ... just if I had to use the display or if I had to rely on visual queuing that I would get in a normal airplane with a HUD with a flight path vector when I'm closer to ground doing a precision task like this. I am not so sure I would get the same normal cueing.

Exposure 7

DATE: 03Dec97
PILOT: E
TASK: 3012
CARD: Composite Flight Director Tracking Task

This is Exposure 7, Flight Director Tracking Task. Actually here, I thought I saw myself exciting in pitch, more than I did in roll. We did get desired performance ... we did bomb the motion off though too. We were getting bounced around pretty good. I guess I am going to go with a four and a four for lateral and longitudinal for the task. Control inputs, I don't think we had any involuntary but I'm going with a three because it did effect the ability to precisely track. For this task, I'm going with a four on the vibration. I would actually probably be in the four and half range but if I have to go with an integer I'd

probably go with a four. With the same caveat, as in the past, under display I'm going to say no.

Exposure 6

DATE : 09Dec97

PILOT: F

TASK : 1012

CARD: Nominal Approach and Landing Task

Okay, pilot comments, pilot F, exposure six, nominal approach and landing. Okay, exposure six, this is the straight in. And the approach, just a general comment, this is a kind of flexible one, and it's a little bit different from what I have seen before. It seems like the control activity was exciting the structural modes more than the turbulence. That may or may not be the case but that was my impression at least. First impression. And also a general comment, for sharp control inputs it's really pretty bad but for smooth inputs not too much problem on this task. We'll obviously see that exercise more later here. But for the straight in task, the approach, both longitudinal and lateral, I'm going to give it a ... well it's kind of borderline four, five. I give it kind of a four because of just the fact that it's a raw data approach but the ride quality's bad enough, let's make it a five. Just based on ride quality primarily. You really have to back off on the control just a little bit to smooth it out. Okay, landing, longitudinal, same old problem trying to get it into the box. So let's give it a five and that kind of those along with the ride. So it's the box and the ride. And lateral, not much for performance problem and I don't think I really had much of lateral excitation problem there but let's give it a five just for general purposes, huh! Okay. Yes, I gave it all five's. And both a mixture of ride quality and performance. Kind of a overriding ride quality one but the performance is kind of up there on some of the tasks. Okay, control for DASE is kind of a borderline two, three but let's give it a two. I don't think I was getting... I don't think I was impacting the precision too much as long as I was smooth for this task. The ride quality, it's a borderline three, four. Naw, I would say let's give it a four for sure. It definitely needs fixing. And the display let's give it, yes there was some impact but it was mostly QSAE. The vibrations didn't bother me.

Exposure 6

DATE : 09Dec97

PILOT: F

TASK: 2012

CARD: Lateral Offset Landing

Okay, pilot comments, exposure six, lateral offset landing. Okay, Pilot F rating the offset for exposure six, the approach which takes us down to fifty feet. Let me just make some general comments configuration again. It's a pretty rough ride as noted above. And I think the thing I really noted here was that even trying to make smooth inputs on the lateral offset task, I just wasn't able to keep from exciting the lateral structural modes. So try as I could, we were still getting a very rough ride laterally. Okay, pilot ratings, approach, longitudinally, it's not too bad. Let's just give it a five based on the ride quality. The lateral is, now this takes us through the correction, doesn't it? So (yes) which I'm not used to. Yeah yeah. Very objectionable but tolerable. I want to give it a six but with the comment that it ... you're not going to buy an airplane like this. The deficiencies warrant improvement. But it's still flyable. Shoot let's give it a seven. Because deficiencies do require improvement not for control handling but just for the fact that the airplane is whacking around so much. Let's

give it a seven based on ride quality. Okay, landing, longitudinal again not too bad. Let's give it a five. And lateral, I was still whacking around trying to recover from my offset so let's give it a seven again. Okay and again this is the ride. We were doing okay on the performance. The DASE, the control, let's give it a three, during that lateral offset, I almost had a little trouble holding on to the controller. Well, it was just kind of banging around. Just difficult to make smooth inputs, you know. Okay, and the ride, I'm going to give it a five. And the display, yes! It was impacted and this time not just the QSAE, but the back that during the lateral offset, things were really whopping around there. So both DASE and QSAE. No, no the HUD symbology. Just hard to focus everything because it was swishing around so fast.

Exposure 6

DATE : 09Dec97

PILOT: F

TASK: 3012

CARD: Composite Flight Director Tracking Task

Okay, exposure six, flight director tracking task, pilot F. Okay, pilot ratings on exposure six for the flight director task and again the performance is always so dependent on how well you can guess on what part of the task is coming next. In any case, though the performance is all desired. Longitudinally it's not as bad as it is laterally. Yeah let's give it a five again. Primarily because of ride. And laterally, again the band pass of the control system just can't keep up unless you can guess what's coming next. And the ride quality really gets crummy. In fact it's crummy to the point that I think that it requires improvement. Let's make it a seven again for ride. Definitely not control. Okay for the DASE, the control, not as bad here. I think it's a two. The ride quality, I still think it's a five and the display; I didn't really notice anything this time. So, no!

Configuration 13 Modal damping increased to 0.15 for modes 1 - 4, damp7

Exposure 14

DATE: 22Oct97
PILOT: A
TASK: 1013
CARD: Nominal Approach and Landing

Okay exposure 14, straight-in approach and landing, approach, longitudinal rating; Cooper Harper, task was controllable. Adequate performance was attainable. Satisfactory without improvement? No. It's borderline desired-adequate, I'm going to rate it a Cooper Harper four however because I think the problem is I'm still getting warmed up a little bit. It's right on the border. I had one very nice solid desired and the other three were just right on the borderline so we're going to go ahead and give it the benefit of the doubt. I'm sorry I'm confusing here the ... that was the landing rating. I jumped ahead, we'll come back to the approach rating. So a four for the longitudinal landing rating. For the longitudinal approach rating, It was controllable, adequate performance was attainable. Satisfactory without improvement? Yes. Cooper Harper of three. There were ASE motions in the longitudinal axis that were damped, not well damped, not lightly damped, kind of moderately damped. I was getting about three overshoots with a moderate large amplitude response from a pitch doublet. The lateral response was similarly three overshoots with moderate amplitude. Rudder doublets resulted in no real large ASE excursions, kind of a slow delay in low frequency response with very low amplitude. The lateral rating for the approach; Controllable? Yes. Adequate performance was attainable. That's true. Satisfactory? Yes for a three. Again with the control laws that we have, even though we have ASE problems, pretty much close to hands off. There are some excursions through the turbulence. You have to get into the loop which then pretty much makes it automatically a three. For the lateral landing rating; Controllable? Yes. Adequate? Yes. Satisfactory? No due to workload. It'll be a four, minor but annoying deficiencies. Mainly, inability to maintain the desired track down the runway requiring moderate compensation for the pilot for the lateral task. So a three, three for approach. Four, four for landing. For the CIR; pilot does not alter control inputs as a result of flexibility. No. Number two; pilot intentionally modifies ... probably two. I didn't hold back a lot but I didn't want to excite that longitudinal mode so I'm very subtly maybe holding back a little bit. So it's probably a borderline one-two, we'll kind of call it a two. For the ride quality; Number one's not true. Number two no they are objectionable. Number three, for that particular straight-in ... I'd say it's borderline three-four and we'll go with a four on that. And the display answer is no.

Exposure 14

DATE: 22Oct97
PILOT: A
TASK: 2013
CARD: Lateral Offset Landing

Again exposure 14 off-set approach and landing, pilot ratings. The approach segment for the off-set longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Comments for the straight-in apply. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. For the approach rating again same comments as for the straight-in. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory

without improvement? No. I am going to rate it a four however. Met desired criteria pretty handily on the second one and very close on the first one. And not too bad over all. Lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. Workload makes that a four, mostly due to the task. So comments here, this is a fairly well damped configuration and even though I have moderate amplitude ASE related motions. Because it's damped, you know you're going to get one on the first turn into correct. I'm very aggressive on that. I've not at all changed my aggressiveness laterally. I go ahead and make the one motion ... I don't do it real abruptly. If you do it real abruptly, you get a larger ASE response. I'm still not tailoring my motions too much. I did about what I would do anyway. You get one excursion that's damped out, then on you're corrective heading, you make a turn back to the right. You get another ASE motion. It damps out and then you're setting up for the flare. Probably just slightly careful in the flare so I don't excite any kind of longitudinal motion but again because it is fairly well damped it's not as bad. So generally I think what I'm seeing is that the better damped ... I will accept a larger motion if it is well damped. The CIR; Number one, does not alter control inputs? No, just the way I explained that, it probably is not true. Number two? Yes and it is not really lateral, more longitudinal and that's really in the flare. And that is that very precise high gain task where you don't want to take a chance on anything uncommanded happening. When I say uncommanded, if I make a longitudinal input, I don't want a larger response than what I am asking for. So we'll go with a two on that but mainly for longitudinal. And for the RQR; vibrations do not impact ride quality? No. Not objectionable? No. Mildly objectionable? It's borderline three-four again and I will go with a four. Display question is a no.

Exposure 14

DATE: 22Oct97
PILOT: A
TASK: 3013
CARD: Composite Flight Director Tracking Task

This exposure 14 flight director tracking task, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? I'll say Yes. Give it a three for longitudinal. For lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. A four. Lateral workload is a little bit higher. Again the same comments apply to this configuration as others. Judging the right inputs to get a consistent track crossing rate, I'm constantly having to vary the angle of bank whereas some of the pitch maneuvers it's pretty much make an input and hold it and you can get a pretty consistent pitch rate more easily. For CIR, I would say, I didn't do any altering what-so-ever. I was very aggressive and did what I wanted to so that's a one. And ride quality; certainly one and two probably do not apply. It's borderline three-four again. I'll go with a four but it is not too terribly bad and again I do prefer the better damped configurations.

Exposure 5

DATE : 04NOV97
PILOT: B
TASK : 1013
CARD: Nominal Approach and Landing

Pilot B, approach Cooper Harper. Gee it really wasn't all that bad on the approach, I'd give it a two. And on the landing, a little trouble spotting the distance. I'd give it a four, for landing. And lateral-directional Cooper Harper really was not a big problem. Two for the

approach and three for the landing. DASE CIR rating, don't think I had any, probably a one. And ride quality would be a three. And displays, I'd say, yes.

Exposure 5

DATE : 04NOV97
PILOT: B
TASK : 2013
CARD: Offset Landing

Exposure five. This is the offset landing, longitudinal. Cooper Harper for Pilot B, approach. I would say that it's a, probably a four or five. Four, and then for landing a five, cause it had trouble getting into the box with sink rate and touch down. This is Lateral-directional, that seemed to be meeting those requirements for desired. I'd say give that a three in both the approach and landing. DASE CIR rating, probably a two. DASE influence on ride quality, ride was not a nice ride. Somewhere between a three and a four. And probably give it a four I guess with a yes on the visuals.

Exposure 5

DATE : 04NOV97
PILOT: B
TASK : 3013
CARD: Flight Director Tracking

Exposure, okay exposure five, and this is a flight director tracking for Pilot B. Longitudinal Cooper Harper, not a big problem. I think we'd have to say it's probably desired performance with a three. Lateral-directional Cooper Harper, I guess I'd have to give it a five, because of the, especially the strong reaction you get when you roll in and stop your roll. With opposite aileron, if you have a quick reversal. Quite a large structural reaction. The DASE CIR, I'd say probably a two. And ride quality is not very good, actually. It was probably on the order of a five. Yes sir, display. Yes on the display.

Exposure 11

DATE: 12Nov97
PILOT: C
TASK: 1013
CARD: Nominal Approach and Landing

Okay, exposure eleven, ILS offset approach to a straight in approach and landing. Again, this is kind of a borderline level one level two but I think the extra workload caused by the oscillations perhaps drove it into level two. That was both axes. Both longitudinal and lateral-directional. The axes are fairly well matched so typically what happens to one happens to the other. In this case for the approach, controllable, adequate, satisfactory and I'm debating on minimal compensation or moderate. Let's call it, for the approach, let's call it minimal. Both axes, HQR of three. For the landing, it's not satisfactory without improvement. Desired performance requires moderate pilot compensation, HQR of four. That's basically just compensating for the vibrations by relaxing on the stick. CIR, two. RQR, four. No display perturbations noted. That concludes these comments.

Exposure 11

DATE: 12Nov97
PILOT: C
TASK: 2013
CARD: Lateral Offset Landing

Exposure 11, Offset approach and landing. The approach segment, workload is relatively high. It is high in both axes. It is predominately driven lateral-directionally by the requirement to line up longitudinally as before, the finesse going into the flare. I want to say, in both axes, controllable, adequate, not satisfactory, desired performance requires moderate pilot compensation, HQR of four. For the landing, I'm gonna split them a little bit. Longitudinal is controllable, adequate, not satisfactory. Desired performance requires moderate compensation, HQR of four. Lateral-directional was a little bit worse this time, Controllable, adequate, not satisfactory. Adequate performance requires considerable pilot compensation, HQR of five. At one point I had to deliberately relax on the controls to avoid getting out of phase with it. So it's almost to the point where controllability is an issue to the extent that I'm fighting for control. I'm not gonna degrade it for that at this point but it's borderline. I couldn't recall any involuntary control inputs but definitely the vibrations impacted the precision. So I'm gonna give it a CIR of three. I'd say we're at the point now where vibrations are highly objectionable. I give it an RQR of five. Particularly that last one, it got to the point where I was deliberately relaxing just to let the vibrations die down so that's a five. I didn't notice any effect of the display however. That concludes my comments.

Exposure 11

DATE: 12Nov97
PILOT: C
TASK: 3013
CARD: Composite Flight Director Tracking Task

Okay, this is exposure eleven, flight director task. Lateral-directional was a little bit tougher than longitudinal this time so I'm gonna give them separate ratings. Longitudinal, controllable, adequate, satisfactory, minimal compensation, HQR of three. Lateral-directional, controllable, adequate, I think its worst than that. So I'm gonna give it, not satisfactory, moderate pilot compensation for desired performance, HQR four, a three and a four. DASE, to some extent I'm modifying the control inputs, CIR of two. RQR, moderately objectionable vibrations, RQR of four. No display impact. That concludes my comments.

Exposure 18

DATE: 19Nov97
PILOT: D
TASK: 1013
CARD: Nominal Approach and Landing

Pilot D, exposure eighteen, nominal approach and landing. Okay, the approach for both longitudinal and lateral-directional was satisfactory without improvement, three's fine for both of them. For the landing, adequate performance? Certainly. Satisfactory without improvement? Having so many desireds, it's hard not to say that it's satisfactory without improvement. The only thing that gets it is, there's still that fair amount of judgment. It

worked out well twice that time and I was happy with it. Certainly got desired performance. Make that a four for the longitudinal. Satisfactory without improvement? Yes for Lat. Dir. and bring that to a three. So four and a three for longitudinal/ lateral-directional for the landing. For CIR, that was a one. RQR two. Display? No.

Exposure 18

DATE: 19Nov97
PILOT: D
TASK: 2013
CARD: Lateral Offset Landing

Pilot D, exposure eighteen, lateral offset. Okay, for the approach. Longitudinal satisfactory without improvement? Yeah, just for the approach part. So that'll be a three. For Lat. Dir., satisfactory without improvement? No. It's minor but annoying. Four, no problem getting the desired performance on this but certainly moderately pilot compensation. So that's a three and a four longitudinal/ Lat. Dir. for the approach. For landing. Longitudinal adequate performance attainable? Yes. Satisfactory without improvement? No. Five would describe it. I could consistently get adequate but no matter what I do, something slips out and I never could get fully desired performance out of it. So five for longitudinal. I'll say five for the Lat. Dir., also. There were no problems with vibrations and oscillations. It was just basic airplane type things. CIR one. RQR two. Display? No.

Exposure 18

DATE: 19Nov97
PILOT: D
TASK: 3013
CARD: Composite Flight Director Tracking Task

Pilot D, exposure eighteen, flight director tracking. Okay, for the tracking. Satisfactory without improvement? I'd have to say no. Longitudinally I'd give it a four and lateral-directional I'd give it a five. This is one of those that once you get behind it's almost impossible to get back. I actually got into an inadequate one time. Just barely on the big one. As long as you can keep the error small enough that a small correction will save it then you can just keep it nailed. It's pretty sensitive to the order or the sequence of the subparts of the task come up too. So some of them easier than others. In general though, four and a five for longitudinal/ lateral-directional. CIR, yeah, this time I really didn't do much in the way of modification but possibly a little bit so I'm gonna give this one a two on the CIR. The RQR three. Definitely more turbulence feel up here. Display? I'll say no for the usual reasons.

Exposure 11

DATE: 03Dec97
PILOT: E
TASK: 1013
CARD: Nominal Approach and Landing

Pilot E, Exposure eleven, Nominal Approach and Landing. Okay, I guess the best that we got was adequate performance here, I don't think it was that bad, lets look at this one more time. Okay, the last run we did we still only got adequate performance but we were close to

desired, we were about nine feet longer than the desired box. For some reason I'm having a hard time at the very end getting the final pitch attitude for touch down where we settle on the runway and don't float forever and don't land hard. One thing I noticed in this last run here is that I got again, right in the flare, just before we got to the very end point, I got a split in gamma. It could be pilot technique but for some reason I'm having a hard time with predictability of pitch control or maybe a better word for that is I'm having a hard time with predictability of gamma control right at touchdown and I'm either dropping it hard or floating down the highway. My perception, not something that I know or am sure of is there is a little bit of an error between the displayed gamma and the actual gamma. Maybe it is not enough to kick out the threshold. The other thing I think is hurting is there is a tendency to go high on glidepath towards the end. A couple times we were getting splits between commanded and actual gamma at 150 feet and then again at 100 feet. I have been trying to use the glideslope as a secondary indicator because I am not sure where the Glideslope actually intercepts the runway. I assume probably at about 1000 foot and your going to go high in it at some point. Looking at that and also just looking at the aim point visually before I start to flare, I can kind of see it moving but it is already moving a little bit because of the droop, anyway, I guess that I don't feel that the airplane flies ... The controllability of the airplane is indicative of level two flying qualities necessarily but based on the performance I would have to at least give it a five. So, for the landing task we are going to give it a five and a five. For the approach ... we get bounced around a little bit so I'm going to give it a two and a two. The approach and intercept phase is really not a problem at all. For control inputs I'm going to come down and I guess I'm maybe going to give it a two. I don't think that there is much modification at all required but I'll still give it a two, I guess. For ride quality, I guess I'm going to give it a two for ride quality too and I'm going to say no on the display. You know, flying this after the last condition that we flew, I think maybe I'm a little more tolerant of the bouncing around, I don't know, but this configuration really doesn't seem to bounce around too much.

Exposure 11

DATE: 03Dec97

PILOT: E

TASK: 2013

CARD: Lateral Offset Landing

This is Pilot E, Exposure eleven, Lateral Offset Landing. Okay, kind of like I said on the straight in task, the thing that really bothers me about this configuration is that it seems to me like it flies better than the ratings that I'm giving it. In fact, on one of the offset landing tasks here we got all desired performance but on all the other ones we got at least some parameters in the adequate range. The thing that I was trying to determine is that it seems to me right at the very last portion of the flare, just prior to touch down I have a problem controlling gamma. I don't get what I expect. I put the gamma cue where I want it to be or at least to commanded gamma cue where I want it to be and sometimes we're getting momentary splits but still I'm not getting the outcome that I expect. I don't know if there is a lag there or what or if it's just I'm getting tired or it's my technique but anyway the predictability of the gamma control on the latter portion of the flare is a problem here rather if it's me or the airplane. We did get adequate performance and that puts us in the level two block basically. I'm going to give it a five and a five for both the approach and the ... actually, I don't like splitting these but I'm going to give it a five longitudinally for both approach and landing and a four laterally directionally. I don't really want to do that, do I? It's really hard to split up the two but yea ...as inconsistent as that probably seems, I'm going to do that. A four ... let me try that again. It's definitely a five longitudinally for both

approach and landing and I'm just going to go with a five laterally directionally too. So, five and five for approach and landing both. Come down to the CIR and I'm going to give it a two for control inputs and I guess I'm going to give it a two for ride quality and a no on the display portion.

Exposure 11

DATE: 03Dec97
PILOT: E
TASK: 3013
CARD: Composite Flight Director Tracking Task

Exposure eleven, Pilot E, Flight Director Tracking. We're not really getting the bangs here as much as you do in the other configurations. If I get a little too abrupt with the pitch I can't get a bang. Again, and I don't know if this is just a holdover or if I'm talking myself into this or what. My perception is that it has been easier to track in pitch before, just maybe slightly lacking in predictability here. That's just a perception, I don't think I could put my finger on there. Is it satisfactory without improvement? After the first run I was going to probably talk myself into a three for minimal pilot compensation. We did get desired the second time and I'm going to, I think I'll give it a four. Is it satisfactory without improvement is a big hard question to answer here. Initially I was going to say yes ... there's something here I can't quite put my finger on here and I know I that I should be able to and I'm sorry that I can't but ... I think basically I'm just not getting the predictability out of here I wanted and I would like to see. I'm going to give it a four on both and I'm going to give it a two for the CIR, a two for the ride quality and a no on the display question.

Exposure 13

DATE : 10Dec97
PILOT: F
TASK : 1013
CARD: Nominal Approach and Landing Task

Okay, Pilot F, December 10th, exposure thirteen, the straight in task. Not too bad of an airplane. You can bang it if you want to but with normal smooth control, maybe not normal smooth control, if I knew normal smooth control for these vehicles with the bending modes, it works out good. Ride quality was, you know, not too bad. You could definitely feel the structural modes but probably not too objectionable. The pilot ratings, longitudinal, for the straight in task is, for the approach now, let's just give it a four. Not too bad. And for the lateral, again not too bad, let's give it a four. Okay, and the landing, longitudinal, now I've got to give it a five because of my performance. And the lateral, I think we can give it a four. Okay, the DASE, it's kind of a one, two but it's a two because I'm ... you can't be rough. You have to be smooth. And the ride, it's a marginal to three, four. What will I give it? Let's give it a three. And the display, no problem, the answer is yes but it's just the QSAE droop. Okay.

Exposure 13

DATE : 10Dec97
PILOT: F
TASK: 2013

CARD: Lateral Offset Landing

Okay, the offset task for exposure thirteen. Again not too bad of an airplane. Not much of impact of the DASE on the controllability of the airplane. Just have to think about being a little bit smooth. In fact not even much there for normal control inputs. It's really not bad. A little bit of a ride problem but again not too bad there. And so, I think, for the approach now which includes the offset maneuver, longitudinally, let's ... well I'm going to make that a five because of the display issue. And the lateral, I'm going to make it a five because of the difficulty of the offset task. What I meant on that five on the longitudinal, you know, you really can't use that depressed pitch line to help you. So that's really a display issue. Okay, landing, I really got one that's inadequate, I'm not going to be able to throw it out, it's only a couple of feet out, so let's give it a five. And lateral for the landing, yeah, it's not too bad, once you get set up. Yeah, I've seemed to have found the track for the offset. Let's give it a four again. Okay, the DASE, I think, will be the same again. Yeah, a two and three and yes. And the yes has a QSAE on it. The wiggles didn't bother me.

Exposure 13

DATE : 10Dec97

PILOT: F

TASK: 3013

CARD: Composite Flight Director Tracking Task

Okay, the flight director task. I did notice, as I've noted earlier, the band pass on the lateral control is just, it's pretty hard to keep up with that lateral task, keeping it in the small circle anyway. So that I had a tendency to bang the DASE there laterally a couple of times. Really did have to back off a little bit. But longitudinally, I didn't notice any problems and let's give it a four, longitudinally. And laterally, let's give it a five because I really consciously had to be careful. Okay that's really kind of because of the DASE. Okay, the DASE ratings are, it's a good strong two. And the ride, I'm going to give it a four because I was banging the lateral DASE there pretty bad. No problems on the display.

Configuration 14 Modal damping increased to 0.30 for modes 1 - 4, damp8

Exposure 16

DATE: 22Oct97

PILOT: A

TASK: 1014

CARD: Nominal Approach and Landing

Longitudinal approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. No real problems there. The quality of this configuration, just qualitatively seems similar to exposure eleven. Both the longitudinal and lateral axis are well damped. About one and half overshoots to an abrupt input, and medium amplitude -not too bad at all. The rudder really had no effect. With large rudder inputs, I got a fairly slow response but no real aeroelastic responses. One thing interesting, if I held rudder to generate a turn through dihedral effect, when I took the rudder pedal out with hands-off the stick we seemed to roll in the opposite direction kind of to a larger degree than I would have expected. That's probably nothing, just toss that out. The lateral rating up and away; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also. No problem at all in either axis for the landing. Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. Cooper Harper of three. Again, two nice landings. I felt in control. No real problems there and very good performance so it warrants a three. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, a three also. For the CIR ratings; One is appropriate. I don't do anything out of the ordinary, as far as this task. This task does not call for abrupt inputs and so therefore I'm not going to trigger really too much of the aeroelastic modes since I make some high gain inputs in the flare, they're not really large enough amplitude or abrupt enough to really cause any problems. For the RQR, one does not apply. Probably a three. There is just enough on the up and away and enough turbulence excitation, that it probably ... it would be nice to take care of its self. A one and a three for the CIR and RQR and a no for the display.

Exposure 16

DATE: 22Oct97

PILOT: A

TASK: 2014

CARD: Lateral Offset Landing

Longitudinal approach rating; Same comments apply as apply to the straight in, a three. Lateral rating; Similar, same comments apply, a three. For the landing; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I'm going to rate it a four even though I did not get clearly desired performance, I blame myself for that, not the configuration. I had really good position and slightly firm or really good H-dot and slightly long, so I'll use my discretion there. For the lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No, for a four also due to the workload. I felt real good in this configuration. I did whatever inputs I wanted. I felt real good in the correction turn. Part of the rating of course for this task includes 250 feet on down and the longitudinal-lateral cases both were desired performance, I believe, all the way up to the flare so I think you have to give some credit for that, even though the performance metric may slightly disagree with what I'm rating it. For the CIR; I did not do anything different for this so it's a one. For the RQR; probably number three is appropriate, just desirable to improve it a little bit but really not too

bad. Again the well damped configurations even though there are ASE motions, seem to be what I prefer. And no for the display.

Exposure 16

DATE: 22Oct97
PILOT: A
TASK: 3014
CARD: Composite Flight Director Tracking Task

Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No for a four, little bit higher lateral workload. Nice longitudinal. CIR; One. No changes in RQR. I would probably rate that a two because the task is fairly ... The task keeps you fairly busy. It's the kind of workload where those motions don't really ... they didn't bother me. I didn't perceive any kind of ASE motions. It was more just motions from my abrupt inputs. Display question? No.

Exposure 14

DATE : 05NOV97
PILOT: B
TASK : 1014
CARD: Nominal Approach and Landing Task

Okay this is exposure fourteen. Fourteen, the straight in approach and landing, longitudinal Cooper Harper. Seem to be just a little long, otherwise all desired, mostly desired. I'd guess I'd have to give it a three. Actually, I can give it a two in the approach and a three on the landing for longitudinal . The lateral-directional seemed to fine. A two for both approach and landing. The DASE influence on control inputs, there was some effect but it was minor. I'd give it a two, I guess. And the ride quality would be a two. And no effect on the visual display.

Exposure 14

DATE : 05NOV97
PILOT: B
TASK : 2014
CARD: Offset Landing Task

This is exposure fourteen and this is the offset landing. Approach and landing Cooper Harpers; nothing exceedingly annoying about the control response. I'd have to give it, like a three for the approach and a four for the landing. Same thing for lateral-directional and the DASE CIR rating would be two. And the ride quality, probably a two, and no influence on the displays.

Exposure 14

DATE : 05NOV97
PILOT: B
TASK : 3014
CARD: Flight Director Tracking Task

Exposure fourteen, flight director tracking task. Longitudinal Cooper Harper; looks like about a three to me with desired performance. And lateral was a three also. I guess I'll call it a one on the DASE CIR rating and the ride quality, a three. I guess I'd have to say yes on the aeroelastic display perturbations.

Exposure 7

DATE: 12Nov97
PILOT: C
TASK: 1014
CARD: Nominal Approach and Landing

Exposure seven ILS offset approach, straight in landing. Very pleasant configuration. I feel like I'm basically looking at the baseline airplane. Very little impact of DASE at least from a perception standpoint. Seeing as how this task is a relatively simple one I don't have a problem with level one in terms of the work load that I saw. It's controllable. Longitudinal and lateral-directional, about equal work load on those, for the approach. I'm gonna give it for the landing too, 'cause I don't think there was significant degradation on the landing phase. Controllable, adequate, and satisfactory, minimal pilot compensation, HQR of threes. Four threes there. DASE, one. I didn't notice myself altering control inputs for flexibility. RQR, two, Perceptible but not objectionable, no improvement necessary. It's tough to say. If you told me that was moderate turbulence. Light to moderate turbulence, I might not even think I had DASE turned on. Since you're telling me it's light turbulence and it feels a little bit more or stronger than light turbulence. That's how I'm noticing it but it's certainly not overly objectionable. No display perturbations. That concludes my comments.

Exposure 7

DATE: 12Nov97
PILOT: C
TASK: 2014
CARD: Lateral Offset Landing

Okay exposure seven, the offset landing task. This is a difficult task. Again, what I'm seeing, terms of the way it feels, baseline performance. The errors that are occurring are due to the task and work load and just the luck of the draw basically. The approach was more difficult than the landing down to fifty feet. But the landing task is kind of exacerbated by what you did in the approach. I'm not getting set up as well as I did in the straight in. So, I'm fighting in both phases. So again, I think I'm going to give the same rating in both approach and landing. The approach because of the difficulty of the task and the offset, and the landing because of the difficulty in making corrections for what I'd drove myself into in the approach. Longitudinal, lateral-directional are about equally difficult. Lateral-directional of course is predominately associated with the line-up right down to the touchdown. You're working line-up all the way down. Longitudinal of course is the trade off between distance and sink rate at touchdown. It's controllable, it's adequate, I think deficiencies warrant improvement. This is one of those again, where I think it's too harsh to say adequate performance requires considerable compensation. So I'm going to give it fours all around, for both longitudinal and lateral-directional in both phases, so four fours. CIR, I'm not intentionally modifying inputs for vibration. CIR is one. RQR, perceptible but not

objectionable vibrations, two just like before. No display perturbations noted. That concludes these comments.

Exposure 7

DATE: 12Nov97
PILOT: C
TASK: 3014
CARD: Composite Flight Director Tracking Task

Okay, exposure seven, flight director task. Relatively pleasant, and minimal compensation. DASE handled it for any oscillations that were there were not objectionable, even right up to and including fairly aggressive inputs on the second run. I'm reluctant to say compensation was not a factor however. It certainly was minimal. This is another one where if I could give half ratings, I probably would be tempted to. Okay, longitudinal, lateral-directional about equally difficult or equally nondifficult. It's controllable, adequate, satisfactory. Minimal pilot compensation, threes for both. CIR ... (If we allowed half ratings what would you give it?) Two and a half. I didn't alter my control inputs as a result of aircraft flexibility. CIR is one. I can't say that I didn't notice the vibrations. So occasionally, particularly with the aggressive inputs, I noticed it. So I'm gonna give it an RQR of two again. No display impact. That concludes these comments.

Exposure 06

DATE: 17Nov97
PILOT: D
TASK: 1014
CARD: Nominal Approach and Landing

Okay, this is the first use of exposure 6, nominal approach and landing. Okay, pretty easy on approach, longitudinal and lateral-directional were threes, all the usual reasons. For the landing: Longitudinal, adequate performance? Yes. Satisfactory without improvement? I'm going to say no and just as a comment, right at the end I started to see just a little bit of oscillation that probably was a little bit of ASE getting in there but I land a little bit long but I'll turn the corner at: Is it satisfactory without improvement? No. However, I think I'd give that next question between a four and a five, I think I'll have to stick with a five on that. And for the lat/dir.: Satisfactory without improvement? No. But that would be a four, it was not ... the problem I had was with the pitch so, yeah, I'll stick with that. So, longitudinal five, lat/dir. four, CIR, I'll say two. Just a very minor modifying of the control input, hardly any. RQR two also, that was more light chop it felt like than some of the others have. The display no.

Exposure 06

DATE: 17Nov97
PILOT: D
TASK: 2014
CARD: Lateral Offset Landing

These are comments for Exposure 6, Lateral Offset Landing. For approach: Longitudinal and lateral-directional certainly adequate performance obtainable. Not satisfactory without improvement. The lat/dir. is what kind of got me there and I don't know whether that was

just my not fighting it or not staying up with it or what but I managed to overshoot that one time and boy, once your out of parameters, getting back to them is tough. I think I'll do two five's for the approach on longitudinal and lateral-directional and I don't know if it was ASE or just control power how quickly you move this big hummer over there. Okay, for the landing: Longitudinal Adequate performance obtainable? Yes. Satisfactory without improvement? No and here near the end I would make a quick input trying to save a sink rate and that would start an oscillation and then I would kind of hold what I had to let that settle out before I continued on and that usually ended up putting me long. That's a fair amount of compensation so, I think for that one I'll probably end up adequate performance probably, barely routinely do but it's ... that's extensive pilot compensation, six. The lat/dir.: Satisfactory without improvement? No and I'd say five on the lat/dir. Lat/dir. kind of got me in trouble on one of them but I think that was with a little more compensation that would not have been a factor. Control ... yes I would say that I did modify my inputs to avoid it especially after I saw the first oscillation in the flare and pitch so I definitely would have to say that would be a two and that is really what was starting all this so it kind of effected my precision, so I think a CIR of three on that. And as an aside, that was in pitch I didn't see problems in lat/dir. but I did see a lack of precision in pitch. For the RQR: Cockpit vibrations? Again, because of what I saw in pitch again, I think a four on that. I think improvement is warranted on it. Nothing there to cause great problems but that's one of those things, I don't know I might have been close to the edge on that one. I'd feel best giving that one a four and I didn't see anything with the displays, so no.

Exposure 06

DATE: 17Nov97
PILOT: D
TASK: 3014
CARD: Composite Flight Director Tracking Task

Okay these are comments on Exposure 6, flight director tracking. Longitudinal: Certainly adequate performance and satisfactory without improvement ... no, I think I'll turn the corner on that and call that a four. I did get desired but some extra special work was involved however. Satisfactory without improvement for the lat/dir.? This one again all I had to do was get a little ways out and trying to get it back I had a hard time especially on reversals on that one so one I had was adequate and one was barely desired so, I think I'll leave that a five. Somebody wanted to really complain, I think I could make that a four but I think five best describes it. It's a good five. Okay, CIR ... I don't think I modified an awful lot but I did some so I'll say a two on the CIR and on that one I'll say RQR of three. If would be nice to improve it but it certainly is not a big item and it was mildly objectionable and display no.

Exposure 5

DATE: 03Dec97
PILOT: E
TASK: 1014
CARD: Nominal Approach and Landing

Pilot E, Exposure 5, Nominal Approach and Landing. For the intercept, again it is pretty much a non-event. There was a little bit more bouncing in this one then the last one. Seems like I could ...with an open loop input I could excite something in pitch more than I could in roll. I'd probably go with a two and a two for the intercept phase. For the approach phase,

I probably would have a tendency to go two and a half here. If I have to pick one, I guess I have to say two and two, I guess. The only thing that I noted was that it seemed like in the past a whole three degree glidepath. It seems as if I could pretty much just set the pitch target on a three degree line once I was established. And here for some reason it seems like I have a tendency to drift high while it's on that three degree line. I know it's the same glidepath that we have been following all along. I noted that on both approaches, especially lower to the ground near the final segment of the approach with the last four hundred feet or so, there is a tendency to drift high, you have to correct for it. I am not seeing a split in the cues either between actual and commanded. We got desired in the first touchdown, the second touchdown we got desired except for the H-dot and we got adequate and I could kind of see that coming because I got a split and I should have brought the actual flight path vector up a little bit. That is something to note, I guess just for day-in and day-out operations. Especially since the pilots with this display would tend to fly flight path vector a lot since that's what they fly during the majority of the flight. In that flare there when you get the split in the Cue, I should have brought it up and I knew that. I didn't do it ... it was not that big of a split or that big of a deal but it is something to consider. I guess for the landing I'm going to go with a three and a three. You have plenty of aids to help you determine what is going on. There is nothing that is really causing you to excite anything that's really too detrimental to the task here. Moving down to the DASE control inputs, I would probably really be somewhere between a one and a two. I don't know that I really intentionally modified my control inputs that much. I was a little bit more tentative in pitch inputs just because of what I had seen just putting in some small inputs, small but abrupt inputs out on the intercept phase. I guess I'd probably go with a two and a two. A two for control inputs, although, I'm awful close to just giving it a one there. I would go with a two for ride qualities and I guess I'm going to say no on the display. Although, I'm not really sure why we were getting the split in the cue and why we were drifting high on the last part of the final approach phase.

Exposure 5

DATE: 03Dec97
PILOT: E
TASK: 2014
CARD: Lateral Offset Landing

Pilot E, Exposure 5, Offset Landing. I guess first ... just as a comparison, I thought this configuration was slightly more difficult than the last configuration just because there was more perceived turbulence to me and more of a perception than necessarily really an observation. I did feel like there was a tendency where if I made a real sharp pitch input that I could maybe excite a little something but that was more of a perception than an observation. During most of the task I never really ... I don't think I ever really saw myself exciting anything. It was just kind of a feeling in the back of my mind, I guess. So, maybe I was just a little more tentative than I normally would have been. The approach phase, I think is fine and I give it a two and two. Let me back up. Again, I think there is a big learning curve between yesterday and today. I would probably say it is a four and a four and I do that for both the approach phase and the landing phase. So a four, four, four and a four. For the DASE, again I'm kind of split between a one and a two but I will probably go with a two just because of that perception I mentioned. I kind of wanted to be a little bit tentative in pitch although, again that was more of a perception than really an observation. Then for the ride quality, I would probably say a two. I don't think there was any impact on the displays or by the displays, so no.

Exposure 5

DATE: 03Dec97
PILOT: E
TASK: 3014
CARD: Composite Flight Director Tracking Task

Pilot E, Exposure 5, flight director tracking. Okay, my perception I guess first of all is there almost seems to me almost to be a little bit of a cliff if I got too abrupt with the stick. All of the sudden I got real jerky responses. Whereas as long as I was in a smaller, slower input band the airplane was very predictable and fairly responsive. It seemed like if I increase that input ... the size of the input just a little bit the airplane became more abrupt and less predictable. So, a little bit of a tendency to back off on my gains there a little bit. There were a couple of times when I felt what I would characterize as a little bit of a galloping. It was particularly on a pushover that, where I was a little bit abrupt. There were a couple of times when there was a slight tendency to ... at least it impacted the input I was making, if not maybe added or detracted from the input but that was only when I went with a more abrupt input. I would probably ... we got adequate one time, desired another time. Is it satisfactory without improvement is kind of a big question. We did get the desired performance in the second run, we almost got it on the first run. I am kind of looking at the minimal versus moderate compensation there. Also, I'm on the borderline of answering the question "Is it satisfactory without improvement?" I think that I would probably ... just because, and again this is my perception, just because there kind of seems to be somewhat of a little bit of a cliff there, I guess I will maybe go to a four. Although, I could real easily talk myself into giving it a three, I'm going with a four and a four. Again, the little cliff that I perceived was in pitch, not in roll. Coming down to the control inputs DASE, looking at the two of the three descriptors, pilot intentionally modifies control input? That is definitely true. Cockpit vibrations impact precision of voluntary control inputs? That occurred, I think. I would really have a tendency to go the two and a half route here because there was some impact on my inputs, I believe but they were real minimal. I think if I probably have to pick one or the other we will go with the three here. Ride Quality? I'll probably go with a three here also, just because, again, especially when I went through the cliff, you kind of get the banging and the bouncing around. And the answer, does the display perturbations? I would say no.

Exposure 1

DATE : 08Dec97
PILOT: F
TASK : 1014
CARD: Nominal Approach and Landing Task

Pilot F exposure one, configuration 14 nominal approach and landing. This is exposure one, Pilot F, this will be the pilot rating, the Cooper Harper pilot rating for the straight in to landing. I was having a little bit of a problem with the X and the H dot tradeoff as I seem to have in all of these simulations, so I got one in desirable and one short and one long. So it is definitely adequate but not satisfactory which puts this us in the four-five-six and we didn't get desired performance so that puts us into a five and so let's give it a five. Moderately objectionable deficiencies, adequate performance requires considerable pilot compensation. Oh We want separate? Okay, so that's for longitudinal and for lateral for this task, we definitely had satisfactory performance and I don't think I noted any deficiencies there although I really didn't perturb the system to see if there were any. Let's

give it, for the lateral, well let's give it a two. With a question mark. Actually my confidence level is low because I really didn't investigate it. I'm sorry, actually that was the landing. Let's back up then. Landing, let's see, this is pilot's rating, we've got some more ratings to go too don't we? Okay so, landing, lateral and longitudinal, say five and two. And so now we want approach. Two ratings on approach? Okay so we did get a chance to look at the lateral a little bit on the approach and didn't notice any deficiencies. Let's give it a three. I'm rating the whole task for the approach, right? Above two hundred feet. Yeah yeah. It's, maybe even three is a little bit strong. Let's give it a four because you know it's just raw data. I've got to do a lot of sitting there and figuring out well do I turn left, turn right to get on. So let's give it a four for the lateral for the approach. And longitudinal, I was definitely desired performance, I believe. Down to two hundred feet and again I'm going to give it a four primarily because the discrepancy between the command and actual as the flaps extend. It causes you to have to compensate a little bit in there. So let's give it four, four for approach. Okay, still going. I've got to get my matrix figured out here. Landing approach ... Okay, now we are into a new game here. So we have two new scales. How many ratings? Okay so let's give it the ... what do you call it? The DASE control. So control, this is a new one so let's take it easy. Pilot does not ... Do I give half's? (No. But you can describe Halves.) Let's give it a two but it is a weak two. It is somewhere between one and two. You are really just kind of smoothing it out a little bit but hardly perceptible. Not much of a problem there. Okay so that's a two minus. And for the ride quality, I would, let's give it a three. Hold on. Moderately objectionable, improvement desired. Yeah it's a three. I've ridden on airplanes as bad as that before. (Okay, and the displays?) Okay, that is yes or no. Huh? (Do aeroelastic display perturbations impact the precision with which the task is performed?) No! Where did you see that? (At the very bottom.)

Exposure 1

DATE : 08Dec97

PILOT: F

TASK: 2014

CARD: Lateral Offset Landing

Pilot F, exposure one, configuration 14, lateral offset landing. Okay, Pilot F, that was the offset landing task for exposure one, the Cooper Harper pilot rating. We will do the approach first this time, as opposite the last time but let's do lateral first. And since it was ... let's see now, the offset is in the approach isn't on here. Okay, that is a pretty tough task. And obviously, laterally, I'm just getting adequate performance, So it puts it in the four five six ... Yeah let's give it a five. Okay so that's a five. And longitudinally, it's a pretty darn tough task too particularly with that depressed pitch line not where it's supposed to be. You know, a lot of things need to be improved on this. The actual structural modes aren't too too bad here but there is just some rigid body problems. Lets give it a five. Oop, Oop. Oop. This is approach Isn't it? Standby. Up to fifty feet, yeah, no it's definitely a five because, you know, it's got that erroneous depressed ... display is goofed up. Now on the previous run, we need to go back and revisit that too. Okay, lets do lateral first. And ... assuming I'm set up at fifty feet it's no problem, but if I'm not ... Okay, now on the approach for lateral I said I was ... what are you using for performance metric for approach lateral. Is that the plus or minus half a dot? That's easy. Yeah, see, I think, there is the problem, you have the hardest part of the task with no metric. Yeah, yeah. You need some sort of metric, how well do you end up, you know, laterally at fifty feet or something because if my ILS tracking was, I'm sure, within the plus or minus half a dot but still it's a very tough task and just based on work load I certainly wouldn't give it any thing better than a level two. What have the guys been doing there? What would you like us to do

there? Use the ILS tracking as the rating for the approach? Now you would have made the break at two hundred fifty feet instead of fifty feet then. So I have to kind of rate it on the work load in the offset and in that I don't have a performance metric, yeah of the approach. Okay so it's still a five. Let's leave it that way. Okay now we're down to the landing and now I've got a little bit of a problem because it's so contingent on how well I did on the approach. But obviously from my landing touchdowns I'm only making adequate which forces us into a level two and also the performance forces us into a five on the lateral landing. Longitudinal landing we are also forced into a five because of the touchdown distances. Okay five and five. So we've got four five's there, that's pretty good. Okay the DASE, the control, okay it's a little more apparent here than it was on the straight in just because of the increased control activity. But still let's give it a two, it's not bad. The ride is three. Okay now the display for the overall, you know the flexible body part of the display isn't bad, Dave, but the QSAE is objectionable. Do you want me to rate that or do you want just the flexible body part? Sure, sure. So on the display, and Irene, on the previous one on the display, let's go back and change that, that should be a yes. And it's the quasi part of it. What do you call that? The QSAE, quasi steady aeroelastic effects, yeah. Okay and this will be a yes. Quasi steady aeroelastic effects. Okay, vibrations no problem.

Exposure 1

DATE : 08Dec97

PILOT: F

TASK: 3014

CARD: Composite Flight Director Tracking Task

Pilot F, exposure one, flight director tracking task. Okay, this will be lateral Cooper Harper rating for the flight director tracking task on exposure one, for Pilot F. Looks like our performance on two runs there was desired but, is it satisfactory without improvement, as we get up that far, and I would say no. Okay, now this is lateral Cooper Harper. I am going to give it a five because of the ... well shoot, you want me to put that into the DASE rating, don't you? No, not necessarily, no. Over all, which is what the Cooper Harper is here, it's moderately objectionable deficiencies because I'm not getting any lead on what to do with the controller, with the inceptor, so therefore I end up making thoroughly abrupt inputs which is causing the thing to bang around a little bit, particularly laterally. So let's give it a five. Longitudinally, it didn't seem to be quite as bad. Let's give it a five, just two be conservative for the same reason, that obviously the performance is okay but then we are effecting the ride quality too much, with the aircraft. DASE. Control also, that should be reflected here also. Okay, let's give it a two with the comment, this is on the control input DASE, with the comment that I really didn't have much time to modify my ... two says, pilot intentionally modifies, so I didn't have much time to modify it if I wanted to track tightly. I would have liked to have modified it. Okay, ride is, let's give it a three again. And the display, we don't have the quasi steady problem here obviously since I'm displaying... meet several of them. Do aeroservoelastic display ... lets put down no because the vibrations don't seem to be coming through enough and the quasi steady is not a factor here.

Configuration 15 Modal damping increased to 0.30 for modes 1 & 3, damp9

Exposure 3

DATE: 20Oct97
PILOT: A
TASK: 1015
CARD: Nominal Approach and Landing

This for Exposure number three, the task rating for the straight in approach and landing. Longitudinal approach rating, controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes, Cooper Harper of three. Some significant ASE effects however longitudinally they were not too pronounced. They were more excited laterally. Exposure two by contrast seemed to have equal lateral and longitudinal excitation but this one seems to clearly favor the lateral axis for its excitation. For the lateral rating for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes it was, Cooper Harper of three again. Yes I stick with a three for the lateral rating. No real problems controlling the task, very good criteria. Again, though, the lateral inputs do excite the ASE motions more prominently than the longitudinal inputs. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I'll say no and go with a Cooper Harper four. I met the desired criteria but probably not as ... a little bit of a work load and I think even though it is a longitudinal rating, I think my longitudinal performance was desired but not solidly desired and basically there were not too many ASE problems that caused that, It's just the way it worked out on this particular set of tasks. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I will say no also and give it a four. Basically, I think the ASE effects did effect the rating, in that there are some significant motions with lateral inputs. So a three-three, four-four. For the DASE influence on pilot control inputs, CIR; Pilot does not alter control inputs as a result of aircraft flexibility. That's not true. Pilot intentionally modifies control inputs. That is true. Cockpit vibrations impact precision of voluntary control inputs. That's not true. So that's two for CIR. DASE influence on ride quality. Cockpit vibrations do not impact ride. That's not true. Number two, perceptible but not objectionable. That's not true. Three, moderately objectionable, improvement desired. That's not true. Four, Cockpit vibrations are moderately objectionable, improvement warranted. This is very similar to exposure two's configuration, both of these are borderline four-five's. I going to rank this a five again also because certainly this configuration, in my opinion, ever so slightly worse than exposure two, however the ratings are fairly the same although I think the Cooper Harpers may be slightly worse on this one. Yea, I gave the other one three, three, three, three and I gave this one three, three, four, four. And for the question no problem with the displays? No.

Exposure 3

DATE: 20Oct97
PILOT: A
TASK: 2015
CARD: Lateral Offset Landing

Approach longitudinal rating; Is it controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes, a three. Same as before, comments apply. Lateral rating, for the approach. Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three also. For the

landing, and the landing starts at the correction point of 250 feet altitude and on down. for longitudinal rating; is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? No it is not. I do however feel that it was borderline adequate. The second landing I think was more representative since I kind of misplayed the flare cue and the power on the first one, so I will give it a four for longitudinal based on workload. Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No, that's also going to be a four and that's due to workload in the offset correction task. A lot of workload required to get it into the desired box. It is just a hard task to do but no real problems. I was concerned initially that the ASE effects might make me too benign with my inputs but ended up being fairly aggressive. I did tone them down a little bit and I didn't seem to have that big a problem laterally as I was anticipating. So the lateral ASE effects are definitely more of a nuisance than the longitudinal but they did not seem to be enough to really effect the rating that time. So a three and a three, a four and a four. For the CIR rating; Number one is not true. I did have to alter my inputs. Number two, I did intentionally modify them to avoid excitation. That's correct. Number three; I don't think it impacted the precision of voluntary control. So let's give it a two for CIR. It appears that a little trend is developing here on this rating, it is difficult for me to get past a two. For the RQR, cockpit vibrations do not impact ride quality. It's not true. Perceptible but not objectionable? Not true. Cockpit vibrations are mildly objectionable, improvement desired. Not true. Cockpit vibrations are moderately objectionable. That's probably true, a four. So let's stick with a four on that. That offset task ended up better than I thought it would. I thought it was going to be a little more colorful. So a three, three, four, four for the Cooper Harper's and a two and a four. And the question; displays? No, no problem.

Exposure 3

DATE: 20Oct97
PILOT: A
TASK: 3015
CARD: Composite Flight Director Tracking Task

Longitudinal rating; is it controllable? Yes it is. Adequate performance attainable? Yes. Is it satisfactory without improvement? No. I'll rate a four. No I'll take that back, Yes it is satisfactory without improvement, I'll rate it a three for longitudinal. The lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No, a four. I met the desired criteria but there is definitely more of an impact on ASE perturbations in the lateral axis and it translates to poor performance in the lateral axis. So longitudinally it wasn't too bad. A three and then laterally a four. For the CIR rating, Number one is not true. Number two, pilot intentionally modifies control inputs to avoid excitation. That is true. Number three, cockpit vibrations impact precision. That's not true. So we'll stick with a two on CIR. For the ride quality; number one, do not impact ride quality. That's not true. Number two, vibrations are perceptible but not objectionable. That's not true. Number three cockpit vibrations are mildly objectionable, improvements desired. Not true. Number four, vibrations are moderately objectionable, improvement warranted. That's true. And five is too much, let's go with a four. So CIR; two, four. And the question; displays is? No, no problem with displays.

Exposure 4

DATE : 04NOV97
PILOT: B

TASK : 1015
CARD: Nominal Approach and Landing

Okay, Do you need to know the task no. or ID? Exposure four. Nominal approach and landing. Longitudinal Cooper Harper on the approach, seem to be pretty reasonable. Give it a three. The landing, tended to land slightly long. Although, sync, rates were reasonable. For the most part it was desired, but I think I'd give it a four. Yeah. For the landing part. Lateral-directional Cooper Harper, it's not satisfactory with out improvement. I'd say moderately objectionable. Moderately objectionable, I'd give it a five for the approach, five for the landing. The ... yeah. And the DASE CIR; I'd give it a three I guess. Yeah, yeah. And the ... a five for ride quality. Yeah, it does ... display perturbations do impact my performance

Exposure 4

DATE : 04NOV97
PILOT: B
TASK : 2015
CARD: Lateral Offset Landing

Okay this is what exposure? Four. Pilot B and this is the side step landing longitudinal Cooper Harper during the approach. Gee, down to 50 feet, not a big problem. However, after you get below say a hundred feet or so, actually begins to be a problem adjusting the flight path to get in the box. So I would say, is it controllable? Well yes, I guess. Adequate performance attainable, probably not. Major deficiencies. I'd say I'm going to give that one an eight for the landing, for the longitudinal and for the approach part of it, I guess I'll give it a five. And the lateral-directional; Controllable? Yea, I guess so. Adequate performance attainable? It's debatable. I'd say ... I'd give it a six. Actually for the approach, I guess it should be through the S-turn on the approach, then I would have to say that it's major deficiencies, seven. I'd call it a seven. It's not bad down to 250 feet. That's where your trouble starts. Down to 250 it's not bad. The actual landing, it will probably be a seven. And the DASE CIR, it's a little hard for me to judge whether I have involuntary control inputs or not. I guess you would have to analyze that after the fact but I suspect that I did. Probably give it a four on that and the ride quality, probably somewhere between a five and a six. We had to abandon it more often than (I abandoned it.) Yea. Oh gee, I give it, probably a six because of the fact that we didn't complete most of them. And yes there is a problem with the display.

Exposure 4

DATE : 04NOV97
PILOT: B
TASK : 3015
CARD: Flight Director Tracking Task

Okay, this is exposure number four for Pilot B, and this is the flight director tracking task. Longitudinal Cooper Harper, actually was not all that bad and I'd say a three. Lateral direction of Cooper Harper was, had major deficiencies. And, I'd give it a seven. The reason being that you had to really punish the airplane, or the simulator to track this thing. You had that infrequent full deflection aileron inputs, roll inputs which really set this motion off. And there is some reluctance to do that, and therefore we couldn't track the symbol. DASE CIR ratings, a little difficult to tell how much involuntary control input I

had but, I think I'd give it a two. The ride quality, yeah, was borderline between a five and a six. I'd give it a five. And a, yeah. Yeah, it was a, basically boiled down to how rough a ride do you want to withstand in order to track this thing, What price, you know, what price do want to pay to track this thing? (Display question?) That's a yes.

Exposure 8

DATE: 12Nov97
PILOT: C
TASK: 1015
CARD: Nominal Approach and Landing

Okay, exposure eight, the ILS offsets straight in landing. Deficient configuration in terms of vibration impact on performance, predominately lateral, predominately directional I should say in the approach. A little bit of longitudinal ringing but not much. It was mostly directional. Particularly down low, definitely impacted my ability to control the airplane precisely, both longitudinally and lateral-directionally. The vibrations were heavy enough that on a couple of occasions, on both occasions as matter of fact, it was difficult to find the radar altimeter to gauge the landing touchdown sink rate and in both cases was touchdown with a relatively high sink rate within the adequate bounds but high and short, again within the adequate bounds of longitudinal distance but short. This impacted, I think both lateral-directional and longitudinal control, precision control. In that I was... the work load was still there for both axes. So for, let's see, where did that occur? That occurred prior to fifty feet but it lasted through the fifty foot point as well. Again, I think the work load is consistent throughout. From about 80 to 90 feet right on down to the touchdown, you're working. If you made the distinguishing altitude at 100 feet I'd give you a different answer here, but at fifty feet I think you're in the middle of it. So, I'm gonna give it consistent ratings for both. It's controllable. I'm gonna call work load tolerable but it's real close. It's definitely not satisfactory without improvement. I think I'm working harder longitudinally than I am lateral-directionally, 'cause I think that's the nature of the task that once you set yourself up on line-up on this straight in, you're pretty much suitcased. Workload is a little bit tougher longitudinally. So, I'm gonna give longitudinal a six in that you're working real hard for adequate performance. I'm gonna give lateral-directional a five and call it considerable. The issue here is the definition of considerable and extensive. So a five for lateral-directional and a six for longitudinal and both approach and landing, same ratings. Okay, DASE, I'm gonna give it a four for CIR. Certainly if you hold the stick tightly, you're gonna get occasional inadvertent inputs. Not frequent, so give it a four. Again, I think we're in the five region in RQR, highly objectionable. Improvement is required to make it acceptable. I did notice display problems. I'm not sure they're perturbations. I certainly, I was vibrating enough that occasionally I had a hard time finding the number that I wanted on the display on both events. So, I'll say yeah it did impact me on that. That concludes my comments.

Exposure 8

DATE: 12Nov97
PILOT: C
TASK: 2015
CARD: Lateral Offset Landing

Exposure eight, offset approach and landing. I think workload is just about as high as it could possibly be and still do the task. I'm gonna say it's tolerable workload but boy it's

real close to intolerable. Again the issue comes about through fifty feet. It starts after the correction. At the correction point the workload goes up fairly high. Then the recorection it's extremely high and it's right about at a hundred feet where you're recorrecting. That workload lasts all the way through to touchdown. The vibrations are definitely influencing it making it a whole lot more difficult. I'll say it's controllable. I'll say adequate performance is obtainable with a tolerable workload but boy it's real close. It's definitely not satisfactory without improvement. I'd say extensive compensation both longitudinally and lateral-directionally so four sixes. CIR, I'd say a five. Frequent involuntary inputs and a five. Highly objectionable, improvement required. Yeah, I think still display perturbations down low, you're moving around enough that it is difficult to find symbology items that you want to look at on the display. So yeah, there's an impact there. That concludes these comments.

Exposure 8

DATE: 12Nov97

PILOT: C

TASK: 3015

CARD: Composite Flight Director Tracking Task

Exposure eight, flight director tracking. Moderately difficult with the vibrations. The vibrations certainly discouraged abrupt inputs. Particularly laterally that makes it more difficult to fly. Longitudinally not much of an issue so there's a slight difference between the two. Let's do longitudinal first. Controllable, adequate, probably minimal compensation, HQR of three for this task. That's a solid three. Lateral-directionally was a bit more of a problem. Controllable, adequate, not satisfactory. Deficiencies warrant improvement. I'd say moderate pilot compensation, HQR of four. CIR, occasional involuntary inputs, four. That was lateral-directionally, laterally I guess I should say in terms of the inadvertent inputs. I'd say from a transport standpoint, commercial transport, highly objectionable vibrations, RQR of five. No display impacts at all. Did you get a questionnaire this time? (No sir.) Okay, that concludes these comments then.

Exposure 08

DATE: 17Nov97

PILOT: D

TASK: 1015

CARD: Nominal Approach and Landing

These are comments to for exposure 8, nominal approach. Okay, the approach longitudinal, these things just look like varying amounts of turbulence, of course but there was more noticeable motion in that one then others but it certainly was adequate. Satisfactory without improvement? No. However, there was enough motion that it took what I consider extensive pilot compensation to get the adequate performance so I'll give that a six. On the lateral-directional this is interesting on one of them I actually banged it in pretty hard longitudinally but I had squeezed the trigger and thought that the show was over and the reason I did it was not a longitudinal problem it was strictly the side to side oscillation that seemed to be building if anything and once you get into that it almost takes all your concentration away from pitch so it kind of distorts the whole picture. On the lat/dir.: Adequate performance attainable? Now here is one on the two that I could stay almost completely out of the loop lateral-directionally, even then what little I was putting in was a causing a problem and certainly on the one that I had to make a small correction,

pretty soon left/right oscillations started so big I had to abandoned it. We're getting down into the point where even well I hate to call it control, it was still going where I wanted to left and right but it had picked up this oscillation that I don't think I had anything to do with and sooner or later that's gotta cause problems so I am going to give that a Cooper Harper eight for the lat/dir. in the landing. I might have slipped when you get too many going here at once. Okay lets do the approach again. The approach and landing. The approach: Adequate performance? Didn't I have a five for longitudinal in the approach. Six? Okay, that's right, extensive it was. Then I was talking about the lat/dir. and I was beginning to mix up the approach and the landing. You did get adequate performance for the approach lat/dir. Satisfactory without improvement? Yes. It was very objectionable, I really hated it, so a six for that also, both of them will be six. With the lat/dir. being worse but still both of them at the six level. Okay, now the landing, okay, get back on cue here for the landing: Adequate performance on longitudinal? Yes. Satisfactory without improvement? No. In the longitudinal for the landing ... I'd probably stick with the six. For the lat/dir., adequate performance? I'm gonna have to give it no, it's over here like I said it is terrible, I was beginning to be concerned about control and there wasn't much pilot compensation I was going to do because any time I got in and tried to do much it started to get bad so I gave it an eight for that. Now when we get down here ... I would say at least a four on the CIR for lat/dir. because I think that was beginning to move the stick around. I can't say frequently but occasionally and the occasionally was when I was trying to tighten the loop up a little bit and trying to get my gain going a little higher. I give it a four on that because there was some involuntary control inputs on that coming in and when we get down here to ride quality I'm going to give it a six. Causes abandonment of task whenever I got in there and move the airplane. The only way I could not is just be so well lined up I didn't have to touch anything so, the fact that I did have to key it off that once, RQR of six on that one. No, I'll have to say no because I don't remember that as being part of the problem. Like I say, the oscillation just overwhelmed everything else of the part of the task was the left/right oscillation.

Exposure 08

DATE: 17Nov97
PILOT: D
TASK: 2015
CARD: Lateral Offset Landing

Lateral Offset Landing, Exposure 8. Okay for the approach they were both ... no, there was a difference. Longitudinal is adequate performance. Satisfactory? No, longitudinally though, five there was considerable pilot compensation and lat/dir. would be a six because it took extensive and I was surprised it was as easy as it was. I got some oscillation but it tended to damp out and I could get it around and got it where it needed to be. Longitudinal for the landing: Adequate performance? Yes. Satisfactory without improvement? Yes. Again the longitudinal wasn't too bad, a five and still had some objectionable deficiencies. I think a six on that also. Five for longitudinal, six for lat/dir. On the CIR, I don't think it got to the point where I even had involuntary control inputs. I'm going to give that a three. RQR, it's still bad but probably could warrant improvement, a four. Visuals were not a difficulty. The only thing I can think of is that first one I may have got some of those resonance things that came up because I didn't do it with inputs and yet here I was making big inputs and I didn't get it. That would tend to say that it was a turbulence problem as opposed to my control input problems that got it started, maybe.

Exposure 08

DATE: 17NovDec97
PILOT: D
TASK: 3015
CARD: Composite Flight Director Tracking Task

Flight director tracking, exposure 8. Okay for this longitudinal was not a particular problem. Satisfactory without improvement? I'd say Yes. Because the lat/dir. overshadowed it so much I wasn't watching it closely but I got desired, four. For lat/dir.: Satisfactory? As far as getting the performance it was desired but I could get an awful oscillation going with a quick short input if ... I could out in a large one if I did it smoothly but if I put in a short quick one it would get the oscillation going which made it really horrendous but I could get the desired but no way could I call that a four because of the problem and once we got it going ... if I wasn't talking about the general performance, I would have turned the corner and brought it down into probably a seven because I had to ... my pilot compensation was more than tolerable and the fact that I got desired performance, is not a factor here. CIR, yes I was getting involuntary ones, I'd say four and RQR here definitely required five and display, yes.

Exposure 10

DATE: 03Dec97
PILOT: E
TASK: 1015
CARD: Nominal Approach and Landing

Pilot E, Exposure ten, Configuration fifteen, Nominal Approach and Landing. I guess a couple of basic comments: One, this is just a display issue but it would be nice for tracking the approach to have the actual course marked on the heading display somewhere so you new exactly what the course was, inbound rather than have to go heads down. The other thing is and I mentioned this not on the tape but before, during the last period. Sometimes when you get close in, some of the normal parameters that you would use, or that I would use just looking out the window or even in other simulators. I don't necessarily get the feedback here that I normally would so I think I end up relying on the flight path vector and the instrument display in the HUD more than I normally would. I think this stops me from picking up small changes in my technique. Like for instance, I think before I was flaring a little bit early again. Consistently I have noticed today that there is a tendency at about 150 feet for the airplane to want to drift high and for your gamma to shallow out. It's not a big change, sometimes you get a split in the flight path vector and sometimes you don't, at least that's my perception. For this task though, I think I was maybe getting warmed up again to doing this task. We finally did get desired performance, we weren't real consistent about it. I guess I am probably going to go ... well lets do the approach and capture task first. For the approach and the capturing the ILS and the glideslope just because of the oscillations that you get, I'm going to I guess I'm having a hard time answering is it satisfactory without improvement? Lets see ... minimal, moderate ... you know, not because of the amount of compensation but because of the descriptors, mildly unpleasant deficiency. I am going to go to the four, I'm going to say it was the four on the intercepting. Actually, I guess I'm going to give it a three longitudinally and a four laterally for the intercept and approach phase. For the landing phase ... I'm going to give it a four longitudinally and I am thinking about giving it a five laterally. I guess I'm going to give it a five laterally. I really don't like the lateral perturbations that we are getting. I don't think that we had any involuntary inputs, so I'm going to give it a three on the control inputs for the DASE.

Although I would have a tendency to lean towards a three and a half actually but I'll give it a three. Remember, a lot of this is that I don't like the lateral motion or the directional oscillations that we are getting and I will give it a five for ride quality and a no on the display.

Exposure 10

DATE: 03Dec97
PILOT: E
TASK: 2015
CARD: Lateral Offset Landing

Pilot E, Exposure ten , Configuration fifteen, Lateral Offset Landing. Okay, the lateral mode that we excite on this I really don't like. Particularly close to the ground, it appears that after I can make the cut towards the runway than when I make the inputs to come back it seems okay and then when I take the input out or as I slowly roll wing level we start picking up the lateral oscillations and we carry that pretty much to touchdown. The saving grace is that the display stays pretty good even though we are rocking back and forth in the airplane. I guess, the best we could do is adequate performance. I'm kind of looking at the five and the six. Moderately objectionable deficiency, very objectionable but tolerable deficiencies. I am not so sure I want to sign up for the tolerable deficiencies part of that. Adequate performance requires extensive pilot compensation, I guess here is where I'm having a hard time with this rating, is that I don't know that adequate performance requires extensive pilot compensation but it is very objectionable and it is not tolerable so, that would kind of suggest that ... I guess if I go back to the actual question between those blocks: Is adequate performance obtainable with a tolerable pilot workload I would have to answer the question yes. I can obtain adequate performance with a tolerable pilot work load but the deficiency there with the lateral oscillations is not a tolerable deficiency in my mind. Even though the question actually addresses workload I'm going to go in and give it a seven. Okay that's a good point and I hate splitting these for axis but I'm going to give it a six longitudinally and a seven laterally/directionally, for both the approach and the landing phase. The CIR, I'm going to give it a four because I think there were occasional involuntary inputs, particularly in the flare. It was hard for me to track pitch in the flare and I don't think it was a pitch tracking problem for the airplane, I think it was a problem for the pilot interfacing with the inceptor as part of it but just the pilot being able to cage his eyeballs more or less to do the test. Ride quality, well we didn't abandon the task but improvement is required. I would probably be at the five and half level here but if we have to go with integers I'll give it a five. I will say no for the display.

Exposure 10

DATE: 03Dec97
PILOT: E
TASK: 3015
CARD: Composite Flight Approach and Landing

Pilot E, Exposure ten, Configuration fifteen, Flight Director Tracking Task. Okay, I'm kind of surprised here I was expecting to see exciting the directional snaky motion that I saw on the offset and landing task. We did to an extent, we saw a little bit but I don't think that much, not as much as I was expecting to. We did bomb the sim off for motion on the first run and I had gotten a little behind the flight director and was a little more aggressive with

the input then we probably could use. The kind of compensation that I was using was basically just to back up on the gains a little bit. All the normal comments about the flight director task, I guess we got desired performance both times. Is it satisfactory without improvement? I guess is the question? I guess I am kind of hung up with that question and I am going to look at the descriptors. I don't know that I'd really say it was a moderate pilot compensation but I have a hard time saying mildly unpleasant deficiencies. I'm going to go with a four. Actually, I really don't like splitting these but I'm just going to go with a four and a four. For the CIR I'm going to go with a three. For the ride quality I'm going to go with the five again but you know, for the offset landing task it was a five and a half, five and this is like a four and a half, five, there's a big difference in these five's. But I'm still going to go with a five just because I think improvement would have to be required not just warranted. I could talk myself into doing either way there I think but I'll stick with the five and no on the display question.

Exposure 17

DATE : 10Dec97

PILOT: F

TASK : 1015

CARD: Nominal Approach and Landing Task

Okay, exposure seventeen, straight in. The airplane appears very very lightly damped on the lateral task. Longitudinal, not too bad. And so for the straight in task if we just take it very very easy laterally it ... I really have to back off a little bit longitudinally even to keep from making inadvertent lateral inputs so it really is pretty bad, laterally. But in any case so rating, approach, longitudinal, let's see this is down to two hundred, get it straight here, yeah, it's not bad. Let's give it a four. Lateral, is adequate performance attainable with a tolerable pilot workload? I would say no. That is not tolerable, not to have to keep hands off the stick. Almost seven. Landing, longitudinal, I'm forced into a five because of performance. Yeah, that's it. And lateral again is a seven. And the control, DASE is a three. And the ride is five and the display is a yes but the wiggles didn't bother me. So it's QSAE.

Exposure 17

DATE : 10Dec97

PILOT: F

TASK: 2015

CARD: Lateral Offset Landing

Okay, not as bad as I thought it was going to be. This is for the offset task. Really kind of strange, I can't really explain it too much but the impression was or my anticipation was that it was going to be quite bad during the offset correction. Turns out that it wasn't as bad as I had anticipated, fairly, making relatively smooth inputs. Have got the feed forward for that task pretty well down now. The only place where we really notice, well not the only place where we notice, but where it was really apparent, lateral dynamics were really apparent was on the final bank angle stabilization to get lined up for landing and we got quite a bit of rattling there, to the point of backing off on control a little bit. Approach rating for longitudinal, not too bad. Let's give it a four. I get a little mixed up here between lateral and longitudinal. Lateral is pretty bad. Even for the straight in part of the approach you have to be so darn gentle. Let's make it a seven. And for the landing, longitudinal is a five because of performance. And lateral, definitely a seven because that is where we were getting our worst excitation of the lateral dynamics. Okay, DASE control is definitely a three. The ride is definitely a five and yes but mostly the QSAE and wiggling didn't bother.

Exposure 17

DATE : 10Dec97

PILOT: F

TASK: 3015

CARD: Composite Flight Director Tracking Task

Okay, comments on the flight director. Not as big and impact as I anticipated. Longitudinal is quite easy. Let's give it a four. Lateral is pretty bad but, you know, nice smooth inputs you can keep it under control. There was no impact on the control. So was it moderately objectionable deficiencies? Well let's make it a six, laterally. And the control is a, let's make it a two. The ride is still a five. And the display, no.

Configuration 16 Modal damping increased to 0.30 for modes 2 & 4, damp10

Exposure 5

DATE: 20Oct97
PILOT: A
TASK: 1016
CARD: Nominal Approach and Landing

For the approach longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes. Cooper Harper of three. Again this one, like exposure four, the ASE effects have seemed to quicken the longitudinal axis. It's jerky in the longitudinal axis and if you make a low to moderate amplitude, abrupt input, you get a pretty good ASE effect longitudinally. Laterally, it's not really a problem, I did a number of pretty aggressive rudder doublets and the like and I didn't have any problems up and away. Similarly with aileron doublets, roll doublets, no problems. So a three for longitudinal. Let's go straight away into lateral. Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also. So a three longitudinal and a three lateral for the approach. For the landing task, longitudinal; It is controllable. Adequate performance is attainable. That's true. Satisfactory without improvement? No and rate it a four. Desired performance requires moderate compensation. It's true and the kind of jerkiness in the pitch axis requires a certain amount of compensation but not too bad. Probably if I practice this one a couple of more times I probably could rerate it level one. It's not really, in the flare, not that bad. For the lateral rating, in the landing; Is it controllable? Yes. Adequate performance is attainable. That's true. Satisfactory without improvement? Yes and a three. So overall not bad Cooper Harper wise. For the CIR rating; Pilot does not alter control inputs. I surely did not alter them in the lateral axis but did slightly in the longitudinal axis which makes it a two. But again, like in the previous one, it's not a bad two. It's kind of a borderline one-two. For the ride quality; Vibrations do not impact the ride. That's not true. Vibrations are perceptive but not objectionable. That's not true. Vibrations are mildly objectionable, improvement desired. I'd say that, three. And those vibrations are mainly from longitudinal inputs not from lateral-directional. And for the display question? No, no problem.

Exposure 5

DATE: 20Oct97
PILOT: A
TASK: 2016
CARD: Lateral Offset Landing

Cooper Harper for the approach in longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes for a three. No problems there, a little bit quick just when you make tiny corrections you get an ASE bounce but not really a problem. Okay for the lateral rating for the approach, for off set landing for Exposure five; Controllable? Yes. Adequate performance? Yes. Satisfactory without improvement? Yes, a three. The lateral axis really was not that much disturbed by ASE effects on this configuration. For the landing, for longitudinal rating; controllable? Yes. Adequate? Yes. Satisfactory? No. I got borderline adequate except for the last one which was a little bit long. So it's a real borderline case here. I am really torn, I would like to give it a four but I tend to be a little on the long side so we'll go with a five on this one. This is real borderline four-five and it gets a five because of the criteria. I felt like it really was, flying wise that it felt desired but it

didn't quite make it. So lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I would say no based on the task difficulty and give it a four. It made desired criteria but a pretty high work load. Although lateral is not so bad with this configuration. For the CIR rating, pilot does not alter control inputs. This is also real borderline one-two, I'm going to go with a two on it but it could easily have been a one. I probably just very very subtly was a little bit more gentle in the longitudinal axis. Certainly I was very aggressive laterally. For the RQR, number one obviously is not true. Number two, not true. Improvements are necessary. Three, it'll be a three. Mildly objectionable. And no problem with the displays so that's not a factor. No.

Exposure 5

DATE: 20Oct97

PILOT: A

TASK: 3016

CARD: Composite Flight Director Tracking Task

Exposure five the Flight Director Tracking Task, longitudinal rating; Controllable? Yes it was. Was adequate performance attainable? Yes it was. Is it satisfactory without improvement? I am going to say yes and a three. The longitudinal axis is so quick that it can ... you can make very quick inputs and correct deviations. For lateral task; Is it controllable? Yes it is. Adequate performance attainable? Yes it is. Is it satisfactory without improvement? No, I'll rate it a four. The lateral kind of always been the weaker link here. So we'll go with a three and a four and that three is kind of borderline three-four. It's borderline level one-level two so we'll stick with a three, four right now. The CIR ... Oh, by the way did not notice any pitch PIO tendencies that time. Exposure four had a similar quick longitudinal axis but I did pick up is a few slight longitudinal PIO where as in this one I did not. Now whether it's in the learning curve or whether there are fundamental differences in the two, they had the same flavor although this one seemed a little bit more dynamic in the longitudinal axis and virtually no problem in the lateral and maybe that's the effect. The biggest problem on this task is when you have the two axis correction when you go from a pure let's say pitch input to a descending right or left turn where you've got to get into both axes, that appears to be the problem where I picked up the PIO before and it had a worse lateral mode so maybe there is some coupling there. At any rate for exposure five and those comments were for exposure four. For exposure five, does pilot alter controls as a result of aircraft flexibility? No I did not so that's going to be a one. And for the RQR ... and it did not alter me either longitudinally or laterally. For the ride quality, the vibrations do impact the ride. Yes they do. The vibrations are perceptible and they are objectionable. Vibrations are mildly objectionable, improvement desired. I am going to say, probably a four on this one because I was able to be very aggressive but at the same time we had a couple of pretty substantial motions that I think probably warrant improvement. And for the display question, not a factor.

Exposure 7

DATE : 04NOV97

PILOT: B

TASK : 1016

CARD: Nominal Approach and Landing

Exposure Seven, Pilot B, straight in the approach and landing. Cooper Harper on the approach, longitudinal, was ... gee, think I'm going to give it a three, because we did have

some mildly unpleasant deficiencies. And also a three on landing. The approach for lateral-directional, I guess, it was pretty reasonable, I give it, actually a two, both on approach and landing. DASE CIR rating, let's call it a two and ride quality, gee, it is probably moderately, or mildly a toss up between a two or a three. A three or four, I'm sorry. I'm gonna call it a three. and yes on the display question.

Exposure 7

DATE : 04NOV97
PILOT: B
TASK : 2016
CARD: Offset Landing

Exposure seven, the sidestep maneuver, approach and landing, longitudinal Cooper Harper. There is a lot of oscillations going on and they are quite objectionable. I'd call them moderately objectionable, I'd give that, approach, a four, and the landing, I'm gonna call it a six. Approach for landing six, for longitudinal. Lateral-directional; I could swear that I had, when I started a correction maneuver, that I induced quite a large oscillation or perturbation in either the lateral-directional or pitch or both. I'm not sure what was going on there, but the minute I came in with a bunch of roll, we got quite a large change in the oscillations. So I'm gonna say it's moderately objectionable, a five for lateral-directional for approach. And a five for the landing. The DASE CIR rating, I'm gonna say it's a two, and the ride quality was quite bad, actually, a five with a yes on the displays.

Exposure 7

DATE : 04NOV97
PILOT: B
TASK : 3016
CARD: Flight Director Tracking

What is it, exposure seven, this is the flight director tracking for Pilot B. Longitudinal, Cooper Harper, actually that was not a real problem. Fair, mildly unpleasant, I'd call it three. Lateral-directional Cooper Harper was more of a problem and I'd say it's down in the six or seven area. Very objectionable, I'd call it six. And ... DASE CIR rating is a two. DASE ride quality is moderately objectionable. I'd call it a four with a yes on the display.

Exposure 5

DATE: 12Nov97
PILOT: C
TASK: 1016
CARD: Nominal Approach and Landing

Okay, exposure five, the straight in, offset ILS to straight in. Not quite as bad as the previous one. Most of the oscillations were longitudinal rather than directional. Although the system did respond directionally it just seem to damp out within about one or two overshoots. Longitudinally, it responded and didn't damp out it rung quite a bit. Although it surprised me I thought this would be more objectionable longitudinally, it wasn't. So, either the combination of frequency and damping was different or it didn't bother me as much in any case. The frequency seemed a little bit lower than the previous one. Again, the oscillations are objectionable but control is no longer an issue I didn't feel at least on the

straight ins. It's controllable, adequate performance is attainable. Not satisfactory without improvement. Let's see, in the approach phase, let's give it a four and a four. And on the landing phase, let's give it a five and a four. This is one of those where I'd like to give it a half rating but Dave asked me not to do that. Longitudinal four and a half. It's worst than desired performance. Requires moderate pilot compensation but it's better than adequate performance requires considerable compensation. But anyway, I'll give it a five and a four. For the CIR's, I didn't feel any involuntary inputs this time, surprisingly. Let's give it a three on CIR. Let's give it a four on RQR. No impact with the display. That concludes it.

Exposure 5

DATE: 12Nov97
PILOT: C
TASK: 2016
CARD: Lateral Offset Landing

Configuration five, offset approach and landing. Of course with the increase in work load on the task this one is tougher. The problem is that you excite that longitudinal axis with your roll out to final at relatively low altitude. It continues ringing right up until just prior to the touchdown. Until the touchdown actually. The ringing is associated with the touchdown. It makes precision in the touchdown point in the flare extremely difficult. The work load is pretty high longitudinally. Lateral-directionally it's not. On the approach, you're working pretty hard but it's essentially, the performance that you need is essentially attainable. It's not really measured, by the way, during the offset maneuver and roll in. Just from my expectations, I think what we're seeing is what you need, again, with a tolerable work load. Longitudinal, lateral-directional, it's controllable. Adequate performance is obtainable. It's not satisfactory without improvement. Longitudinal I'm working a little bit harder than lateral-directional. So let's say longitudinal is a five, lateral-directional is a four for the approach phase. For landing, the issue here is tolerable work load. This is another one where the words don't express it adequately. It is controllable. Let's go lateral-directional first. Adequate performance is obtainable, not satisfactory without improvement. Say moderate pilot compensation, HQR of four, lateral-directionally. It's definitely an isolated task issue. Longitudinal, it's controllable. I don't think work load is tolerable so I'm gonna say no on this one. But controllability is not in question. So I'm gonna ignore the first part of the sentence and consider the second part and give it an HQR of seven. I don't think the oscillations are quite as bad as they were lateral-directionally before in terms of fighting for control. So I'll give it a seven. CIR, four. Occasionally I getting involuntary inputs on longitudinal in close. RQR of five, highly objectionable. I didn't notice any display perturbations that time. No. That concludes my comments.

Exposure 5

DATE: 12Nov97
PILOT: C
TASK: 3016
CARD: Composite Flight Director Tracking Task

Exposure five flight director tracking. No real problems. The oscillations were objectionable but I don't feel like they impacted control a whole lot and again, they're predominately in the longitudinal axis. Responds pretty well lateral-directionally. You do get some vibrations but after one or two overshoots it pretty much damps out. So, HQR longitudinally, it's controllable, it is adequate with a tolerable work load. Satisfactory

without improvement. Certainly not longitudinally. Let's say moderate compensation longitudinally, HQR of four. Lateral-directional, I think I'm working a little bit harder than minimal. Let's give it a four as well. I didn't notice any involuntary control inputs. I'd say cockpit vibrations impact the precision, CIR's three and RQR is a four, moderately objectionable. No impact with the display and that concludes these comments.

Exposure 3

DATE: 17Nov97

PILOT: D

TASK: 1016

CARD: Nominal Approach and Landing

Approach, longitudinal lat-dir., they were very similar. I'd give them satisfactory without improvement for the approaches. Three, minimum pilot compensation and it was in pitch, usually have to work just a little bit harder to keep that in the lat-dir., I really didn't see anything with. So a three for the approach, longitudinal / lateral-directional. For the landing, the lat-dir., adequate performance was attainable satisfactory without improvement, I'm going to say no. It's a little misleading when I got that one adequate in there I was working so hard in pitch, I was just letting the lat-dir. go, but I'll stick with a five for the lateral-directional in landing. For the longitudinal that's where the problem is, throughout the whole thing it appeared to be primarily a longitudinal problem. I didn't really feel that much left and right but certainly up and down was pretty ugly. Adequate performance attainable with tolerable pilot workload. I could get the adequate performance especially when I got the throttle taken care of properly. Questioning about the tolerable pilot workload, I'll say Yes. Satisfactory without improvement - No. Six. Six for longitudinal and five for lateral-directional in the landing. For the CIR, yes I did intentionally modify my control input; and again it was in pitch. To avoid excitation, yes - definitely. Precision of voluntary ... Kind of agonizing here over the three or the four, cause occasional involuntary ... No, there weren't any involuntary. I think I'll stick with a three on the CIR and the problem, I'll just again repeat it, the problem was in pitch, the lat-dir. I didn't notice being a problem. RQR did impact ride. Were perceptible, more that mildly objectionable, moderately, improvement warranted. Certainly would be a four at least. Okay, four. I'll give it a bad four but a four. Displays, that time I intentionally varied them and due to my technique, I'm just hawking the HUD and as a result it doesn't bother me that much. Every time I would cross check it with the visual it was a little unsettling but then I would just go right back to the HUD and that seemed to get the job done. So by using that technique then the perturbations didn't bother me. The HUD wasn't moving around so much, just didn't look as though it was in the right place. If I put the flight path marker on the end of the runway like I'd like to do on a visual day I don't think I'd get the right answer, at least doesn't appear that way. I'm just using the one that will give me the right answer. Through technique it doesn't bother me.

Exposure 3

DATE: 17Nov97

PILOT: D

TASK: 2016

CARD: Lateral Offset Landing

Approach for longitudinal, that was where the biggest problem was, it kind of felt like the bottom fell out when I got into the turn, and so on. So it was uncomfortable to say the least,

adequate performance, attainable tolerable pilot workload. Yes, barely. Is it satisfactory without improvement? Definitely not. Six for longitudinal on the approach. Lat-dir. was adequate and satisfactory without improvement? I'm going to say, No. I think lat-dir. is close to desired on the approach as I'm going to get. Maybe it's because the longitudinal overwhelms the lat-dir. so much that I'm concentrating on that so much that I don't notice any deficiencies in lat-dir. I think I might even go with a four on that. I will go with a four with the approach lat-dir. Again, it might be because I'm working so hard in pitch that I'm not seeing the lat-dir. For the landing, for longitudinal, adequate performance, attainable, tolerable pilot workload. Again, barely, a little long. It's definitely a very high workload the tolerable pilot workload makes me come very close to making me turn the corner, but not quite. Satisfactory without improvement, No. And again a Six. Lat-dir. adequate performance attainable tolerable pilot workload and satisfactory without improvement - No. And the time that I was outside of adequate there, I wasn't paying much attention but I would be hard pressed to give that better than a five. So five for the lat-dir. Six and five for the landing longitudinal, lat-dir. For the CIR, I think pretty much the same thing as I saw before. Didn't have any involuntary but it was affecting the precision so a three. And for RQR a four. And the display didn't really impact my precision that I could tell.

Exposure 3

DATE: 17Nov97

PILOT: D

TASK: 3016

CARD: Composite Flight Director Tracking Task

The discomfort and so on just tracks with the rest of it. Primarily longitudinal, this task is a lot harder lat-dir. than it is longitudinal so it didn't surprise me too much. Managed to get some respectable performance out of it. Adequate performance - Yes. Satisfactory without improvement - No. That is a lot of work in longitudinal, even though I ended up with desired all the way, I'm still going to stick with a five longitudinal but a four in lat-dir on that one. And it's the workload and compensation there in the pitch that is dragging it out even though I got the better performance, I have a hard time calling it a four. That's definitely the hard part. And the other thing, is that once you get behind it's real hard to catch up and so if I got away, the first time I managed to stay in and so was making small corrections, it was fine. The next time I'd get off and try to come back to it, that was a lot of work trying to get it back in a lot more than really would like. Longitudinal was five, lat-dir. was four. CIR is going to be the same, three. RQR the same with four and no problem with the display.

Exposure 14

DATE: 04Dec97

PILOT: E

TASK: 1016

CARD: Nominal Approach and Landing

Exposure fourteen, Nominal Approach and Landing. Okay, we did several of these runs, first of all, my observation is, it was pretty easy to excite something in pitch particularly with a doublet kind of movement or any kind of reversal movement of the stick. Also, with any semi-sharp input, even if it was fairly small, you could control the airplane fairly well, as long as you were pretty smooth and used small inputs and were fairly patient. The tendency to go high on the glide slope, down around 150 feet or so that we've noticed before. Maybe

I haven't noticed it, but the display bounces this time with the motion that you're feeling. I think there's good and bad things associated with that one. I think that the display bouncing makes it a little bit harder for the pilot to compensate but I think it's a little bit more realistic and the visual cues and the motion cues are not as discrepant as they are, maybe I'm confused but I thought that we've flown some configurations where the HUD was steady and not bouncing. Anyways ... the motion that we get on final is distracting, it makes it slightly harder to track the glide slope and localizer during the approach, but you could still do that task fairly well. I have a hard time with is it satisfactory without improvement ... to do the task, yeah it is, but I would classify the bouncing around on final that we're getting as being more than some mildly unpleasant deficiencies in fact I would even have a tendency to say that it's even a little bit more than minor but annoying deficiencies. I guess I'm going to temper my dislikes for the bouncing around on final for the tracking, I'm going to give it a three and a three for the approach phase. For the landing phase, though, we did get all desired the last time, I guess. We mostly got adequate performance for one or two parameters mostly related to pitch and again, I'm not sure if it's me or if it's the airplane, but I don't think that the predictability is as good here in pitch as it has been in other configurations. I can compensate for it, but it's hard to get exactly what I want in the very final portion of the flare and even the last time when we got all desired, I had set what I thought would give me the desired touch down at the desired point, at the desired sink rate and we were floating and I saw that so I pushed forward a little bit and we just made it inside the desired box. I don't really like splitting the axis here, but in this case I think it's definitely worse in pitch than it is in roll and I didn't notice that much excitation in roll except for maybe some of what I was either was coupling with the stick or maybe there was cross axis coupling, but it seemed like the abrupt opened loop roll inputs actually caused it to be excited in pitch. You'd have to go back and do an open loop study to really determine that, that's just kind of an impression. Anyway ... I guess I don't like splitting axis but I'm going to give it a five longitudinally and a four laterally directionally. I don't think we had any involuntary inputs, but I'm definitely going to go with a three. I would probably, left to my own devices go three and a half. But if we're going to pick an integer, I guess I'll go with a three. The only reason I say that is, there were a couple times when, ah, a three's good, we'll just go with a three. Ride quality ... getting the motion and that that we get close to the ground, I really don't like, I would probably again tend towards a four and a half here. I guess I could talk myself into going either with a four or a five, I'm really right in the middle on that. I guess I'll give it a four for right now. And on the displays, I'm going to say yes. I'm going to say that the aeroelastic perturbations on the display affected my ability to do the task, but I think it did in two ways as I already covered and I don't want to say that it was necessarily a negative affect. There is a lot of goodness, I guess, in having the visual display and the motion not to be discrepant and that's hard to quantify. On the other hand, if I just play this like a video game and ignore the motion and just try to fly the specific task having it stabilized makes it easier to perform the precision task as long as the stabilized display is accurate. So, there's some good and bad affects there, but the answer is yes.

Exposure 14

DATE: 04Dec97
PILOT: E
TASK: 2016
CARD: Lateral Offset Landing

Okay, I guess the first comment that I would make is that there was a pilot perception that I was inducing some of the longitudinal motion with the roll inputs but I think looking at the

traces that there is probably some slight roll, or some slight pitch input along with the roll input and that was probably exciting it. It's still something worth looking into though on the post data review. Lets see, the approach phase goes down to 50 feet here, basically the longitudinal control, it seems fairly reasonable here. I'd still like it to be a little crisper but it does okay. The best we could get was adequate performance. I think if I really played around here and tried to optimize my gains for this particular task and configuration you probably could eke at desired performance but I think it would take more than moderate compensation to do that. Which puts us down to at least to a five or worse. I don't think adequate performance requires extensive pilot compensation so I'm going to go with a five. Actually, the longitudinal, I'm sorry, the lateral control is really not too bad here. It's hard for me to split up the two though ... I think in this case, I'm not going to split the two, I'm just going to give it a five and a five for landing task and the approach task. And I think that part of that is due to just trying to blend the roll and the pitch inputs together and the impact that the roll has on the pitch, splitting the workload impact of roll and pitch together. One other thing that I noted is we did get some gamma splits all the way down in the flare. What I was doing towards the end to try to stay in the box and it was resulting generally in a higher descent rate was trying to control the actual gamma rather than the commanded gamma and from a work load stand point from just trying to mentally decide what I'm going to go, it's a little more difficult to do that. The other thing is I not so sure when I have a split control how quickly everything responds to the inputs especially down that close to the ground and again, as I noted before there are visual displays that you pick up in addition to using the flight path vector normally when you have a normal visual scene outside that I'm not picking up here with this visual display. Which might help some of that out, but anyway, the point is my biggest complaint is predictability, longitudinal predictability, particularly towards the end of the, well actually for this configuration, probably for the entire flare, but particularly towards the end of the flare. And its this predictability problem that I think is causing the most problem in getting the performance you want and it is my major complaint. I need to give, I guess, give a DASE, yes, I think I would be between a three and a four. I don't think I was picking up any involuntary inputs so I'm going to go with a three for CIR. For ride quality, I'd be between a four and a five, I'm going to go with a five on this task. Again, I would be pretty much at the four and a half level. I'm going to go with a five because especially after we correct making the fine inputs at the end, we've set up some fairly good vibrations or modes that are close to the ground are not good ... that I don't like. And the same comment on the display, the display bouncing around, I think there's good and bad things. Does it affect the task? Yes. But I think there's some pro and con to the display bouncing around.

Exposure 14

DATE: 04Dec97

PILOT: E

TASK: 3016

CARD: Composite Flight Director Tracking Task

Okay, I guess the first thing I would note, is that if I was fairly patient and not super aggressive at following the cue, I actually got better results. As your gains increase, you end up picking up more motion and over controlling and you get worse results. The pitch is, at least where I perceive you're picking up the excitations, and it's the pitch inputs in particular that I have to be easier with. We got desired performance, the tracking task, I guess, again, is it satisfactory without improvement is kind of a big point where I'm having a hard time answering that question. As for as if I just ignore the fact that I don't like the bouncing around and I just look at the part of the bouncing around that effects task

performance, I'd probably give it a three. I don't like splitting the axes here, I guess I have a tendency to give it, I'm going to go ahead and give it a four longitudinally and a three laterally directionally. And I guess the big point there is that I'd like the roll control to be a little crisper, but really the roll's fairly controllable, it's the pitch that really degrades the task and really what I'm looking at there is the minor but annoying deficiencies and the pitch is probably even more that minor but annoying, I don't know, but I'll go with a four. I think we're right on the verge of maybe getting some involuntary control inputs, I would go with a three and a half. I guess if I'm going to pick an integer value I'll just give it a three and for the cockpit vibration, I'd be at the four and a half range. Just because if you do pick up your gain, you, I think you'd start picking up objection motion. So I'm going to go ahead and give it a five there. Display, I don't think the display has as much impact on this one, in fact, thinking back I'm not so sure that I really noticed the display bouncing around as much as I did for the landing configuration. I think part of that is maybe because we are away from the horizon. I think I have the same basic comments but I think I'm going to say no because I don't think it really impacted that much here.

Exposure 15

DATE : 10Dec97

PILOT: F

TASK : 1016

CARD: Nominal Approach and Landing Task

Okay, general comments on exposure fifteen for the straight in task, the lightly damped longitudinal DASE was very apparent in the ride quality but just by smoothing out the control inputs at all, there was very little impact on the control. Longitudinally for the approach, let's make it a five. You have to be careful with what you do with the stick. Laterally for the approach, it's not too bad. Let's give it a four. For the landing, longitudinally, it's a five for both the control and the performance. And laterally for the landing let's give it a four. Okay. Okay, for the DASE. It's a good strong two plus, it's almost a three but it's not effecting the precision. It's just that you really have to be careful. So it's a two plus. The ride quality is getting worse, in fact, I think it's a five. And the display, a yes but again a little QSAE. The longitudinal bouncing doesn't bother me.

Exposure 15

DATE : 10Dec97

PILOT: F

TASK: 2016

CARD: Lateral Offset Landing

Okay, the offset landings and what I suspected might be a problem indeed was a problem. That being that, longitudinally it's very lightly damped and if you can be smooth it's not a big problem from a control input but the offset landing task forced me into being a little bit rough, not being able to concentrate longitudinally as well as I would like, and we got some pretty rough rides there. Kamal noticed something in the approach, but that didn't bother me, but I noticed in the offset correction and going into the flare, I was banging the longitudinal and that makes quite a bit. So I'll take that into account on the ratings here. And the approach, including the offset, longitudinally, it's getting a little bit worse this time. So let's go up the outside to make sure. And I'm going to give it, is adequate performance attainable with a tolerable workload? I don't think it was tolerable. Deficiencies require improvement. Let's give it a seven, longitudinally. And laterally, not too bad, but it is a

difficult task. Let's give it its five. And for the landing, again I just really didn't have a chance to get settled out so I could be smooth. So let's give it a seven. And for the lateral. I don't think I had any problems laterally, did I? Well I did get one out, didn't I? Yeah, let's give it a five. Okay, for the DASE, the control, it's a three. Really couldn't control as well as I would liked to have. No involuntary inputs as far as I could tell. The ride quality is a five. And yes but mostly QSAE. I didn't notice any effect of the banging or the bouncing.

Exposure 15

DATE : 10Dec97

PILOT: F

TASK: 3016

CARD: Composite Flight Director Tracking Task

Okay, the flight director task and it was a little bit interesting there. I didn't get that coupling from the lateral task into the longitudinal task. The longitudinal task just seems to be easy enough that I was able to prevent exciting it. So longitudinally, let's give it a four just for general reasons here, well now hold on. Yeah, really as long as you're smooth, it's really not too bad. Yeah but consciously I have to be smooth. Longitudinally, let's make it a five. Laterally let's make it a five. So this is DASE. The longitudinal was because of the smoothness that you have to use. Lateral is that it's just a poor vehicle for the task. For the DASE ratings, yeah let's give it a two. The ride quality, let's give it a four and a no. (For ride quality that was four?) I concur.

Configuration 17 Modes 1 & 2 control excitation eliminated, cancel

Exposure 20

DATE: 22Oct97
PILOT: A
TASK: 1017
CARD: Nominal Approach and Landing

For the longitudinal rating up and away; Controllable? Yes. Adequate performance? Yes. Satisfactory? Yes for a three. I'll give the lateral rating and then make some comments. Lateral rating similarly; Controllable? Yes. Adequate performance? Yes. Satisfactory? Yes for a three also. This is an interesting configuration. This seems to be very susceptible to turbulence where. I confirm where at light turbulence, three feet per second, for the one sigma case, and the configuration really gets bounced around a lot in that regard. It appears that since it is so susceptible to those kinds of motions in that light turbulence, it must have some mode cancellation going on because the longitudinal inputs really didn't excite anything and it seems like there is some cancellation going on longitudinally. There were no ASE responses at all that I could tell. Occasionally that would fool you though because it would hit some turbulence and it really bounces around a lot. Laterally it seemed to be a little bit worse like it did not quite have as good a cancellation. It appeared to be damped, in that we had three overshoots. We had moderate amplitude responses. The rudder also appeared to be damped and basically, I'm calling damped about three or so, two to three overshoots, well damped say about one or one and half and lightly damped, around five or six overshoots and seven and above is very lightly damped but at any rate that's kind of my personal scale there. The rudder was also damped but moderate amplitude responses. So the lateral-directional axis seems to have some ASE characteristics whereas the longitudinal doesn't. The effect appears to be that you are kind of canceling out the responses in the longitudinal axis and partially in the lateral. But the turbulence really does seem to really kick it around. The landing ratings because it's a fairly good configuration, I had some nice landings, two of them that met all the desired criteria, so for the landing longitudinal; Controllable? Yes. Adequate performance? Yes. Satisfactory without improvement? I would say no and rate it a four. The reason being; the responses to the turbulence or there's some motions going on. My supposition is that it is turbulence related. It's such that really are working ... you're bouncing around a lot and it's a high workload. So I'll give it a four. And the same thing for the lateral rating; It was controllable. Adequate? Yes but not satisfactory. A four again due to workload and the workload is coming about from all the motions you are getting from the turbulence. CIR rating; It's borderline one-two, I probably very slightly modify my lateral inputs because the lateral axis is a little bit active whereas the longitudinal axis is very very well behaved. So we are going to go with a two on that but I'll say borderline one-two and it's only lateral and not longitudinal. For the RQR; vibrations do impact the ride quality. They are perceptible and they are objectionable. Vibrations are mildly objectionable -improvement desired. I'm going to go with a four on that. They just seem to be just enough amplitude there to be a real nuisance and the display question, no problem.

Exposure 20

DATE: 22Oct97
PILOT: A
TASK: 2017
CARD: Lateral Offset Landing

This configuration is a very interesting one, exposure twenty. I would like to come back and look at this later if we have time, maybe at the end of the evaluation week. I can't really tell, it seems like there's a very very delayed response to both pitch and lateral inputs. It may have confused me initially. I may have interpreted it as a turbulence response but I tried a couple of times, I'd make a lateral input and I wouldn't get much, I'd get a little bit of response and then maybe five seconds later or so, I'd get a response. And similarly with the longitudinal inputs, where I'd make an input, nothing would really happen which tends to make me think that it's fairly well controlled and then I would get a kind of a response that would be about four or five seconds later and whether this was just some kind of coincidence, I don't think so. What really keyed me to it is at the first couple of offsets I got all kinds of responses there when I made my correction onto the final and just... the airplanes going nuts and I wasn't doing anything and it made me think that maybe it was a delayed response to my initial fairly aggressive input to make my turn because I was thinking that I didn't have to worry too much about aggressive inputs because it was fairly well behaved and it was more of a turbulence response. So, I am kind of at a loss right now, this would take a lot more perusal of this configuration to figure it out. This is probably not necessary for this task. At any rate so with that in mind now I may be changing my initial impression. Never-the-less for the rating for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three. The same comments apply that apply to the straight-in. For the lateral rating, same thing, let's give it a three. For the landing, looking at the performance, I had an adequate on the first one, a really nice landing on the second one, and adequate on the third one but I really felt like at times I wasn't totally in control of what was going on and initially I was thinking it was a turbulence response but I just couldn't imagine getting that large a turbulence response coincidentally at 100 feet every time after I had made this big aggressive lateral input. So it would just have to be a very coincidental turbulence model. At any rate, so let's go ahead and rate for the longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? No. I'm going to go ahead and rate it a five because of adequate performance was attained at a high workload and the predictability I didn't particularly care for. Let's look at lateral; Controllable? Yes. Adequate? Yes. Satisfactory? No. I met adequate performance or desired performance rather but the workload was high enough that I'm going to give that a five also. The CIR; I really did not intentionally modify my inputs, however I think I may have gotten bitten by that, you know, after that lengthy delay so I am going to have to rate that a one even though ... and that's why this configuration is so interesting. I was thinking it was something a little bit different that what it may end up being. Let's go for RQR; definitely the vibrations are a nuisance so we can go down to at least number three. I am going to go with a four right now and I'm going to caveat that with that this configuration would be one if I was just going to buy this airplane, I would want to do a lot more investigations. I think this configuration may have some cliffs in it and not bad ones but this is enough of a mystery that it would warrant a lot further study. For the display question, the answer is no.

Exposure 20

DATE: 22Oct97

PILOT: A

TASK: 3017

CARD: Composite Flight Director Tracking Task

This is flight director tracking task for exposure 20 which is, I think, one of the more interesting configurations we've had. Some interesting things went on -I did some straight and level flying at the end of the last task, just left it alone and we do get these ... about every

... intermittently but not all the time, not continuously, these fairly large amplitude disturbances that obviously are caused by turbulence since I'm not doing anything. I was hands off. But there is also a correlation between me making an aggressive input and about six or seven seconds later seeing a response so I'm kind of really torn. This would be the one that I would spend a lot of time looking at. There are several of them but this would be one in particular. At any rate, the task, I met the desired criteria. I probably could attain that better but I was actually to be aggressive and try to stimulate these responses, these delayed responses. For the longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, a three. The lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No, a four. Once again lateral workload a little bit higher. For the CIR rating; I was very aggressive. I had absolutely no compunction about being aggressive so let's give that a one. In both axes for the ride quality, it certainly is objectionable so let's go to three. I would say probably a four on this. Probably we do need ... it's a little bit too high an amplitude in disturbances to let it go. (So that's a ride quality of four?) Yea a ride quality of four. And let's go with a no for the display question. Again I kind of torn here as to what is going on, it's either ... I think we do have turbulence responses and I just have a gut feeling that we have some kind of really delayed ASE responses from pilot inputs.

Exposure 16

DATE : 05NOV97
PILOT: B
TASK : 1017
CARD: Nominal Approach and Landing Task

Okay this is exposure sixteen. Straight in landing, approach and landing. Cooper Harpers for the ... what did we get? We probably got mostly desired? Okay, so, it's mostly desired do you think? Could give it a, I guess, a three ... the approach part was a two. The landing part was a three for longitudinal. The lateral-directional of, is that the one that did the most exciting? Maybe if we came out okay on the lateral, it was all desired. Two for the approach, three for the landing and the influence on the controls, since the ... actually we were seeing involuntary control inputs there. I'll give it a four on the DASE CIR rating and the ride quality was not very good. A four on the ride quality and a yes on the display.

Exposure 16

DATE : 05NOV97
PILOT: B
TASK : 2017
CARD: Offset Landing Task

Sixteen, Okay. Exposure sixteen, the offset landing. Cooper Harper longitudinal approach and landing. Getting, generally adequate to desired, but mostly adequate. The approach I think I'll give it a four and a four. Well I ... I think that I'll change that. The approach a four, the landing a five. The Lateral-directional Cooper Harper, what did we have desired in that one? Adequate. Give it a ... the approach I think I'll give it a three and the landing a four. The DASE CIR ratings, a three and ride quality was not very good, like it's probably a five and a yes on the displays.

Exposure 16

DATE : 05NOV97

PILOT: B
TASK : 3017
CARD: Flight Director Tracking Task

Okay this is exposure number sixteen. Flight director tracking task. Longitudinal Cooper Harper's; We got desired performance, so I guess I'd say it was a two and the lateral Cooper Harper a three. The DASE CIR rating, a two and the ride quality, I think we're gonna have to give it a five. The aeroelastic display perturbations, I guess yes is the answer there.

Exposure 16

DATE: 13Nov97
PILOT: C
TASK: 1017
CARD: Nominal Approach and Landing

Exposure sixteen, offset ILS approach, straight in approach and landing. On the approach, fairly clearly level one despite the background oscillations. I didn't like the oscillations but it wasn't causing me significant problems prior to the flare. So I'll give it minimal compensation for desired performance, threes on both, three and a three. On landing, same thing lateral-directional, minimal compensation. Longitudinal however, I feel like I'm working a bit. Its controllable, adequate performance is attainable, not satisfactory. This is one of those where neither statement for four or five is true. So, I'm gonna give it a four. I'm gonna give it the benefit of the doubt. Lateral is a three, longitudinal is a four. CIR is three, RQR is five, really vibrating. I didn't notice any display impact that time.

Exposure 16

DATE: 13Nov97
PILOT: C
TASK: 2017
CARD: Lateral Offset Landing

Exposure sixteen, offset approach and landing. This time definite effect from the abrupt inputs. The issue seems to be how abrupt the input requirements are. If you got to put abrupt inputs in, you're really shaking it and it's impacting the precision. If you don't it's fairly benign. It's just objectionable from a ride quality standpoint. So on the approach and landing, same ratings `cause all this is occurring basically from a hundred feet on down to touchdown. Lateral-directional, HQR of five. Considerable compensation longitudinal. The issue is, is it a five or a six. I'm gonna say a six. On that last landing I was really working longitudinally. So give the lateral-directional a five and the longitudinal a six. CIR is four, RQR is five. No display impact.

Exposure 16

DATE: 13Nov97
PILOT: C
TASK: 3017
CARD: Composite Flight Director Tracking Task

Exposure sixteen, flight director tracking. I was saying, you get sharp edged with it, it really punishes you for it by increasing the oscillations. So it's impacting the precision. Okay, longitudinal HQR, let's give it a four. There's a lot of compensation going on here. I was a bit aggressive with it that time but it was really fighting me. So, obviously controllable, adequate, not satisfactory, moderate compensation, HQR of four. Same thing lateral-directional, HQR of four. CIR is three, I don't recall any involuntary inputs but there's a definite impact on precision and ride quality is five. It's really shaking around. No display impact.

Exposure 12

DATE: 18Nov97

PILOT: D

TASK: 1017

CARD: Nominal Approach and Landing

Okay, for the approach, adequate performance all the way around. Satisfactory without improvement? Yes. Longitudinally on two out of three I got off, and I think it was just from not concentrating on it but I did get adequate twice so I guess I'm gonna have to say that I had to use compensation, moderate compensation to keep that, so Four for longitudinal on the approach and lat-dir. was satisfactory without improvement, a Three. So Four and Three for approach. For the landing, adequate performance? Certainly. Satisfactory without improvement? Seemed to fairly consistently touchdown just a little bit hard so I'll have to turn the corner here, and a Five. It wasn't more than considerable pilot compensation to keep it in adequate, so it was a nice Five. Lat-dir. I really didn't see very much, didn't have to exercise it an awful lot and in the turns it didn't bother me, so a Three for that. Five and Three longitudinal, lat-dir. for the landing. Did you get that? Is that okay? (Yeah.) Okay, and CIR, Two and RQR, Three. That's really the, probably get a better check at that later. But, ugh, certainly wouldn't be any worse than that and display? No.

Exposure 12

DATE: 18Nov97

PILOT: D

TASK: 2017

CARD: Lateral Offset Landing

On the approach adequate performance was attainable. I saw a very definite felt structural even left/right oscillation throughout it. It was enough it took concentration off the pitch but for the approach part I could certainly get the satisfactory all right, I could certainly get adequate performance it wasn't satisfactory and so ... I would say Four for pitch on this one and Five for the lat-dir. and that was due to the extra compensation due to the oscillation, so longitudinal Four, lat-dir. Five for the approach. For the landing, there was still some residual oscillation that took a fair amount of concentration on ... and that may have been what contracted from the pitch but in any case I consistently only got the adequate performance for pitch. So longitudinal landing Five and lat-dir. I'm going to also give a Five due to the compensation. It was fairly consistent to get the - - with one exception fairly consistently got adequate performance. Actually got desired, I take that back got desired and it was still adequate even when it, I lost it a little bit, so I'll stick with that, Four and Five longitudinal, lateral-directional landing. Okay for CIR I would say Three. And I'm not getting much in the way of involuntary controls but the technique I'm using is very light

touch on the controller. For RQR ... that's pretty bad, certainly a Four. I would think that would be a Five for lateral-directional oscillations and I'll say No on visual. I don't recall it specifically being a problem. (..... Four/Five for your longitudinal lateral on your landing?) Uh huh. (Okay, good.)

Exposure 12

DATE: 18Nov97
PILOT: D
TASK: 3017
CARD: Composite Flight Director Tracking Task

And... Adequate performance attainable? Certainly. Satisfactory without improvement? It's kind of hard with those scores to say needs much else. Actually, I'm surprised that one worked out as well as it did, but it did. So, I think I'll say it's satisfactory without improvement, a Three. And that's certainly longitudinal and even the lateral-directional, I don't know maybe I'm learning it too well or something but it didn't seem to cause a problem. From CIR? I would say Two is correct and RQR? A Three it was still the ride quality, was not bad but it would be nice to have that fixed. So Three and Display? No.

Exposure 15

DATE: 04Dec97
PILOT: E
TASK: 1017
CARD: Nominal Approach and Landing

Basically, just from playing with it a little bit on the intercept leg, it looks like we have a tendency to excite things more in roll than necessarily in pitch. The approach task, it's pretty easy to track the glide slope and the localizer. The bouncing around is a little bit, affects your ability a little bit, but not much. I probably did back off on my roll control inputs a little bit, so I'd probably give it a three and a three for approach tracking, I guess. And, for the landing phase, we got desired once and adequate once. The adequate one, though, I was a little bit late in initiating the flare and I think that why we landed a little bit short, a little bit firm. I would say that for this task it's going to be interesting the see the offset landing task, but for this task I'd probably be inclined to give it a four and a four for the landing. The CIR, I would probably give it a three just because, I'd probably be in the two and a half to three range here. You definitely modify your control inputs and roll a little bit, the vibration impacts precision a little bit, well lets think about this, I guess for this task I'd say I'd give it a two, not a three. It's enough that it probably effects for small roll adjustment but for small you're pretty slow and we weren't picking up that much, so we'll go with a two for CIR. And for ride quality, I'd go with a three, I guess and no on the display.

Exposure 15

DATE: 04Dec97
PILOT: E
TASK: 2017
CARD: Lateral Offset Landing

I guess basically the approach phase goes down to fifty feet here, so I'm going to kind of rate them together. We got desired performance on the first try. The second try we got adequate, just a little bit long outside the desired box, actually 250 feet long outside the desired box. Anyways ... I guess, again it's really hard to divide out my predictability comments from maybe things that, small changes in my technique versus the airplane but it seems, my perception is the predictability is a little bit better in pitch than it has been in the past on some of the configurations. And we're not seeing as many split gamma cues in the flare. I was surprised, I was expecting to pick up some more vibration than we did, although we still picked up some pretty significant vibration when we do the turns to align ourselves with the runway. I think the pitch axis is better than the lateral-directional axes, I'd probably go with a four and a four, I guess, although, I guess I'm a little bit tempted to go ahead and split the axes here and give it a four and a five. I'm going to go with a four and a four, I guess, although, the same kind of note before, that's kind of disregarding the impact of the vibration as far as comfort level and just looking at the impact of vibration on my ability to fly the maneuver. The vibration that we're picking up in the latter portion of the short approach like from 150 feet down is enough that it would push my comfort level on a regular airplane, I would be looking at maybe going around unless I was sure that I knew what it was and I was sure that it was just normal. But anyways, going down to the CIR. It's a three, I do temper my roll control inputs a little bit and getting bounced around on the final portion, does impact my ability to precisely control things some. I could maybe, I probably would be looking at a two and a half, if we were doing half's, but probably more towards a three. And for the ride quality, I am going to go with a four, I guess. I was really looking at a five, between a four and a five, I guess. Again, I don't know, I could probably go four and a half. I could probably talk myself into a four or a five. We'll go ahead and go with a four. The display does bounce around a little bit. Same comment, I think there is pro and con to bouncing around the way it does. But I didn't notice it, maybe I've gotten used to it but I didn't notice it bouncing around as much on this run as I did on one of the previous two runs. I forget which one it was. One of the previous two configurations. So I'm going to say no on the display.

Exposure 15

DATE: 04Dec97
PILOT: E
TASK: 3017
CARD: Composite Flight Director Tracking Task

I felt like I got ... to excite things with roll commands more so than pitch, the airplane bounces around basically in the turbulence to begin with. We're, I guess I'll go with a three and a three. Although, I think the bouncing around that we get, again, that's the same comment that I'm basically looking at the turbulence and ability to do the task. The turbulence is kind of bothersome. I guess, I'd probably be looking at two and a half, I think just the bouncing around is enough that it probably pushes me to a three. For the DASE, ride quality I'm going to go with a four.

Exposure 8

DATE : 09Dec97
PILOT: F
TASK : 1017
CARD: Nominal Approach and Landing Task

Okay, rating the straight in task for exposure eight configuration. Just some general comments. The control no apparent effect on the DASE but the DASE is providing a poor ride quality with a borderline effect on making precise control inputs (difficult), particularly laterally. Okay, pilot ratings for the approach, longitudinal down to two hundred fifty feet, okay ... taking into account the ride quality, longitudinal is not too too bad but let's give it a six. And laterally let's give it a seven. So this is ride on both of them. And landing, even though we were getting desired performance, I think it was a fluke so I'm five's on the longitudinal performance by definition, but that is not the overriding thing. Let's give it a six because of the ride and a seven on lateral because of the ride just as in the approach. (The longitudinal ratings for both approach and landing were changed to five in the comments for the offset approach and landing for exposure eight.) And the DASE ratings, let's give it a three on the control with a comment that it's just borderline. Just ... it's just to the point where that's possible. Okay, for the ride is a five and for the display, yes. The vibrations really didn't seem to bother me too much on the straight in. It might be worse here on the offset but let's say mostly QSAE again. Okay.

Exposure 8

DATE : 09Dec97
PILOT: F
TASK: 2017
CARD: Lateral Offset Landing

Okay, my general comments are kind of ditto from the straight in except at least on one approach there I almost felt like I was exciting the lateral modes. On the third approach I made some intentional abrupt inputs and it's really hard to see that I'm exciting it. It may have been a patch of turbulence on that first approach and the ride quality just due to the turbulence, laterally, is so bad that it might be a little hard to sort out there. In any case, approach, pilot rating down to fifty feet now, and I think on the straight ins I was down rating it to six's longitudinally, it's really a little better than that longitudinally, I think. I think we can go back and change the ratings on the two longitudinal ratings previously. On the straight ins, let's make them five's on longitudinal. Looking a little closer this time, it's mostly lateral. When I say ride, I mean the thing is just whacking around and if it had been coupling into the control task I would have commented that way. So it's primarily just the fact that I think that's objectionable. You know, that goes along with that. For instance when I said six, I mean that the ride is very objectionable. Okay, so on this one, let's give it a five and a seven for the approach. Yeah, because laterally it requires improvement, definitely. Longitudinally, it's not too bad. Okay, landing. I think five and seven again. And this is all primarily ride. The lateral is marginally getting bad enough that it's effecting control inputs but not much. Okay, we've got five, seven, five, seven and now we need another rating over here and let's give it a three, a five and a yes. Now I think still mostly, DASE but I think in the offset the Wiggling was bothering me a little bit. Mostly QSAE, I'm sorry. Wow, those acronyms. Okay that does that.

Exposure 8

DATE : 09Dec97
PILOT: F
TASK: 3017
CARD: Composite Flight Director Tracking Task

Okay, on the flight director, exposure eight. I think, just my overall comment is that the lateral ride qualities are pretty bad. But giving it a rating, stand by. I'm a little bit behind here. Longitudinally, let's give it a ... Well we got desired performance, didn't we? Let's give it a four. Wow! Laterally, let's give it a seven, primarily ride, with marginal control. And what I mean I that is, is that it's almost to the point of impacting the lateral control. Okay and the DASE. Okay, the control, let's give it a three again. The ride, let's give it a five again. Am I being consistent? Yeah I am. And no on the display. It's not bothering me. I opened my mouth and made a comment about lateral PIO to Boeing south here. But that's just a feature of this particular lateral control system had which I have had always through Ames.5 and on this simulation also. Occasionally I get into just a little bit of a lateral PIO and this strictly a rigid body effect and I think it's caused by just slightly loose in roll. For instance, if you put a fairly good roll rate in and let go it, takes five or ten degrees to snub it down.

Configuration 18 Modes 1 & 2 control excitation eliminated, modes 1-4 damped at 0.07, canc2

Exposure 13

DATE: 21Oct97
PILOT: A
TASK: 1018
CARD: Nominal Approach and Landing

The straight-in landing Cooper Harper for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. This airplane appears to have all the characteristics of a mode canceling configuration in that I could do about whatever I wanted with the airplane and not trigger any ASE modes however I am getting bounced around to beat the band in light turbulence. And at times, due to the random nature of the turbulence, I get some maybe, sort of seemingly light damped motions that were slightly less in moderate amplitude but enough to be a nuisance. But it was in no way related to any of my inputs in any axis. However it still did not effect the performance for the approach. Similarly the lateral rating will be a three also. No problems there. For the landing; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? I'm going to say no. Had two pretty nice landings and one slightly firm and slightly short that I'm not sure but may have been triggered by me not having the flare attitude established due to some of the turbulence induced ASE motions, it's difficult to say. But certainly we went right through ground effect and had the firm touchdown. I could have just been late in establishing the flare. It could have also been the result of ASE effects. At any rate, I'm kind of borderline desired-adequate. I'm going to rate this a four. I think, I wasn't working that hard but pretty much some things are out of my control. For the lateral ratings; Controllable? Yes. Adequate? Yes. Satisfactory? No, we're going to go ahead with a four on that too. Met the desired criteria but I had a little bit of a high workload. The effect of the ASE modal characteristics are more in the longitudinal axis than the lateral. I had more of seemingly vertical accelerations that I felt rather than lateral accelerations. For the CIR chart; Pilot does not alter control inputs as a result ... that's true, so that's a one. They actually did nothing to effect ... I had no impediments what-so-ever placed upon myself to make inputs. I felt free to do whatever I wanted. Ride quality, vibrations do not impact ride. Not true. Vibrations are perceptible but not objectionable. That's not true. Vibrations are mildly objectionable -improvement desired. Vibrations are moderately objectionable -improvement warranted. I would say a four. They were kind of annoying, I thought. I seemed to dislike them more than the ones actually I caused myself and I guess that's because I'm not in control of them. And no for the display question.

Exposure 13

DATE: 21Oct97
PILOT: A
TASK: 2018
CARD: Lateral Offset Landing

For the rating, up and away, longitudinal-lateral; Same comments as applied to the straight-in, a three and a three. A real nuisance -the motions excited by the turbulence are really a nuisance and I'm finding that they are really uncomfortable for me. I don't particularly care for this. I would much rather generate my own motions than to have them generated for me. So this is kind of not an enjoyable exposure to fly. But still you can maintain the

desired criteria quite handily in both lateral and longitudinal axis. For the landings, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? No and basically it's a little bit difficult. I was even trying to dump the nose in this correction turn but for some reason it is just kind of difficult to establish a flare just where you want it. I am able to set up a good attitude for the sink rate but it is just tends to want to float and I've had this problem on my off set landings across the board. Where I've tended to float a little bit long and what I'm thinking is happening is as I come out of that final turn correction fairly aggressively there is a lot power on the airplane and I think it just takes time for the engines to unspool and so I'm not decelerating at the same rate as I am on the straight-in. That's kind of just my guess right there but there's some reason why I continue to float a little bit long on these off sets. At any rate for the longitudinal rating; We determined that adequate performance was attainable but it was not satisfactory. It looks like it's going to be just borderline desired-adequate and we'll rate it a five longitudinally. For performance, it's borderline four-five. You might note that. And for the lateral; Similarly, adequate performance is attainable, workload ... we'll give it a four. Did a pretty good job on the lateral performance. For the CIR; Number one is clearly the right one. Did not do anything to alter my control inputs as a result of flexibility. For the RQR, certainly we need improvement. I would say a four probably. It certainly would be nice to make them but I don't think you could say it's absolutely required but it's kind of borderline four-five as was the previous ratings for the straight-ins. We're really kind of on the border where really you need something, where you are going to have to have an improvement or it's really really strongly warranted. And no for the display question.

Exposure 13

DATE: 21Oct97
PILOT: A
TASK: 3018
CARD: Composite Flight Director Tracking Task

Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Lateral; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for another three. No problem at all this is ... I command whatever I want, it's just a very annoying motion due to the turbulence induced ASE effects and it's just very annoying but it does not seem to effect Cooper Harper. For the CIR; One again is the rule here, I didn't do anything to, that I could consciously tell, that changed my inputs based on flexibility concerns. RQR, it certainly is objectionable so let's move on down to the three's and four's down there. It is more than mildly, I find that it's at least moderately ... looking at the ride quality from the pilot's station, kind of thinking from the handling qualities point of view, I would rate it a four. If I thought about how I felt about it, I would rate it a six but I guess I better stick with a four on that. I just found that very very uncomfortably objectionable.

Exposure 19

DATE : 06NOV97
PILOT: B
TASK : 1018
CARD: Nominal Approach and Landing Task

Okay, this is exposure number what? Nineteen. Straight in approach and landing. Longitudinal Cooper Harper were mostly desired but we had slightly over in the adequate range on the sink rate. Approach, I'd call it a two and a four for the landing because the

sink rates were a little high, but frankly I think that was mostly attentiveness and probably could have been lower. Lateral-directional Cooper Harper was all desired, I'd give it a two for approach and landing. DASE CIR ratings were a one and I did not see any particular problems with the vibrations. I'd give it a two and a no on the displays.

Exposure 19

DATE : 06NOV97
PILOT: B
TASK : 2018
CARD: Offset Landing Task

Exposure nineteen, offset landing and approach. Cooper Harper for the approach, I guess we'd call it a three. For the landing a four. Lateral-directional for the approach a two, and for the landing, was it adequate do you think or desired? Probably desired, yeah, I'll give it a three. DASE CIR ratings; a one and a two for the ride quality and a no for the display impact.

Exposure 19

DATE : 06NOV97
PILOT: B
TASK : 3018
CARD: Flight Director Tracking Task

Exposure nineteen, ratings for flight director tracking and capture. Longitudinal Cooper Harper, two. Lateral-directional, three. DASE CIR rating is a one and a two for the ride quality. No on the displays.

Exposure 2

DATE: 10Nov97
PILOT: C
TASK: 1018
CARD: Nominal Approach and Landing

This is Pilot C, nominal approach and landing, exposure two. Okay HQR for the approach. Objectionable, mildly objectionable oscillations, but certainly not unsatisfactory. Control was not really influenced during the approach phase. So I'm gonna say both longitudinal and lateral-directional, controllable, adequate and satisfactory. It's borderline but I'm gonna say it's at minimal compensation HQR of three. The issue there would be ride quality and I'll talk about that after I finish the whole thing. Landing is controllable, adequate, I'd say it's not satisfactory. Desired performance ... this is longitudinal now, desired performance requires moderate pilot compensation HQR four. Lateral-directional though, I'm gonna give it a three. This is baseline airplane basically. All the issues here I think were ride quality. If the frequency has gone up on the oscillations, I'm not sensing any coupling between the inputs and the oscillations so control isn't an issue here. It's predominately ride quality. So the CIR, I'm gonna say they effect the precision of the inputs. I'm not sensing any involuntary inputs at this point so I gonna say it's a three. The RQR though, is ... well the issue is whether it's moderately or highly objectionable. Let's call it call it moderately objectionable. Improvement is definitely warranted on this.

Customers certainly are gonna complain in the back. Let's give it an RQR of four. Display perturbations did not impact anything. I'll say no that, and concludes these comments.

Exposure 2

DATE: 10Nov97
PILOT: C
TASK: 2018
CARD: Lateral Offset Landing

Okay this is Pilot C, exposure two lateral offset landing task. I was able to get desired performance but I think the work load is pretty high here. This doesn't feel like a level one configuration. The baseline doesn't feel level one to me either. So in the approach, longitudinal, lateral-directional, controllable, adequate, not satisfactory, moderate pilot compensation desired performance HQR four. That's both for longitudinal and lateral-directional. The lateral-directional associated of course, with the lineup. The longitudinal associated with establishing correct glideslope going up to the flare. On the landing, same thing. I'm doing last minute lineup corrections all the way down, touch down. And of course longitudinal is the sink rate trade off with landing distance. So on both of those again, controllable, adequate, satisfactory, moderate pilot compensation, HQR of four. The oscillations aren't really effecting control a lot, here. It's responding pretty well to the abrupt inputs. It's just an annoying background vibration that occurs frequently. So, I think you'll see that reflected in the DASE ratings. The CIR, there is a little bit of precision effect in the cockpit vibrations. When you start making the fine controls down low the vibrations are effecting that a little bit. And that's adding to the work load that results in the HQR of four. So, I'm gonna say that's a three on CIR. RQR, whole different story. Again I'd kind of like to give half ratings here. It's between moderately and highly objectionable. I'm gonna say moderately, 'cause I felt a lot worse before. Get an RQR of four. Occasionally the display perturbations are impacting ... I'm noticing some vibrations in the display, which is a little bit disconcerting. So, I'm gonna say yes on that question on the bottom. That concludes these comments.

Exposure 2

DATE: 10Nov97
PILOT: C
TASK: 3018
CARD: Composite Flight Director Tracking Task

Pilot C, exposure two, flight director tracking test. Slightly different technique on the two runs. The first one, I kind of held myself to real stringent criteria and I got it. I was able get 90% within the inner circle. But I would have called have that moderate on compensation both longitudinal and lateral-directional. The second one I kind of relaxed compensation to what I would consider minimal. I was still able to just get desired performance. Level one, it's borderline level one, but I'm still gonna call it level one. So longitudinal and lateral-directional, I don't think either one are harder than the other. That's controllable, adequate, just satisfactory. Minimal compensation, HQR threes on both of those. DASE, occasionally I'm modifying the control inputs a little bit but not a whole lot. Boy! it's either a one or a two. I'm gonna say a two. Just 'cause there is some vibration there that's noticeable and mildly objectionable. Last one I'd say, RQR of three, mildly objectionable. Improvement would certainly be desired from a ride quality standpoint but not required this

time. It didn't feel like as much of an impact as the other tasks and display perturbations didn't impact anything on this one. That's a no and that concludes these comments.

Exposure 2

DATE: 17Nov97

PILOT: D

TASK: 1018

CARD: Nominal Approach and Landing

Okay, for the approach both longitudinal / Lateral-directional were satisfactory without improvement, just the same minimal little compensation is required so three's for the approach in both longitudinal / lateral-directional. In the landing for longitudinal, adequate performance attainable, tolerable pilot workload. It was and I'd say with tolerable pilot, satisfactory without improvement, no, sure warrants improvement and I got desired once and actually got inadequate on the second one, didn't I? But, its ... You were adequate on the second one? Okay, good. Then Five. I really question the ability to consistently do the desired and adequate, I think I could consistently do so, Five. And it was just ...considerable pilot compensation. It wasn't ...Okay, CIR I didn't really modify it for that, I didn't intentionally modify it at all now that, come to think of it. Okay, I'd say a two, I'll go with two on that because there was a little bit when I got in close, had to just back out a minor amount but that would be an intentional modification input and RQR perceptible ... mildly improvement desired, naw. I think I could probably live with that. I'd say two on the RQR. Probably being kind of nice to it there, but I could live with that amount of ... Okay, I keep forgetting the display here perturbation impact these. No, I'd say. The perturbation didn't bother me.

Exposure 2

DATE: 17Nov97

PILOT: D

TASK: 2018

CARD: Lateral Offset Landing

For the approach longitudinally, with the offset and everything is not satisfactory without improvement but it was not horrible, in fact I was thoroughly happy with the pitch control throughout the offset and everything so I could even say that was probably four. For the approach in longitudinal. Lateral-directional in the approach, satisfactory without improvement. No. And I got five on that. The first time everything just fell into place which is nice but two out of three times that was not the case so a five on that. Now for the landing longitudinal adequate performance attainable with tolerable pilot workload. I'm going to say yes, satisfactory without improvement, definitely not. And boy, I had to work like crazy I thought, even though I did get desired once the other times. The thing is if your not really set up when you roll out then you've got to work really hard in longitudinal especially. My case, Six. And Lat-dir. for the landing, adequate performance, Yes. Satisfactory without improvement. See I don't know, I think those were all desireds, weren't they? Did I have any "Y" that was out? Yes. I did ... Okay, then five. (Sorry, no you didn't, all the "Y's" were desired.) Okay, well it's between a four and five. Because it's one of those where it's fairly easy to get adequate but it's struggle to get the desired, I stick with a five on that. Then for CIR, all their control ... two again, it wasn't ... I wasn't as nearly as concerned about any flexible modes that time as some, so a two on that and RQR,

perceptible. Yeah, I'd say two on that also. RQR is two. Display was not a problem, not a factor.

Exposure 2

DATE: 17Nov97

PILOT: D

TASK: 3018

CARD: Composite Flight Director Tracking Task

For longitudinal certainly adequate, satisfactory without improvement. The pitch, I never seem to have much trouble with that, the problem is more Lat-dir. on this. So I am going to say that it's satisfactory without improvement and three for longitudinal. For lat-dir., satisfactory without improvement, I'm going to say no and turn over and give that a four. There were times in there that I hated to put in as big a roll input as I'd really like to just because I didn't want to get things stirred up and it just took more compensation trying to keep it in there left and right, so four on that. CIR I didn't think the DASE influence was a big deal at all, I'd give that a one on the CIR. RQR, certainly noticeable, two on the RQR. The display perturbation did not play a part.

Exposure 13

DATE: 04Dec97

PILOT: E

TASK: 1018

CARD: Nominal Approach and Landing

Okay, December 4th, Pilot is E, Exposure thirteen, Nominal Approach and Landing. Okay, we are feeling the turbulence a fair amount, picking up some of that galloping motion that we talked about before on the final. It seems like the perturbations that we feel in the airplane are a function of the turbulence and not necessarily a function of the pilots inputs and that's from some open loop little pulses that I did while we were on the intercept leg. The intercept and the approach phase, I don't really see any problem at all and I would probably give them a two and a two for longitudinal and lateral-directional. For the landing task I think I would probably go for a three and a three. One thing that I notice here, I got adequate twice and desired twice out of four runs. The little flare guidance or information that comes up in the cue, everything seems a lot more predictable here than what I saw in the configurations we flew yesterday. I get exactly what I'm expecting to get. I was kind of fudging the cue, I think for maybe the last couple of runs we did yesterday slightly low because we had a tendency to float I thought yesterday. Basically I can bring the cue right back up to just below the horizon and I felt, my perception is that I'm getting fairly consistent results out of what I've seen in the display today. For the CIR I would probably, I think I would probably go with a one for the control inputs. I don't really think I had to alter my control much at all and probably not any. I might tend towards a one and a half but I really didn't find myself trying to compensate for the flexible modes for this task and I would probably give it a two for the ride quality and a no on the display. Although, the same comments that I noted early for the display as far as it seems like the cue marches up to the runway where it really should be fixed on the runway. One other comment that I had is that we did get a few excursions, not many where the cue split in gamma. Mainly though we're still getting that split. I don't know that we're getting it every time but my recollection is we got a couple splits right around the 150 foot AGL point that we've seen in the past.

Exposure 13

DATE: 04Dec97
PILOT: E
TASK: 2018
CARD: Lateral Offset Landing

Configuration thirteen, Lateral Offset Landing. Okay, we did several runs on this one. First of all laterally, I could ... it seemed like my control input really didn't do much to excite any structural modes as far as I would feel ... you know, in vibration or anything like that. I could even use full roll control for the lateral offset task. I did do that at times and again I think that goes back to my comment that I wouldn't mind it being a little bit crisper in roll for this task maybe a little bit more roll control power, I guess. The turbulence is present and for light turbulence, or I guess you guys are calling it mild turbulence, it's quite a bit and you get that galloping motion on final which I don't like very much. Anyway the main thing that I saw on this task that I didn't see in the tasks before, particularly close to the ground, we were seeing a lot of splits in the commanded versus actual cues. Now maybe because I felt I could put in the stick inputs without exciting the structural mode too much. Maybe I was being more aggressive or too aggressive in pitch but I think my pitch inputs, at least on some of the runs, at least what you would expect a pilot to do trying to do this task. I think because this is a little bit more of a high gained task both in pitch and roll that maybe we were maneuvering more and there can even be some coupling of axis here, I'm not, I don't know. I do think that predictability suffered in this maneuver for the pitch control. It becomes very difficult for the pilot to correct when he has to split cues up there, it's a very busy display. It takes a while for the pilot to mentally grind through the process of what kind of correction to make and for which cue and how to do it. So, anyway, I guess my main complaint would be predictability in the last 150 feet of the approach to touch down and maybe we didn't see it in the straight in approach as much because it's not quite as a high gained task and there is not as much maneuvering in both axes. In Cooper Harper for the approach, now lets see the approach segment goes down to 50 feet here. If I was going to rate the approach it would still be probably, I think we gave it a two and a two the last time but following the glideslope and the localizer down is not a problem at all. For the offset maneuver you can use full deflection on the roll if you want to. You don't really need to do this task but your close to it, we never got desired performance, so that would really put us in a five or lower range. The airplane flies pretty good but the predictability, especially being able to nail the touch down point at a decent rate you want is difficult. I would probably say a five and a five. This is one of the better lateral axis that you have and I might almost be able to say a five longitudinally and a four ... I really don't like splitting the axis but I think I will here. I think I will give it a five longitudinally and four lat/dir. for both the approach and landing. So a five for longitudinal, a four for lat/dir. I think I'm going to say it is a one for control inputs. For ride quality, I think I'm going to drop down and I probably should have on the other ratings too, I'm not going to go back and change it though. You know, I think I would probably be down in a three and a half range if we were doing half ratings, I guess I'll go with a three. Particularly that galloping motion that we got on final, or at least that is the way I feel best describes it. I really don't like that motion, so we'll go with a three and no on the displays.

Exposure 13

DATE: 04Dec97
PILOT: E

TASK: 3018
CARD: Composite Flight Director Tracking Task

Exposure thirteen, Flight Director Tracking Task. Okay, we did two tracking tasks, I guess the first one we got desired, the second one we got adequate. Part of that I think was due to the reversal that was in that tracking task and also I anticipated the wrong direction a couple of times and was a little bit sloppy in staying out. This is one of the better configurations. One thing that I did notice ... actually I think I would like to do the tracking test one more time. Okay, we did do another run. It's funny here, I saw ... usually I've seen exciting to flexible modes more in the lateral offset task than I have in the tracking task. Maybe that is because like the typical lab rat, I'm sure I could probably adapt a little bit and measure my inputs when we get to the tracking task. Here, because the configuration flies fairly well I think I was a little bit more abrupt. Particularly if you use a doublet kind of motion you can excite, I think, some of the modes in pitch. Roll seems, and this is the only configuration we have flown today, so this is a, I guess something that I perceive but I can't really be positive about it, but roll seems a little bit more sluggish to me than it did in the ... maybe it's in past configurations. Just by a little bit, maybe it's just because I, when not exciting as much I can be a little more aggressive with the control inputs. Anyway, we did get desired performance. I would probably give this a three and a three for the Cooper Harpers both Lateral, Lat/Directional and longitudinal. The CIR, I would probably be in the one and a half range here, I think I'm going to give it a two here because I did intentionally back off of my gains a little bits at times and we did get some of the motion when I was a little bit overly aggressive. I guess the point is that I probably can give it a one because you can get away without modifying your gains ... but there is enough there that it does make me back off just a little bit, I think. I'd go, I'd probably look at the two and a half range. For the ride quality ... I'll go with the three on the ride quality and a no for the display question. The reason I went with the three is we did get a couple sharp responses from the airplane and I'd prefer not to see that, I guess.

Exposure 4

DATE : 08Dec97
PILOT: F
TASK : 1018
CARD: Nominal Approach and Landing Task

Okay, this is exposure four and that was the straight ins. And really it's not too bad of an airplane, just a little bit of a ride quality problem. Longitudinally, on approach, I'm not really going to down grade it too much. But let's give it a four. Yeah, let's give it a four. Two reasons, one is a little bit of a ride quality problem. And two is just that you're using raw data and that takes some compensation to figure out what to do. Laterally, again the performance is desired and again let's give it a four. Okay, now landing, longitudinally, let's ... I don't think there's any impact on the task to the DASE, getting a little bit of, you know ... the QSAE is effecting it a little bit on the display but I am definitely ... yeah okay, it has to be a five, longitudinally. And mostly I think just display. As I noted there, we have a problem with the command gamma and the actual gamma not agreeing and we got a little bit of a float on the second approach there. Digital altitude was going up with the command gamma actually down and as far as I could tell no break out. Also, I need to comment a little bit, and this kind of applies backwards a little bit, that the flare cue was a little dim and the digital altitude is a little hard to see in there. And I can't quite tell why but I'm having a little hard time playing off flight path and digital altitude and flare cue there all at the same time. I'll try and look at that a little closer in the future here. Laterally for landing, really not too

much of a problem. Not much of a task. Didn't get any of those high frequency inputs. Let's give it ... oh shoot, I did have one out, didn't I? That long one went out point nine feet so I've got to give it a five. Okay. And with the comment, workload pretty low. Yeah, it was a five, it has to be, because I had a ten point nine on one of the ... but with the comment that the workload was low. Okay, DASE. I think this is almost a one. Yeah, let's give it a one. I don't think I was really modifying much. Ride, yeah let's make it a three on the ride. I was just thinking that it kind of reminded me of the 757 that I was riding out yesterday in some turbulence at altitude. You know that's kind of a long skinny airplane too and I was sitting in the back end and it wasn't too comfortable. And that's kind of what this reminded me of. The display I think, yeah, let's say no. The QSAE was there but for the straight in approach that's not a real big factor. And I may not be consistent with my previous ratings in that respect. But it wasn't a factor, no. Okay let's move on.

Exposure 4

DATE : 08Dec97
PILOT: F
TASK: 2018
CARD: Lateral Offset Landing

Okay, just summarizing. Really this configuration there doesn't seem to be any impact on the control aspects. The ride quality is just not really ... you would like to fix the ride quality. But it's even probably acceptable although you would have to see this in a more extreme turbulence to really be happy with it, too see if it's okay. But for this level of turbulence even the ride quality is good. Okay, the rating, approach, down to fifty feet, longitudinal, not too bad. Let's give it a, it's definitely level two, let's give it moderately objectionable and primarily because of the effect of the displays not being real good. So this is a five. Lateral, let's give it a, this is a high workload, let's give it a five. Okay, and the landing, longitudinal, I'm level two and so that makes it a five. Lateral, I got one that's actually on except for the bank angle. I don't think I'm going to give that an inadequate because of that though. I realized it. And I should have sacrificed the bank angle for the lateral dispersion, but I didn't. So let's ... you know, I think with enough practice avoid that. So let's give it level two and ... well let's give it a five. Okay, QSAE, control. I'm going to give it to a one. And the ride, let's give it a three. And the display, let's give it a yes primarily, not totally, but primarily the QSAE.

Exposure 4

DATE : 08Dec97
PILOT: F
TASK: 3018
CARD: Composite Flight Director Tracking Task

Okay, Pilot F, that was the flight director task and got my record on performance, got a ninety seven and a hundred on one there. It really makes a difference if you can kind of guess what the maneuvers are that are coming up, which kind of says, hey we really need a navigation display, which you really would have. And so I think it kind of points up that maybe we should have a navigation display. Because if you can guess what the maneuvers are, that are coming up, you can really do pretty good on the performance. Okay, in any case, besides all that, that's kind of beside the point a little bit. The pilot rating, longitudinal, not bad. No effect that I can see and, I think, let's give it a five but just because I need a navigation display. You know, I have a task where I can't predict what the heck's going to

happen next. And I think the same thing laterally. Five and five. There is no impact, there is no DASE impact but it's just strictly a display issue. Okay, the DASE ratings. The control is a one. The ride is a three, well maybe, yeah a three. And the display, no effect, no.

Configuration 19 Modes 1 & 2 control excitation eliminated, modes 1-4 damped at 0.15, canc3

Exposure 24

DATE: 23Oct97
PILOT: A
TASK: 1019
CARD: Nominal Approach and Landing

A couple of comments about the configuration. Pretty good configuration. All axis we had small amplitude ASE response to inputs. They were all well damped, one to one and half overshoots, not bad at all. Apparently light turbulence but there was not too much of a nuisance. Good control all the way around. Not quite as good as twenty-three which was apparently appeared to have no ASE responses but certainly not a bad configuration. For the longitudinal approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. No problem there, minimal compensation required is pretty much standard in this light turbulence. For the lateral, similarly; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, for a three. No problem making desired performance but minimal compensation is required. Okay for the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes and this is going to be borderline level one-level two. I'm going to give it a three for longitudinal rating. It's a better rating than exposure twenty-three which I thought was actually a little bit better configuration but the performance either due to learning curve or whatever or because of those little subtleties that I felt in the flare on twenty-three make this in the actual flare, a little bit better performance so a better rating. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? I'm going to say yes again. I don't recall hardly any workload to get that line-up so we'll give it four three's. CIR; For this particular task which is pretty benign, straight in, I would say a CIR of one is appropriate. I can imagine that ... I can extrapolate and say I'll probably taper off on some of the aggressiveness of my inputs on some of the other tasks, but for this one it's a one. I did not really recall doing anything to alter my inputs. DASE influence on ride quality; One; They do impact it. Two; They are perceptible but not objectionable. I would rate this a two and no, for the display question. (The RQR for this configuration was changed to a three in comments for lateral offset landing.)

Exposure 24

DATE: 23Oct97
PILOT: A
TASK: 2019
CARD: Lateral Offset Landing

On this one, not quite as good a performance as I would have liked. A little bit more trouble on the flare than on the straight in. For the approach though however; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. No problems at all with longitudinal approach. For the lateral approach rating, similarly; It was controllable. Adequate performance was attainable. And it was satisfactory without improvement for a three also. For the landing, longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. Basically it's kind of high adequate performance. I'll rate it a Cooper Harper of five. A little bit of ... not quite as smooth as the previous configuration in the turn. I didn't tailor my inputs to ... I wasn't concerned with any type of ASE response. I flew it aggressively but I just didn't quite perform as well. Not quite as smooth in the turn and I tended to have

a little more of a problem getting in to land, a little bit more of a problem with perceived floating and then trying to actually put it in the box. I had to release a little attitude and get a little bit of a firm landing one time. For the lateral issue however on the landing; Controllable? Yes. Adequate? Yes. Satisfactory? No. I'll put it a four for task workload, met desired criteria quite easily but a little bit more than minimal compensation was required. For the CIR; I did not alter my control inputs as a result of aircraft flexibility, a one. That's true. For the RQR; This time for some reason my perception was that it was more of an annoyance, the bouncing around due to light turbulence. So vibrations do not impact ride quality. That's not true. Perceptible but not objectionable. Not true also. Mildly objectionable - improvement desired. Improvement warranted ... I'm going to go a four on this one and I would like to if possible change my previous RQR on the straight in to a three if that's acceptable to the powers that be. Thank you. No for the display question.

Exposure 24

DATE: 23Oct97

PILOT: A

TASK: 3019

CARD: Composite Flight Director Tracking Task

Not too bad all the way around. For the longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. And for the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No for a four. Once again, lateral workload a little bit higher than longitudinal. Longitudinal workload was not an issue, certainly minimal pilot compensation was required at the very least. Again, not enough ASE responses on this one to make me alter any of my inputs so that's a one for the CIR. And for the ride quality; For this particular task, you get so wrapped up in the high gain nature and the continuous high gain nature of this task that you don't feel the vibrations as much as on the approach when you're just kind of going along for the ride. So basically I would say this one would come in at a three, mainly because the perception of ride degradation is not there. However there are motions that should be ... be nice to get rid of and they do appear to be turbulence generated ASE motions. For the display question; A no.

Exposure 13

DATE : 05NOV97

PILOT: B

TASK : 1019

CARD: Nominal Approach and Landing Task

Exposure thirteen, straight in approach. Longitudinal Cooper Harper ratings for the approach, actually it was quite nice. I'd give it a one and a two for the landing. The lateral-directional for the approach, I'd give it a one and a two for(end of side A). (Continued) Okay, looking at exposure thirteen. The offset landing longitudinal Cooper Harper approach, a two. Landing a two and lateral Cooper Harper, give it a two and a two. DASE CIR rating one, and ride quality one and no effect on the visual perturbations.

Exposure 13

DATE : 05NOV97

PILOT: B

TASK : 3019
CARD: Flight Director Tracking Task

Okay, we're rating the flight director capture with exposure thirteen. I'd have to say, we're getting desirable performance. I'd give it a two longitudinally, two lateral-directionally and DASE influence on control inputs, just modifying my control inputs slightly, I'll give it a two. And mildly objectionable, I don't know. I'd say probably a two on this ride quality. With no problems with the aeroelastic display perturbation impact.

Exposure 9

DATE: 12Nov97
PILOT: C
TASK: 1019
CARD: Nominal Approach and Landing

Pilot's C, it's the afternoon session on the twelfth, exposure nine. Can you turn the lights up a little bit please? Basically, I think we're looking at, in this task, a level one airplane. No major problems longitudinally or lateral-directionally. It's controllable, adequate, satisfactory, minimal pilot compensation, HQR's of three for all four blocks. Again, no major problems. The oscillations are there, they're well damped. They get excited but they're damped almost immediately. So you kind of feel a background shaking but it's not of high altitude and there's no ringing to speak of. I didn't alter the control inputs, so CIR of one. This was between a two and a three. I noted the other one as being a two earlier. This one's a little bit worse. Since you don't want half ratings, I'm gonna give you a three. You could live with this but improvement would help. I did not notice any display interplay with the vibration. That completes these comments.

Exposure 9

DATE: 12Nov97
PILOT: C
TASK: 2019
CARD: Lateral Offset Landing

Okay, exposure nine, offset approach and landing. No major effect due to the vibrations. What I'm seeing is similar in workload to the baseline configuration. It's a difficult task. The workload pushes it, I think, into level two. In both longitudinal and lateral-directional axis but it's a task oriented push. It has nothing to do directly with the oscillations. So Cooper Harpers again, all four of the same block. I'm fighting both axes with the task. The lateral-directional is associated with the correction and recorection on line-up. The longitudinal of course is associated with finessing the glideslope into the flare. Then after the flare to try to control the sink rate and longitudinal touchdown point. In both cases it's controllable. It is adequate in terms of attainable workload, or tolerable workload I should say. However, I think it's not satisfactory without improvement for this task. Moderate pilot compensation for desired performance, HQR is a four. That's four fours. CIR, I'm not intentionally modifying my inputs for flexibility, that's a one. Vibrations are mildly objectionable. Improvement desired but not required, RQR of three. No display perturbations impact on precision. That concludes my comments.

Exposure 9

DATE: 12Nov97
PILOT: C
TASK: 3019
CARD: Composite Flight Director Tracking Task

Okay, exposure nine, flight director tracking. Clearly a level one task. Not a problem even with aggressive inputs. The vibrations are well damped. They're there, not particularly noticeable this time, but very very well damped. Okay, controllable, adequate, satisfactory both axes, minimal pilot compensation, HQR of three. CIR, one. RQR, I'll give it a two this time. I didn't notice them hardly at all. It may be that I'm accommodating to them but I can't say that they were mildly objectionable even this time. It seemed pretty close to the baseline. No display impact. That concludes my comments.

Exposure 4

DATE: 17Nov97
PILOT: D
TASK: 1019
CARD: Nominal Approach and Landing

Longitudinal lat-dir. three and three again. Landing, adequate performance - certainly. Satisfactory without improvement - Of course you get use to these after awhile, you're accepting things you wouldn't when you start out. Lets talk about longitudinal first, satisfactory without improvement, I'm going to say satisfactory, Yes. Three. The lat-dir. for the landing was definitely a three. That's a solid three the other one was a little harder to decide. But both of them are three's. You can give them three's across the board on that. As far as the CIR, I don't think that I had to alter my input for aircraft flexibility on that one. Let's see, intentionally modifies to avoid flexible modes, did I do anything? I don't think so. I think I'll have to go with a CIR of One. Perceptible not objectionable and for a turbulence ride, you have to expect a certain amount. So, I would say on that one probably a two. Yeah, a two. So CIR was one and RQR was two. Boy, I'm getting awfully soft here in my old age. And no display.

Exposure 4

DATE: 17Nov97
PILOT: D
TASK: 2019
CARD: Lateral Offset Landing

Approach longitudinal Cooper Harper adequate. I think that whole time was at least adequate and especially when I when I really kept the glide slope in my for thought there, it was easy to keep in there. Even through the offset was not too difficult. So satisfactory without improvement? No. And I'll probably do a four on that one also. That would probably describe that the best. So longitudinal ... So certainly that one would be a four. Lat-dir. that's a little more objectionable but I think that I was able still able to do the desired so I'll give that a four too. So four four for the approach longitudinal, lat-dir. For the landing, longitudinal, adequate performance attainable? Yes. Satisfactory without improvement? No. And I could do the adequate performance okay, and that really wasn't that tough so five would be the longitudinal and the lat-dir., I think, I landed a little bit left on one there. I'll do them both at five. Let's do five and five on that. And CIR is likely going to be the same. I don't think so. Let's try two on ... I was modifying very slightly for the

flexible modes, not very much. So a two for the CIR and RQR is two also. And the display, No.

Exposure 4

DATE: 17Nov97
PILOT: D
TASK: 3019
CARD: Composite Flight Director Tracking Task

For longitudinal, really didn't see a lot a problem with that, satisfactory without improvement, I'm gonna say yes and I'll give that a three. For the lateral-directional, definitely harder working, and I sometimes feel like I don't quite have enough control to get over there and I don't know it's anything to do with the flexible modes and the turbulence or anything else, but something makes it a lot tougher a job to do and lat. dir., as a result, when I turned the corner I did get desired performance, a four. As far as the CIR and so on, those are all, I'm gonna say CIR of one and RQR of two of that. The displays no.

Exposure 18

DATE: 04Dec97
PILOT: E
TASK: 1019
CARD: Nominal Approach and Landing

I tried to just trying to excite things open loop out on the intercept leg and you can, I guess, maybe excite a little bit, but I didn't really see too much in pitch or roll. My first impression, though, was that it was maybe just a little sluggish in roll and I guess I've kind of talked myself out of it. I guess it's probably about normal of what we have seen in the past. Anyway, that was kind of an impression I had initially. For the intercept and the approach portion, down to 200 feet, I would probably, I don't know, I guess I'd probably give it a two, a two and a two. For the landing portion, we got desired one time and we got adequate the other time, but I had kind of, ended up ducking under the glideslope a little bit so I kind of guess I saw that coming. I would probably, I guess it didn't seem too bad, I'd probably go with a three and three for the landing task. For control inputs, I'm tempted to give it a one, I guess you know we still are bouncing around a little bit, but I don't really know that I really modified my inputs that much. I think, if we were giving half ratings, I guess I'd probably be leaning towards a one and a half, but I guess I go with a one. I guess I'll go with, again I'd probably be in a two and a half to three range on the ride quality, I guess I'm going to go with a two. I think we're getting bounced around a little bit more than I would expect for light turbulence, but I guess as far as the task goes, it wasn't that big of a deal. Aeroelastic displays and perturbations impact the ease of precision of which the task is performed, I guess no.

Exposure 18

DATE: 04Dec97
PILOT: E
TASK: 2019
CARD: Lateral Offset Landing

Okay, I guess we got desired one time and adequate the other, we were slightly long on the other one and that was probably due to, I guess I perceived that we were going to be a little bit short and also we were a little bit high and I think I kind of dove in and flared a little much, then floated. I guess, for the Cooper Harper, I'd come in and, I'm going to say, I think it requires probably moderate pilot compensation. I guess I'm going to give it a four and a four, for both the approach and landing. I played with it a little bit more and I think maybe I'm just getting used to the turbulence we're getting bounced around a fair amount, I guess and I did notice that if I make a fairly sharp input in roll I feel like I can probably get it to excite a little something, maybe get a lurch out of it. It's still not that bad and for the normal maneuvering that I'm doing, I guess maybe I'm just getting numb to it but I'm not feeling like I'm picking up that much of a lurchiness or structural feedback or anything doing the actual offset landing maneuver. I am trying to be kind of smooth so I guess I'm going to go with a two this time for the inputs. Again, I'd be in the two and a half range on the ride quality, I guess left to my own devices but oh I guess I'll give it a three this time and no on the display question. I guess after thinking about it a little more, I would really be at the two and a half on the ride quality but I'm going to change it from a three to a two.

Exposure 18

DATE: 04Dec97
PILOT: E
TASK: 3019
CARD: Composite Flight Director Tracking Task

Pilot E, Exposure eighteen, Configuration nineteen, Flight Director Tracking Task. Okay, I guess I noticed the airplane bouncing around more in this task than I did the previous two. Although, it's really hard for me to say that there's much bouncing around or lurchiness due to control inputs, most of it is just due to the turbulence. I think every once in a while I might be exciting something in roll, it feels like maybe I'm getting a lurch because I've put in a larger roll input or something. I think the compensation here is probably minimal so, I give it a three and a three on the tracking task. I don't know I'm ... to do the task I'd probably be in the one and a half area, I do try to reduce my roll inputs just slightly. I can't really say that I'm making a really big effort to reduce or to alter my control inputs because of it. You know, I'm kind of a one and a half to a two, I guess I'm going to go back to a one here, I don't know ... I guess I'm going to go with a two. If we were using half ratings I think I'd really go with a one and a half. I think the only control inputs that I'm altering are lateral or roll control inputs and boy it's real minimal but I guess I do alter them just a little bit just so we don't lurch around. Although, I can be pretty abrupt and really not get much at all as far as exciting any flexible modes, at least that is my perception. As far as the bouncing around, I would probably go with a three on this one, I don't like the bouncing while I'm trying to do the tracking task, so we'll go with a three and no on the displays.

Exposure 7

DATE : 09Dec97
PILOT: F
TASK : 1019
CARD: Nominal Approach and Landing Task

Okay, rating exposure seven for the straight in task. Just the general comments first. Smooth inputs don't seem to really excite the DASE at all. So it's really isn't a factor just making some intentional square inputs or bangs on the controller, you can feel it bang but it

damps right out. So very acceptable, I think. Pilot ratings for the approach, longitudinally, okay approach is down to two fifty on this one, and let's just give it four's. Well, hold on, hold on. Let's give it four both longitudinally and laterally primarily because it's a raw data approach and there's a little bit of ride quality there that if you could fix it, it would be nice. But it certainly is very acceptable. Okay, the landing, again I'm forced into a five because of my performance and trying to get H dot and X. Well X is the only thing I'm really having a problem with. Lateral, there is no real problem at all. I didn't have any lateral coupling at all like I get sometimes with this going south control system. Let's give it a four. Okay and control, I think it's a two. I'm intentionally trying not to make abrupt inputs, so let's give it a two for control. And four the ride, well it's a borderline two, three. Let's give it a three. And the display, only the QSAE part, so yes, QSAE.

Exposure 7

DATE : 09Dec97
PILOT: F
TASK: 2019
CARD: Lateral Offset Landing

Okay, pilot ratings for the offset task on exposure seven. Just general comment: kind of jiggled the straight in although did get a couple of ride quality bangs due to the lateral inputs on the offset maneuver. But still a pretty nice airplane. Approach, two fifty and fifty are confusing me. Okay, at any case, approach, longitudinally, let's ... it's a borderline four, five. Let's give it a five. I'm not sure I'm being consistent with previous but let's give it a five primarily because with the droop in the display and the poor visual cues, it's just kind of hard to really get set up for the proper flare. It's ... I'm really just kind of doing it open loop based on experience versus the feedback I'm getting from the displays or the visual cues. Okay so this is really the visual and display. Laterally, it's definitely a five because of the difficulty of the task. It's just kind of a borderline five, six. Let's give it a five, you could ... just difficult task. And also you were getting a few bangs in ride. Okay, landing, longitudinally, I'm a five based on performance. No ride quality problem. Okay, laterally, I got one bank angle which I'm going to put into the adequate, just a little slow getting the bank in there initially. And I think I pretty well had the ride under control, let's give it a, I've got to give it a five, don't I? At least. Yeah, let's give it a five. Okay, the DASE ratings. Let's give it a two for control. For ride, let's give it a four. And display, let's give it a yes but mostly QSAE, I just didn't really. Yeah let's just say QSAE. I didn't notice any vibrating effects.

Exposure 7

DATE : 09Dec97
PILOT: F
TASK: 3019
CARD: Composite Flight Director Tracking Task

Okay, flight director ratings for exposure seven. Just general again, the DASE is not causing any control problems. It is effecting the ride a little bit. Particularly laterally and just a little bit longitudinally. But pilot ratings for longitudinal, getting desired performance all across the board but deficiencies warrant improvement. Let's give it a four. Longitudinally. And laterally, deficiencies warrant improvement still, yes, particularly when we consider the ride. Let's give it a five. And the DASE ratings, for control, it's a two. The ride is not too

bad but let's give it a four because occasionally were banging it laterally, inadvertently. It is a fairly high band pass lateral task. Okay, the display, no! Didn't see anything.

Configuration 20 Modes 1 & 2 control excitation eliminated, modes 1-4 damped at 0.30, canc4

Exposure 1

DATE: 20Oct97
PILOT: A
TASK: 1020
CARD: Nominal Approach and Landing

Okay, Cooper Harper rating, again exposure one, straight in approach and landing. Is it controllable? ... This is for the longitudinal approach segment rating, is it controllable? Yes it is. Is adequate performance attainable? Yes. Is it satisfactory without improvement? Yes. Pretty much for longitudinal, up and away, I'd rate it a Cooper Harper of three. Fair, some mildly unpleasant deficiencies and again we did notice a little bit of what I consider to be either damped ASE modes or possibly mode cancellation. But I felt there was some ASE response in there but not bad. So it's three, longitudinal, up and away, met all the desired criteria. For the lateral-directional, for the approach segment, controllable? Yes. Adequate? Yes. Satisfactory? Yes. Again a Cooper Harper of three. Again up and away, I made a number of lateral and pitch doublets, determined that I didn't have a whole lot of problems, ASE wise although there was some slight evidence of it but it did effect my technique or my performance. So again a Cooper Harper of three, lateral-directional for the approach. For the landing, longitudinal; Controllable? Yes. Adequate? Yes. Is it satisfactory without improvement? I would say Yes and rate it a three. Solid desired performance on the second one and almost all desired on the first, just landed about 14 feet short. The flare cue certainly has helped, I've noticed as far as my X-position and H-dot and I did not have any trouble following the flare cue, so a three for that. For the lateral-directional; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. Again a Cooper Harper of three. Not a whole lot of surprises there or changes. All three's for the Cooper Harper ratings for the task. For the DASE influence on pilot control inputs. I'll step through this list until I find the appropriate one. Pilot does not alter control inputs as result of aircraft flexibility. I would say yes that's true and rate it a one. DASE influence on ride quality; cockpit vibration does not impact ride quality or display legibility. I think actually display legibility is suppose to be stricken. So cockpit vibrations do not impact ride quality. Let's look at the next one, cockpit vibrations are mildly objectionable, improvement desired. I would say this is borderline one-two and if you pin me down I'll put a two discriminate the fact that I feel there were some motions there and not objectionable handling qualities but objectionable more for ride quality which is what this rating is for. So we'll go CIR of one and RQR of two. And finally do aeroelastic display perturbations impact the ease or precision with which a task is performed? No they don't. There was no problem with the displays or interaction from ASE.

Exposure 1

DATE: 20Oct97
PILOT: A
TASK: 2020
CARD: Lateral Offset Landing

Okay, exposure one, the lateral task. Obviously a little bit more difficult maneuver than the straight in. For the longitudinal approach rating, Is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? Yes. I'll rate it a

Cooper Harper of three, no real problems on the approach. No ASE effects that effected my performance. The lateral-directional ratings; is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? Up to the correction point , yes it is. Cooper Harper three. So a three and a three for the lateral and the longitudinal . For the landing, longitudinal rating; is it controllable? Yes it is. Is adequate performance attainable? It certainly is. Is it satisfactory without improvement? No it's not. It looked like I tended to be a teensy bit long on all of them. So did not meet desired criteria but it was not a bad configuration at all, it will be a Cooper Harper of five based on criteria. My only objection with the deficiencies, the main thing was coming out of the correction, with that workload, with that part of the task, I was unable to get it into the box, although I had good H-dot. For the lateral rating, for landing; controllable? Yes. Adequate? Yes. Satisfactory without improvement? No. I'll rate it a four. It did meet the desired criteria but the workload is fairly high. That's just based on the task. So we'll come in with a five for longitudinal based on touchdown X-position and a four for the lateral based on workload. The CIR or DASE influence on pilot's control inputs; Number one, pilot does not alter control inputs as a result of aircraft flexibility and that is true. I felt no restrictions what-so-ever on aggressively maneuvering the airplane. So a one on CIR. For the DASE influence on ride quality. Cockpit vibrations did not impact ride quality, that's true. Number two, ASE motions noticeable but improvement is not required. I would rate that as number two also. So a CIR of one, RQR of two. And this is on the new RQR scale. And on the, did Aeroelastic display perturbations impact the ease or precision of the task performed? No, they did not. No effects whatsoever on the displays from the ASE motions.

Exposure 1

DATE: 20Oct97

PILOT: A

TASK: 3020

CARD: Composite Flight Director Tracking Task

Okay, flight director for exposure one and let's see here. The Cooper Harper rating, this is for the longitudinal task. Is it controllable? Yes it is. Is it adequate performance attainable? Yes it is. Is it satisfactory without improvement? Yes it is. Cooper Harper of three. No problems longitudinally. I noticed some DASE motions but nothing significant. I flew it very aggressively and had no fear whatsoever of exciting any type of a motion that would be objectionable. Lateral-directional, is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is satisfactory without improvement? Yes it is. A Cooper Harper of three. Once again this task tends to take me a second or two to warm up to. But the first time I did it I had almost 80% in the inner and 100% in the outer and the second time almost 97% in the inner and I flew that very aggressively so it is doable. So a three and a three for lateral and longitudinal ratings. For the DASE influence on pilot control inputs; Did I alter my control inputs? No I did not in fact I was very aggressive. So a CIR of one. And for the RQR; cockpit vibrations did not impact cockpit display or ride quality? Yes that is true. ASE motions noticeable but improvement not required? That's true so that's two for RQR. And just comments generally about that particular configuration; Very slight ASE motions are detectable but they have absolutely no impact on my ability to aggressively fly the tasks and complete them. The not meeting desired criteria for the off-set approach and landing I think has no relationship to this particular configuration more so the fact on that task, every once and a while it is just difficult to get it in the box. I was very close to borderline desired performance on that so basically from my point of view, pilot in the

cockpit, handling qualities wise, this is not a bad configuration. Certainly acceptable for the extent that we evaluated it.

Exposure 18

DATE : 05NOV97
PILOT: B
TASK : 1020
CARD: Nominal Approach and Landing Task

Exposure eighteen, straight in landing. Approach, I think was all desired. Call that a two for approach, longitudinal Cooper Harper. Landing was, occasionally desired, occasionally adequate. I guess we'll call it a four. Does that qualify for a four or a three? Four. Lateral-directional Cooper Harper, I think we were within desired on that, weren't we? Two on the approach, three on the landing. DASE CIR, what is that a one? Ride quality, I don't think we had much impact on that did we? Maybe a one and no on the visuals.

Exposure 18

DATE : 05NOV97
PILOT: B
TASK : 2020
CARD: Offset Landing Task

We'll be calling this exposure eighteen. The offset landing Cooper Harper longitudinal for the approach. I think we can call the approach all desired and probably a two. The landing is a four because of the inability to balance the sink rate and the X distance. The lateral-directional, I think we can say is probably a two for the approach. How did we do on line-up? Desired. Probably a two for the landing. The DASE CIR, is a one and the ride frankly, was, I think ... it was between a two and a one. I think I'll give it a one. A no on the display effects.

Exposure 18

DATE : 05NOV97
PILOT: B
TASK : 3020
CARD: Flight Director Tracking Task

Okay, this is exposure number eighteen. Flight director tracking, longitudinal Cooper Harper two. Lateral-directional, I guess a three. And a one on the DASE CIR rating and the ride quality didn't really have any vibrations. A two, I think I'll call it and no on the display.

Exposure 3

DATE: 10Nov97
PILOT: C
TASK: 1020
CARD: Nominal Approach and Landing

Okay this is Pilot C exposure three, nominal approach and landing task. Okay this one's fairly pleasant. You notice some vibrations in the background but I don't think interfering with control at all. They're noticeable, mildly objectionable. Cooper Harper on the approach, longitudinal and lateral-directional, it's controllable, adequate, satisfactory, yes. Minimal pilot compensation HQR of three. Three's for both. For the landing, again, controllable, adequate, satisfactory, minimal pilot compensation, HQRs of threes. As I was mentioning to Dave. There's an issue about whether it's minimal or moderate compensation for desired performance. I think it's probably somewhere in between. Minimal doesn't sound strong enough to me, even for the baseline airplane. Moderate sounds too much. This time I gave it the benefit of the doubt and gave it a three. As I mentioned, whether or not I give it a three or four is probably gonna be largely dependent on second order effects . 'cause it's very much a borderline level one level two configuration even in baseline. I don't feel like elasticity effected that a whole lot this time. It was there but it didn't really effect anything to speak of that is. Okay, CIR, I can't say that I ever modified my control inputs for DASE this time. So, I'm gonna have to give it a one for control. RQR, a three, mildly objectionable. It's there, it would be nice to reduce it but certainly not required for a satisfactory airplane, I don't think. And I didn't notice any display impact on precision or performance so that's a no. And that concludes these comments.

Exposure 3

DATE: 10Nov97
PILOT: C
TASK: 2020
CARD: Lateral Offset Landing

Okay this is Pilot C offset landing task exposure three. Okay this time, I think the HQRs are driven largely by the difficulty of the task. Our comment in the past, you can argue, and I think successfully, that it's not a reasonable task. Given the nature of it, I think the workload's too high to push it to level one and I'd give it a level two rating for both longitudinal and lateral-directional. The issue longitudinally for the approach is to keep the desired sight picture, glide slope transfer type maneuver under control during the offset. Of course lateral-directional is control of the offset. It's a very demanding task in both cases and I think work load is too high to give it a level one rating. So, for the approach segment, longitudinal and lateral-directional both. It's controllable, adequate, not satisfactory with out improvement. Desired performance requires moderate compensation, HQR of four. For the landing, the issue is predominately a longitudinal one. Lateral-directional is not really an issue. That's fortunate 'cause you can kind of ignore it. In the longitudinal task there is a little bit daunting because you haven't had precision guidance going into the flare and a lot of things have been changing so the task, again, is demanding. So, longitudinal, controllable, adequate, not satisfactory, desired performance requires moderate pilot compensation, HQR of four. Lateral-directional though, I'm gonna let it ... I can't (say) that I'm continuing the correction problems lateral-directionally into the flare. So, after fifty feet you can ignore the lateral axis, lateral-directional axis. So, it's controllable, adequate, satisfactory, yes. Minimal compensation, HQR of three. So, four, four, four and three for HQRs. DASE, I can't say that I ever changed my control input as a result of the flexibility. CIR is one, mildly objectionable vibrations just like before. RQR of three. No impact to the display. That's a no. That concludes these comments. Pretty pleasant configuration.

Exposure 3

DATE: 10Nov97

PILOT: C
TASK: 3020
CARD: Composite Flight Director Tracking Task

Pilot C, exposure three, flight director tracking task. Okay, consistent with before, fairly pleasant configuration. No major control difficulties caused, I think by ASE. Longitudinal and lateral-directional both, controllable, adequate, satisfactory, yes. Minimal compensation, HQR of three. Three and a three, no specific problems with either axis. DASE CIR, I didn't alter the control inputs again, so CIR is one. And again, mildly objectionable cockpit vibrations considering that we're in light turbulence, so RQR of three. The effect is very similar to if you were in light to moderate turbulence. So, the effect is kind of ... I think it down grades the turbulence a little bit. No display impact on precision or performance. That concludes these comments.

Exposure 15

DATE: 18Nov97
PILOT: D
TASK: 1020
CARD: Nominal Approach and Landing

Okay, exposure 15, nominal approach, your comments. It was actually quite similar to the first one. The approach, adequate performance, certainly. Satisfactory without improvement, for the approach, sure. Three and three on that. For the approach I didn't see any difficulty. For the landing, adequate performance. Well, we pretty well had a good spread on it but adequate I would say is okay. Satisfactory without improvement, no and five in pitch. The Lat. Dir. four, didn't exercise that an awful lot. I'd say something on the order of four would be fine on that. For CIR, I wasn't conscious of making any changed control inputs, I'll say one on that. It's really a comfortable ride here. These two are quite similar. If I got any mildly objectionable,... I don't even think that was mildly objectionable. RQR of two and the display, no.

Exposure 15

DATE: 18Nov97
PILOT: D
TASK: 2020
CARD: Lateral Offset Landing

Comments on exposure fifteen, offset approach. On the approach, certainly adequate, satisfactory without improvement. Yes, I'm gonna say all the way. Three and three on the longitudinal, Lat. Dir., I don't have any complaints with it any more. Landing, adequate performance, yes. Satisfactory without improvement, I got to turn there because the best I could do is adequate usually for distance, so five. Lat. Dir. has that same, I can get the desired performance and so on but best I can give it is a four on that. So five and a four longitudinal, Lat. Dir. on the landing. CIR one, RQR two. (No display input perturbations?) No.

Exposure 15

DATE: 18Nov97
PILOT: D

TASK: 3020

CARD: Composite Flight Director Tracking Task

That's exposure fifteen, flight director tracking task here are the comments. Okay, just the general comments on it. I had one excursion that was outside and I had an awful time getting it back. It ended up with inadequate performance. It's one of those if I can stay on top of it enough to keep it in then I don't have any problem getting desired. If I let it get out, the control authority or something it just didn't allow me to get back. I had the feeling that it was a lot of adverse yaw 'cause it was right in the reversal of direction and the nose just didn't seem to come around like I expected it to. That's general comment. Specifically for the ratings, adequate performance, I'm gonna say yes. Satisfactory without improvement, I'm gonna say no. Pitch, I'll say four. Lat. Dir., that was, I'm gonna say five for considerable pilot compensation to keep it in for that task. CIR one, RQR two, and I don't think the perturbations played a part. So no for display.

Exposure 12

DATE: 03Dec97

PILOT: E

TASK: 1020

CARD: Nominal Approach and Landing

Pilot E, Exposure twelve, Nominal Approach and Landing. Okay, I guess first thing I will note is that on the intercept and the fine final we had quite a few splits in the flight path vector between commanded and actual gamma, which was a little bit disconcerting. I thought that there might be a problem in the flare with that. As it turned out I didn't really see that much of a problem with the first flare and we got all desired performance. With the second flare, I under flared and I guess what I'm saying is we got a firm touchdown minus six but I expected it, I just didn't pull the nose up enough or get gamma up enough right at the end there. So, we'll look at the predictability a little bit more on the offset landing task but I didn't really know ... I might have been a little bit smoother with the flare on this one. My initial impression was that I was smoother in the flare than I was in the previous configuration. Anyways, if I go in here, I guess I probably ... Well, for the approach and landing phase, the approach and intercept phase, I would probably give it a two and a two for lat, lat/dir. and longitudinal. For the landing phase, Is it satisfactory without improvement? We probably could have done one more but I guess I and again, it's just my perception but I would probably say yea and give it a three and a three on this one. For the CIR, I don't think I was really modifying much on my control inputs. I'd probably, if we were going half ratings, I'd probably go with a one and a half. I think I am going ... you know, I think I'm going to go with a two and a two, I guess for control inputs and for ride quality and no on the displays. I guess I'm real tempted to give it a one and a one. Yeah, we'll just do that, a two and a two. Okay. I guess I'm not perceiving as much bouncing around that time as in the past. (Got a two and a two for the approach, a three and a three for the landing, and a two for the CIR, two for the RQR) And again my impression is that those are high two's, I don't know. I didn't perceive that much in turbulence, in the flexibility.

Exposure 12

DATE: 03Dec97

PILOT: E

TASK: 2020

CARD: Lateral Offset Landing

Okay, I think part of this may be that I am getting tired because the airplane seems to be doing pretty much what I ask it to do and I really don't think I'm getting surprised that much. I'm having a hard time getting the longitudinal touchdown point here. We're not missing it by much. The last couple of times though I've ended up with a float and I pushed it over to try to get it in the box and ended up being maybe a little bit firm, firmer than I need to. I guess we never got desired performance. I am going to go with a five and a five, actually I'm going to go with a ... I'm going to go with a five and a five, I guess. This is actually one of the better configurations that I've seen, I think, just from a qualitative stand point with the exceptions of the splits that we saw on final that I really didn't like on the intercept portion which wasn't on this particular task. Actually I'm going to change that. For the approach and landing, I'm going to go with a five longitudinally and a four in lateral-directional for both of those. So it will be a five and a four, five and a four. I had second thoughts on the last one and I was kind of inclined to go with a one and a one for the CIR and the RQR ratings. I don't know. It's kind of a hard call. I really don't think that I'm exciting much. And I am probably barely modifying my inputs if at all. Its more of a perception than anything else. I guess I am going to stick with a two and a two. I don't know though. If we did half ratings, I would definitely go one and a half, one and a half. And I'll say no on the displays. And I don't know, I probably really should be giving one's on the CIR and the RQR but I'll stick with a two.

Exposure 12

DATE: 03Dec97

PILOT: E

TASK: 3020

CARD: Composite Flight Director Tracking Task

Okay, just a note, I guess, quantitatively this just seems like one of the better configurations we have flown. Even in roll, it seems like I can start and stop the roll a little bit better without ringing anything. I do think that if I make a sharp pitch input, I do get a little bit of what I would characterize as a ringing, just a couple of higher frequency little pulses that I feel in the seat of my pants. After flying this, I kind of more inclined to think that the landing task performance that I did, that maybe my performance is lagging just because it's getting late in the day. Anyways for this particular task, I thought the predictability was real good and we got pretty good performance out of it. In fact I would probably be, if we took half ratings, be a two and a half. I'm going to give it a three and that may be more of a function of just the flight director and I can't get an immediate response as much as I would like. Again personal taste, I would like it to be crisper, just a little bit crisper in roll, for both the offset landing task and this maneuver. So that's probably what's driving me down into a three. The little vibration that we get with the pitch inputs is not really a big deal and I have been waffling between a one and a two on the CIR and the RQR's and I'm going to go ahead and stick with the two's, I guess. Just because in pitch, I don't like that little tickle I get and so I do try to avoid it, I guess. It's perceptible, I guess, its probably not objectionable and we could live with that and I've felt this in other airplanes too, so ... and no on the display.

Exposure 18

DATE : 10Dec97

PILOT: F

TASK : 1020

CARD: Nominal Approach and Landing Task

Pilot comments on eighteen for the straight in task. Seems like a pretty nice vehicle after some we've seen. I would guess that the longitudinal burst modes have been canceled, the DASE was obviously there because the QSAE droop was there. And maybe just a little ringing for a sharp input, must have been the higher modes. Laterally, the DASE was there but it was very well damped and particularly for the straight in approach, no problem at all. Approach longitudinally, is a four. Laterally is a four. Landing longitudinally, and those ratings are pretty much just the fact that it's a raw data display, I don't have any guidance, or precision guidance. Landing longitudinal, I've got to give it a five for performance, typical on this configuration. Lateral, let's give it a four. No problem. Yeah, four is good enough. Okay, DASE is control, is ... I think it's a one for this task particularly. The ride, it's still bouncing wasn't it? Yeah, like to have it better but not bad, how about a three? And no, well yes because of the QSAE.

Exposure 18

DATE : 10Dec97

PILOT: F

TASK: 2020

CARD: Lateral Offset Landing

Okay, on the offset there was no impact of the DASE on the control task and longitudinal for the approach, which takes us down to fifty feet in this case, let's give it a four. Let's give it a five laterally just because it's a very difficult task. The landing let's give it a four. Oops! I have to give it a five, in fact I should give it a seven but I'm going to give it a five. I think that's a fluke. I think if I did enough of them we would average acceptable. And lateral let's give it a four. Okay the DASE is control, is a one. The ride is ... it's still a three and a yes for the QSAE.

Exposure 18

DATE : 10Dec97

PILOT: F

TASK: 3020

CARD: Composite Flight Director Tracking Task

Okay, flight director task, exposure eighteen. No impact due to the DASE. It's just a matter of learning this little task. So longitudinally let's give it a four. I would like some anticipation of what's coming up but it's really a very easy task. Lateral, it's moderately objectionable there and that's where I'm bumping the performance so let's give it a five. DASE is one and, let's back up here. Let's go to two on this one. And no.

Configuration 01 Mild (Sigma=3.0) turbulence (nominal approach and landing only), qsae0

Exposure 10

DATE: 21Oct97
PILOT: A
TASK: 1001
CARD: Nominal Approach and Landing

Longitudinal Cooper Harper rating for the approach; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Actually we are going to make this a two for the longitudinal rating for the approach. Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. A three. Just because the lateral task is a little bit harder on the intercept. And I'm giving this a two but I just want to differentiate this from being a really good configuration. Certainly it's less compensation longitudinally than any of the others. Absolutely no ASE effects were noted in any axis during the rudder, roll and pitch doublets. For the landing longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. And that's my opinion based on the second landing, I was kind of distracted on the first one. I landed a tad short but a good sink rate. The lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes. I'm going to disregard the slightly wide on the second one again based on a distraction. The CIR ... (Cooper Harper ratings?) Two, three, three, three. CIR; Pilot does not alter control inputs as a result. That is absolutely true for a one and the ride quality; Cockpit vibrations do not impact ride quality. That is absolutely true for another one. No, for the display question.

Exposure 21

DATE : 06NOV97
PILOT: B
TASK : 1001
CARD: Nominal Approach and Landing Task

Exposure twenty-one, this is a straight in ILS approach. Cooper Harper ratings for the approach, I would say, were pretty close to a one. The landing Cooper Harper's, I think I would call it a two. Lateral-directional a two. Approach and landing, both two. DASE influence was one and a one for ride quality and the aeroelastic displays were a no. It seems as though the best technique for hitting the spot with a touchdown sink rate is at fifty feet when, or a hundred feet I guess, when the flare cues start coming up. If you keep the thousand foot point half way between the flight path vector and the flare cue. Then when they meet, follow it up to five feet and then translate to the attitude cue and just slowly start lowering the nose about one degree per second. That seems to give you a pretty good result.

Exposure 21

DATE: 13Nov97
PILOT: C
TASK: 1001
CARD: Nominal Approach and Landing

Okay this is Pilot C, nominal approach and landing for exposure number twenty-one. The offset ILS, straight in approach and landing. Borderline level one, level two, longitudinally. Certainly level one in the approach. The only issue is longitudinal control for sink rate control and touchdown distance and I've talked about this one before. I'm gonna give it the benefit of the doubt and give it level one. At one of the two I got desired in some areas and the other, I got desired in other areas. So it's controllable, adequate, satisfactory, minimal pilot compensation. HQR of three in all four blocks. CIR is one, RQR is one. No impact of the display.

Exposure 21

DATE: 19Nov97

PILOT: D

TASK: 1001

CARD: Nominal Approach and Landing

Okay comments for exposure twenty-one, pilot D. Okay, for the approach three and three for the longitudinal/ lateral-directional. For the landing, adequate performance, satisfactory without improvement? Boy that's as close as we've come after all this practice. After all this practice it ought to be pretty good. I guess I'll bring that up and make it three and three, on the longitudinal and lateral-directional. Really didn't do anything with the Lat. Dir., but longitudinal was probably as good as it gets. It was all right. Minimal pilot compensation I'll say. Let the airplane do its own thing looks like. CIR one and RQR, boy I hardly felt any on that. Perceptible. Well, two, I guess if I felt real hard I could feel a little bit. So I'll say two. The display was not factor.

Exposure 21

DATE: 05Dec97

PILOT: E

TASK: 1001

CARD: Nominal Approach and Landing

Pilot E, December 5th, exposure twenty-one, configuration one nominal approach and landing. Okay, basically this configuration seems, I guess fine. For this task, the only thing that I'll note is, we did three runs and a couple times if not all three, we got splits in gamma during the latter portion of the flare which kind of made a precise touchdown a little bit more difficult. I would say there's a little bit of a predictability ... the predictability for the task is degraded a little bit because of that. I guess I kind of feel it should be a three and a three because it doesn't take a lot of compensation to correct for it. Let's go talk about the approach first I guess. I think it's fine on the approach and I give it a two and a two for approach. For the flare and touchdown, I think I'm gonna go with a three and four. I mean a four for longitudinal and a three for lat. dir. Just simply because I felt predictability was not great in pitch. Although it wasn't really that hard to compensate for. I guess I'm gonna go with a four longitudinally and three lat. dir. Although I could easily talk myself into a three for longitudinal 'cause it's not that bad. I don't know that I really saw, during this task, any inputs that caused any flexible modes that I saw. I'm gonna go with a one on the CIR and a two on the ride quality. We did feel a little bit of the turbulence but not that much and no on the display question.

Exposure 21

DATE : 10Dec97
PILOT: F
TASK : 1001
CARD: Nominal Approach and Landing Task

Okay, pilot ratings on the exposure twenty one which is the QSAE with three feet per second RMS turbulence. My overall comment is that the ride seems to be a little too smooth for that level of turbulence based on what I've seen at Ames. Pretty hard to correlate it to flight. Okay, approach, longitudinal, is really pretty easy. I'm just going to give it a four because of no precision guidance. Same for the lateral, no precision guidance. Landing, I'm going to ... well we can say it ... no, no. Landing, I'm going to give it a five because I know that I don't consistently get in the desired box even without structural dynamics. The lateral is really no problem, let's give it a four though. There's that inherent tendency on this airplane for a little bit of a PIO for me on the roll axis. The DASE should be easy. So it's gotta be a one, one and a no. I guess, huh? By definition.

Configuration 21 Moderate (Sigma=4.5) turbulence (nominal approach and landing only), qsa0

Exposure 17

DATE: 22Oct97
PILOT: A
TASK: 1021
CARD: Nominal Approach and Landing

Longitudinal task up and away; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. No problems on the approach. One thing we did notice though is that we are getting airspeed deviations of anywhere from six and a half to eight and half to nine knots in autothrottles which seems unnatural. The up and away characteristics are basically, it seems very much like the QSAE zero configuration in that I noticed no aeroelastic motions based on my inputs and I made some very aggressive inputs. So we are not really getting any type of aeroelastic motions or ASE motions whatsoever. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three also for the approach. No problems whatsoever. For the landing. The landing is a whole different story here and we had some confusion here as to whether or not we had sim problem or whether it was just this configuration. There are number of landings -very inconsistent with certainly an occasional desired but mostly adequate and at times inadequate performance. So for the landing, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? No. I would have to rate this a six for unknown reasons and it's based on performance after doing a number of landings, we just do not have good performance and it's very inconsistent. The display symbology I looked very carefully at and it seemed from all I could tell to be nominal. However I did notice that some things happened that were unusual. I tended to get a big balloon at about a hundred to one hundred fifty feet. In order to keep from going way high on the glide slope I would have to push the nose over and then make a flare from about a minus four degree gamma position. If I would flare to my normal flight path marker prospective -my normal sight picture I would land short and firm. The times I would have soft H-dot's I had to flare to put the flight path marker on a closer point to the horizon than nominal for the past sixteen exposures, resulting in a different sight picture for me but it's difficult for me to know exactly where to put it. The last time for example, I had a good H-dot but I landed a little bit long. So it's very inconsistent in where I put the flight path marker to get a proper flare final attitude position. At any rate, going to the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. I had a lot of ... which seemed unusual, I thought I was right on center line but yet I'm showing a lot of nine and half feet to the right, 9.6 feet to the right, and the like. I'm going to rate that as probably a Cooper Harper of four. I met the desired criteria but certainly not real good quality desired. For the CIR there was nothing that I did based on any perceived DASE inputs that caused me to change anything. If anything was going on, it was unknown to me so I'll rate that a one. For the ride control; I really didn't notice any cockpit vibrations whatsoever so that would be a one also and no for the vibration (display) question. At any rate this is a very puzzling arrangement in that it was difficult to figure out exactly where to put the flight path marker in order to get the desired landing performance.

Exposure 22

DATE : 06NOV97
PILOT: B
TASK : 1021

CARD: Nominal Approach and Landing Task

Exposure number twenty-two, straight in ILS approach. Believe I will give this a one for the approach and a two for the landing, on the Longitudinal Cooper Harper . Lateral, I'll give a two and a two. DASE CIR rating a one. The ride quality a one and a no on the displays.

Exposure 22

DATE: 13Nov97
PILOT: C
TASK: 1021
CARD: Nominal Approach and Landing

Okay this is Pilot C, exposure twenty-two, nominal approach and landing. Okay very much the same task as before and I'm gonna give it the same ratings for the same reasons. Borderline level one, level two in longitudinal, in the landing phase but again I'll give it the benefit of the doubt. Give it an HQR of three, same for the other three, four threes. CIR one, RQR one, no display impact.

Exposure 22

DATE: 19Nov97
PILOT: D
TASK: 1021
CARD: Nominal Approach and Landing

Okay that was exposure twenty-two, here are the pilot comments. Okay, on the approach the turbulence was beginning to effect it. Where I saw it graphically was the amount of time the segmented flight path marker was away from the commanded one. So I didn't have this precise control as I did a one adequate and one desired. I'll say four for the longitudinal and the approach. Lat. Dir. I didn't see any problems. Three on the Lat. Dir. for that. For the landing, adequate performance attainable? Sure. Satisfactory? I'm gonna say no. Did get one adequate and one desired. I'd say five for longitudinal since I don't think I could consistently get the desired in pitch for that. For the Lat. Dir., four. That was a minor problem. Okay, CIR, yeah I'd have to say two on that. It says, due to excitation of flexible modes. But I was really ... it could have been that or it could have been in turbulence. I wouldn't know normally but if you say it's rigid it probably isn't. I'm still gonna give it two because what I saw with the variations could have been flex. Anyway, as far as RQR ... nah I can't do that either. CIR is one, I don't think I'd change that. Did it for other reasons. RCR, probably would be nice to be fixed, three. Improvements desired, mildly objectionable. And displays no.

Exposure 22

DATE: 05Dec97
PILOT: E
TASK: 1021
CARD: Nominal Approach and Landing

Pilot E, exposure twenty two, configuration twenty one. We did three runs this time. Part of that was just looking at it. The airplane really flies fairly well for this configuration. I was kind of wondering if I really should've given it a four and three last time. I do think

that getting the touchdown parameters in the box and at the desired H dot because of the small box that there is ... I guess it probably is an appropriate rating. We did get a split cue once or twice on those runs in the latter part of the flare. I guess it does take a fair amount of , I guess, concentration to try to get everything nailed together. If you're off a little bit at 150 feet or 100 feet or so, it's hard to make an appropriate adjustment in the flare. The adjustments that you make have to be real small so I'm gonna go ahead and give it, I think the same ratings that I did last time, a two and a two for the approach. A four for longitudinal, three for lat dir., for the landing phase. A one for control inputs and a two for ride quality. A no for displays. I have made a comment on one of the runs that I thought it was slightly, just a slight increase in attention was needed for the line-up task. I don't know, that was my perception, it's very very slight if that's the case. I think I could have talked myself out of that comment during the next two runs but there maybe a real slight increase in pilot attention needed. Other than that though, everything seemed to work out pretty well.

Exposure 22

DATE : 10Dec97

PILOT: F

TASK : 1021

CARD: Nominal Approach and Landing Task

Okay, after the very first run I noted I made a comment here, ditto above. The increased level of turbulence was really pretty hard to see the difference and not seeing it in the actual G cues that I can feel. You know, maybe just a tad. But still very smooth and of course as Bruce pointed out, I'm kind of miscalibrated right now. And it didn't seem to be effecting the dynamics of the airplane enough to effect the task either so it's pretty hard to change the pilot ratings. Let's just give a four, four, five, four, one, one, no.

Configuration 22 Heavy (Sigma=6.0) turbulence (nominal approach and landing only), qsa0

Exposure 21

DATE: 23Oct97

PILOT: A

TASK: 1022

CARD: Nominal Approach and Landing

Okay for the straight in approach and landing for this exposure 21, approach, longitudinal rating; First couple of comments; Slightly different from some of the other exposures in that this one flown in moderate turbulence and it was noticeable. It did feel a little bit more turbulence response, or turbulence amplitude than what I am used to in the light turbulence although to be quite frank, it is a little bit difficult to detect turbulence motions and separate them from ASE motions. It is more apparent in close, believe it or not, that you do have the higher turbulence level. The character of this one seemed like turbulence was not a big factor on the approach or on the landing although it was noticeable. Longitudinal response seemed to be of moderate amplitude, damped, that's about two overshoots, according to my scale. Lateral, similar, about moderate amplitude ASE responses and seemed to be damped with two overshoots and the rudder did effect this one with about one and half overshoots, moderate amplitude. As far as the approach rating, we got the initial score card showed adequate for glide slope but I was doing a lot of doublets and the like, trying to get a feel for how the whole thing was interacting with turbulence and the like, so I did not feel that it was a problem controlling glide slope. Certainly on the subsequent and closest the glide slope is not an issue. So with all of that overall in mind, we'll go ahead and rate that a three, for the longitudinal rating for the approach. Lateral rating; similarly about a three. No significant workload difficulties due to turbulence or ASE effects on the model. For the landing rating, actually I ended up with two really good landings, solidly desired and one almost desired and the other one slightly long and just a teeny bit firm. That was off the first one. So certainly a learning curve effect here but basically it appears that desired performance is achievable. So for the longitudinal rating; Is it controllable? Yes it is. Is adequate performance attainable? Yes it is. Is it satisfactory without improvement? I'm going to say no and rate it a four longitudinally and I do believe that the turbulence effects in the landing flare and in the final part of the preflare area, say about 100 feet on down, are more noticeable and make the task a little bit harder than I think this configuration otherwise ... Turbulence, I think, is making it a little bit more difficult than it otherwise would be, the response to the turbulence. Laterally, similarly; Controllable? Yes. Adequate? Yes. Satisfactory? No, for a four also. So in sum total, the turbulence was noticed. It was not a problem on the approach. It was more noticeable as far as handling qualities in close and did make the workload a little bit higher. The CIR was not an issue really. Since it was fairly well damped, it was not really a problem for me as much so I'm going to say that I did not do anything to change my inputs so a CIR of one. For the RQR, again it's very difficult for me the pilot to separate turbulence effects from ASE effects. I don't necessarily think the turbulence was causing a lot of additional ASE effects. If that was moderate turbulence, it was moderate turbulence, it felt like moderate turbulence, no more than that, so it does not appear that we were getting a lot of excitement of the ASE modes from the turbulence at least from the seat of the pants feel and from the handling qualities apparently and performance, I think, it's also true. At any rate, it says DASE influence on ride quality. Assuming the moderate turbulence level there then the DASE did not seem that bad. I would say one is probably not true. I would say, I'm going to rate this a two and say that the motions I felt were mostly from the turbulence and they did not excite any ASE

modes that made it objectionable. This again though, a caveat, this is a difficult call for me in the simulator to separate the pure turbulence responses from any kind of excited ASE modes. No for the display question.

Exposure 23

DATE : 06NOV97
PILOT: B
TASK : 1022
CARD: Nominal Approach and Landing Task

Exposure twenty-three, straight in landings. Cooper Harper's for the longitudinal axis approach, frankly a two I believe. A two for the landing and the lateral-directional, I think we'll call it a two and a two. DASE CIR rating, a one and frankly the ride wasn't that bad. I will say it's a one and no, on the visual influence.

Exposure 23

DATE: 13Nov97
PILOT: C
TASK: 1022
CARD: Nominal Approach and Landing

Okay this is exposure twenty-three, nominal approach and landing, Pilot C. Okay, very much the same as the previous two configurations. The workload is degraded a little bit in the approach. I'm not noticing any degradation in the landing but still not to the point where I'm willing to bump it into level two. So I think it's all level one, borderline level one all be it in the landing phase. In the approach phase it's fairly solid level one. Again, a little bit higher workload then before and if we were doing a workload rating that might be reflected there but certainly not enough to degrade performance in the Cooper Harper ratings. So four threes, a one and a one. No impact of the display.

Exposure 23

DATE: 19Nov97
PILOT: D
TASK: 1022
CARD: Nominal Approach and Landing

Okay this would be exposure twenty-three comments. Okay, as far as the approach goes, yeah the workload, it was definitely higher this time. For the approach in pitch in particular, pretty consistently ended up with adequate performance on that. The variations that are brought in by the turbulence just keep you spending a lot more concentration on that. I'd say considerable probably would do it. For longitudinal in the approach, five. Lat. Dir., four for the approach. For the landing, adequate performance attainable? Well after the first one I was suspecting it was going to be a seven. I think with enough compensation I probably could keep it out of a seven though. Since the other two were desired that tends to say that it is possible. Satisfactory without improvement? I'm gonna say no and six for longitudinal. The problem is being consistent with these things. You do some of them ... a couple of them and they're fine and all of a sudden the bottom drops out from under you. I'll go with a six on that. The Lat. Dir., really didn't do much with it on that approach. I'll leave it at four. Just 'cause it really didn't exercise it, didn't appear to be a problem. CIR,

I'm gonna say two. Well again, flexible modes, what I've been seeing before I didn't know whether it was flexible or turbulence so I'll stick with two on that. Four for the RQR. I guess ... kind of tough on the visual. I'll say yes. No, I won't do that. Take that back. No. What I was looking at was something different. No for the visual, for the display rather.

Exposure 23

DATE: 05Dec97
PILOT: E
TASK: 1022
CARD: Nominal Approach and Landing

Pilot E, exposure twenty-three, configuration twenty-two. Okay, first I guess I have to comment that the turbulence that we were feeling in the cockpit is not indicative of what I would consider to be heavy turbulence. I guess a very slight perception of a slight increase of pilot attention needed to stay on glidepath and localizer. Particularly during the final portion of the approach. Not a big increase at all. If any it's just a slight, a perception of a slight increase. Predictability I think is maybe slightly worse in the latter portion of flare on both approaches. We got a split in the gamma cue. Trying to decide what to do when you get the split and trying to make a precise correction, I think is somewhat difficult. I don't know, I guess in my mind I keep on going back and wondering if I really should be going with fours in longitudinal for the landing task. I'm gonna go ahead and do a four for landing for longitudinal and a three for lateral-directional. A two and a two for the approach phase. I could easily make that four a three I think. Although, I'm gonna stay with a four. I do think that the predictability is an issue here. I think it's not helped by the way that ... The display is helpful in some regards in that it tells you that you're not getting what you're commanding. But in other regards being able to really make a precise correction. I'm so sure the display helps out that much. Not so sure how lag there is in the display. Again, I'll just note that you don't have normal external cues. I don't think I'm picking up normal external cues that I pick up outside the window in this simulation. I'd still go with a one for CIR. A two for ride quality and a no for displays. Let's see if there's anything else. Oh, the other thing that I was gonna say is... you can see a lot more motion in the HUD with all the symbology. You can see some pretty good pitch changes being made by the flight control system to hold gamma where you've set it.

Exposure 23

DATE : 10Dec97
PILOT: F
TASK : 1022
CARD: Nominal Approach and Landing Task

Okay, we were getting some apparent attitude dispersions, or motions, what ever you want to call it, as well as significant flight path breakouts. And it's definitely effecting the landing performance, I feel. Whether it's enough, well let's just see what happens here on the ratings, as we head for that. Okay, longitudinally on the approach, we really still weren't having much of a problem. Let's just give it a four still. Lateral, a four. Now for the landing, longitudinally, we did have one firm touchdown there and I could rate it down. I'm going to kind of disregard that ten point three, due to lack of visual cues here. But I am going to down rate the performance a little bit. Adequate performance requires considerable pilot compensation. I think it's still a five really. Okay, laterally, is a ... we weren't having a

problem laterally. I did get out once just because I goofed off. Let's just put that at four also. And one, one, no.

Configuration 13 Mild ($\Sigma=3.0$) turbulence (nominal approach and landing only), damp7

Exposure 22

DATE: 23Oct97

PILOT: A

TASK: 1013

CARD: Nominal Approach and Landing

Task rating for the straight in approach and landing with heavy turbulence. It appears that, trying to analyze the characteristics of this configuration, it looks similar to exposure 21 as far as the vehicle. I was guessing from my inputs about moderate amplitude damped ASE responses, about one and half to two overshoots, lateral was the same. The rudder did not appear to have much effect unlike exposure 21 where the rudder seemed to have more of an ASE response. The turbulence, I flew one approach almost all the way stick free and we reset before we touched down and compared that to when I was coupling with it and did not seem to couple too much with the turbulence. Again it's difficult in the simulator as a pilot to be able to determine really what are turbulence motions and what are ASE motions. We weren't getting a lot of lateral since it was damped in the lateral axis. We weren't getting a lot of lateral side to side motions. We were getting more bumping in our seats, more vertical motions which is more of a turbulence flavor, not the tell-tell side force that comes from your lateral inputs. So it appears that turbulence is effecting it somewhat but not a tremendous amount, is my guess. For the approach rating, up and away; Controllable? Yes. Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes with a three. Again $\gamma \cdot v$ pretty much handles it very well. For lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? Yes, also a three. For the landing rating, for the longitudinal rating; It looks like performance wise I made borderline desired-adequate but mostly adequate. We had a slightly firm, slightly long on the first one and the learning curve goes up just a teeny bit firmer than desired, in the box and then a desired $H \cdot \dot{h}$ and in the box, then a little bit firm and short. I think that may have been a turbulence effect there. And the last one, I thought definitely a turbulence effect, a nice soft landing, but when I was going to land initially I felt I got a little kind of a balloon effect which carried me long. So the last two appeared to have, from my point of view, more turbulence effects than the other four and again I guess it's somewhat random as to when the model kicks in the turbulence to cause the effect. But those two caught me at bad times. At any rate, it looks like we predominately had adequate performance so the rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. Let's go with a five for longitudinal. For lateral; Controllable? Yes. Adequate? Yes. We always went into the desired box. I am going to say, satisfactory? No. So let's give it a desired rating of four. Workload probably keeps it at a four and not a three. For the CIR; I did not feel that I had to change my inputs whatsoever. Again, bear in mind that we are only looking at straight-ins and not anything dynamically laterally, so I'm not really having to tone off on any very dynamic lateral task. But it says, pilot does not alter control inputs as a result of flexibility. In the flare, I possibly did in the longitudinal axis, it's very subtle if I did so let's go to number two. Pilot intentionally modifies control inputs. Let's probably rate that a two. This is borderline one-two and the difference between this one and exposure 21 is probably additional turbulence maybe makes me more sensitive. So that will be a two for the CIR. For the RQR, again this is, we are not worried about turbulence, the way I'm interpreting this rating, it's just DASE influence. Vibrations do not impact ... That's probably not true. Number two, vibrations are perceptible but not objectionable. I think one of the problems we are going to have here, or just let me caveat this because this thing is an

important point, the motions feel like to me maybe moderate turbulence. This was a heavy turbulence model. It felt like moderate turbulence to me as a pilot and I could not ... it did not feel like it was coupling. One concern I have is that this simulator does not give us a real good heavy or moderate turbulence model but it does give us good ASE effects. What I'm interpreting as turbulence, maybe ASE effects so this a difficult distinction for me make. If you are going to call that heavy turbulence then the motions that I felt were not heavy turbulence, they were more on what I would consider from my flying experience, moderate turbulence and if it's steady continuous heavy turbulence then I'm interpreting the motions I felt as steady continuous moderate turbulence and if they were ASE influence or ASE excitation I would have expected a more, based on the moderate amplitude from my abrupt inputs, I would have expected more of a motion in the cockpit. So I think this is going to be a difficult one for me to distinguish between. I'm going to say that my feeling is that those were turbulence. What probably is the truth is is that the turbulence model is not strong enough to really make me think it's heavy turbulence. I am getting ASE effects caused by the turbulence because of the way it's modeled here but it's not perceptible to me because it feels to me like turbulence. So after that round about explanation we're going to say that DASE from my perception, set of the pants; I'm going to say it's a two. They're perceptible but not objectionable. Again that's predicated on you all calling that heavy turbulence and I think here we can see the problems with these limitations the simulator gives us and the problems we are going to have with these particular configurations. For the display question; negative.

Exposure 24

DATE : 06NOV97
PILOT: B
TASK : 1013
CARD: Nominal Approach and Landing Task

We'll call that one, on approach, frankly, a three. Landing would be four for longitudinal Cooper Harper and lateral-directional, I guess we were within all the parameters for that. Call it a two and a two. DASE CIR rating, probably a two. The ride quality was some what more objectionable. I guess I'd give it a four with a yes on the display question. Exposure number twenty-four.

Exposure 24

DATE: 13Nov97
PILOT: C
TASK: 1013
CARD: Nominal Approach and Landing

This is exposure twenty-four nominal approach and landing, Pilot C. Okay, I'm definitely working harder. Particularly in the flare and touchdown longitudinally. The approach was pretty much the same as it was before. I'm gonna give it two threes up there. For the landing though, three in the lateral-directional axis, that's fine. I'm gonna give it a four in the longitudinal. Desired performance requires moderate pilot compensation. I'm really working on the longitudinal. I think ultimately I could get desired and I'm not willing to bump it down to a five because I don't think its fair to say considerable pilot compensation was require. I'm definitely working here, so, three, three, four, three, on the ratings. CIR is a one. I'm not intentionally modifying anything. RQR is three, mildly objectionable oscillations. The display impacted in a different way than it has before that time. I noticed

in the flare that there was a disparity between the symbolic horizon and the image horizon. On the first one, for some reason I wanted to flare up to the image horizon, which would have been too high. That's one of the reasons I floated so much that first time. The second time there was a bit of that effect too. I didn't float a whole lot it was only thirty-three feet outside the desired box that time. Both times it effected me to some extent. That's it.

Exposure 24

DATE: 19Nov97

PILOT: D

TASK: 1013

CARD: Nominal Approach and Landing

That's exposure twenty-four, here are the comments. Okay, approach, satisfactory without improvement. Four for the longitudinal. Still desired and that was moderate pilot compensation. It wasn't horrible and that'll be the same for the Lat. Dir. also, four. Four and four. For the landing, adequate, yeah satisfactory ... Longitudinal, okay. All right, I'd say five for the longitudinal. Never could get them all desired at the same time. Out of three tries I should have been able to. I think five is a good descriptor of that one. I didn't do much with the Lat. Dir. Four for that, so, five and four. CIR, really wasn't conscious of making any special ones for the flexible modes. I'll say one. I guess two on the RQR, really ... make it three, three on the RQR. Yeah, if had a choice I would desire to have it improved but it certainly isn't horrible. It was only mildly objectionable. Three for RQR and display.

Exposure 24

DATE: 05Dec97

PILOT: E

TASK: 1013

CARD: Nominal Approach and Landing

Pilot E, exposure twenty-four, configuration thirteen, nominal approach and landing. Okay, looking at some open loops out in the intercept leg we could excite a little bit both in roll and pitch. I think I caused me, on this task, to back off in my gains just a little bit and try to be a little bit smoother. You can't make as quick and precise corrections as you could with the rigid airplane which we flew before this. The turbulence level does feel like its, probably what I would characterize as moderate in a normal airplane. Just from the response that we're getting in the cockpit from just the turbulence inputs. Again, my complaint would be in the flare. I'm not so sure about the predictability that you'll get. You really have to kind of game the cues. I think we did three runs and at least on two of them if not all three, I think we had a split between actual and commanded. It was a small split. It clutters up the HUD. It makes the pilot ... it's harder for the pilot to process the information given to him in the HUD. It makes more difficult to make very fine corrections which is really what you need for this higher gain task to make the box with the desired touchdown rate. I think for this level compared to the last configuration we flew. The workload is increased slightly but I don't know that it's really increased that much by the level of turbulence. It does take away the ability to do some ... at least my perception is, I want to back off in my gain a little bit. So I can't make as quick and as fine as precise corrections as I think I could with the other configuration. It's not a large magnitude change. So anyways, on the approach I'd go with a two and a two. For the landing phase, I

think I'd probably go with a four longitudinally and a three lateral-directionally. The four basically coming from the at least a predictability problem, I guess that I perceive. For the CIR, I'd probably go with a two this time. And again, I'm not so sure that I couldn't get the same response out of it. Just because the motion that I do, that I can excite, it's in the back of my mind and I do I guess modify my inputs slightly. I would probably go, if this were mild turbulence and we're getting this response I would probably be in the two and half range. I could probably talk myself into a two or a three. I'm just gonna go with a two I think. No on the display question.

Exposure 24

DATE : 10Dec97

PILOT: F

TASK : 1013

CARD: Nominal Approach and Landing Task

Okay, that was exposure twenty four which was the DASE with the point one five structural damping and that was with the light turbulence. And with that level of damping, there's no problem with the DASE effecting control and having to back off or anything. In fact the ... I would have guessed that it was like moderate turbulence with rigid body. And it wasn't enough to effect performance, we actually did better this time. Well, yeah we did pretty good. So let's just give it the same ratings as I did before which was a four, four, five, four. Now let's think about the DASE ratings a little bit. Yeah, I think it's a marginal one, two because I did realize we had it so I was consciously being just a little bit smoother so it's a two for control. Ride is a ... yeah, let's make it a three. Nobody likes that kind of bouncing either whether it's a rigid body or structural. In fact, dwelling on it will only make it worse. Let's make it a four, you know, that was a pretty bumpy ride. Passengers wouldn't like that. Let's make it a four. And no on the ... well let's make it yes because definitely I was seeing the QSAE effect.

Configuration 23 Damp7 with Moderate Turbulence(Sigma=4.5)

Exposure 25

DATE: 23Oct97
PILOT: A
TASK: 1023
CARD: Nominal Approach and Landing

Straight in approach and landing, approach longitudinal Cooper Harper rating; A couple of comments first, did not seem to have much response to turbulence, assuming again that we are in light turbulence conditions. Both lateral and longitudinal axis however seem quick. When you made an abrupt input you got a quick, a very quick ASE response, fairly large amplitude and it was damped, maybe two to three overshoots. The rudder seemed to be less quick in triggering an ASE response in the lateral axis and amplitude was weaker. The amplitude ... less amplitude and it was well damped. For the approach, a little bit of a nuisance ride due to the fact that quick abrupt response is to a pilot input. But never the less we got good performance on the approach. Longitudinal rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes for a three. Lateral same thing. No problem meeting the desired criteria. Controllable? Adequate? Yes, yes. Satisfactory? Yes for a three. For the landing, longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? No. I'm going to rate it a four. Borderline desired-adequate based on the first one which tended to go a little firm, a little long. Workload appears also to be about ... justifying a Cooper Harper four. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? No, a four also for workload. Seemed to not have quite as good a control over the line-up as I would like in close. As far as CIR; Yes this one did have because of the quick response, the high frequency response to my inputs. I had to be careful not to make an abrupt input so for the CIR; Pilot does not alter control. That's not true. I did intentionally modify my inputs. Vibrations impact the precision of voluntary control inputs. Not for this task they didn't. So let's go with a two. RQR; Vibrations do not impact quality. No. Two's no. Cockpit vibrations are mildly ... naw. Cockpit vibrations are moderately objectionable - improvement warranted. A four for that one and no for the display question.

Exposure 25

DATE : 06NOV97
PILOT: B
TASK : 1023
CARD: Nominal Approach and Landing Task

Exposure twenty-five, straight in landing. Approach Cooper Harper we can call a two and the landing a four. Lateral-directional Cooper Harper, I guess we were good on that we'll call it a two and a two. DASE CIR rating, the rating would be two and the ride quality, I believe that was a four with a yes on the displays.

Exposure 25

DATE: 13Nov97
PILOT: C
TASK: 1023
CARD: Nominal Approach and Landing

Okay this is exposure twenty-five, pilot C, straight in approach and landing. Okay the workload has degraded from the light turbulence but I don't feel to the extent that I can say adequate performance requires considerable pilot compensation. If I could give it a half rating, I would, but forced to give it a single rating, I'm gonna stick with the better one. So for the approach, a three and a three. Those are low threes. For the landing, a four and a three ...a four, yeah, a four and a three and that's a low four. It's almost degraded to a five. CIR, two on this one. I think I'm getting fairly light on the control. Particularly longitudinal to avoid exciting the oscillations. Four on the RQR. No impact on display that time. That concludes the comments.

Exposure 25

DATE: 19Nov97

PILOT: D

TASK: 1023

CARD: Nominal Approach and Landing

That's exposure twenty-five. Okay, approach and landing? Four and four on that for the approaches. The system takes care of itself quite nicely there. Now, for the landing. Adequate performance attainable, tolerable pilot workload? I did sneak one out of adequate but I'll say that normally the adequate performance was attainable. We'll turn the corner up here and I'll say six. That is really a hard thing to judge and working at it pretty hard. I'll say six longitudinally. On all of these, these are pretty much no brainers. Lat. Dir., it's not moving around much. I'm not having any corrections to make. It's hard to ... and it's certainly in desired performance. For everything I see on these kind of approaches, four for the Lat. Dir. So six and four. CIR, jeez, I don't know. Two I guess on the CIR. RQR, yeah I'd say four. It's warranted, 'cause I'm assuming that part of that problem in getting the smooth touchdowns is in the vibration area. I didn't notice display perturbations being a problem so no.

Exposure 25

DATE: 05Dec97

PILOT: E

TASK: 1023

CARD: Nominal Approach and Landing

Pilot E, exposure twenty-five, configuration twenty-three. I guess a couple things. One, we're seeing more splits in the flight path vector cue and gamma throughout the approach. Particularly in the last 300 feet. Even without getting a split there's a tendency, if you're holding what you had before, for the airplane to start drifting high. There's increased pilot attention needed to maintain a glidepath. For a precision touchdown task like this it's important at the last to kind of be stabilized and have something that's predictable to start from. So you need to kind of really get in the slot for that last few hundred feet. I think it's more difficult to do that and I think that's degrading the task some. I still think that I'd go with a, I would probably be in the two and a half/two and a half range for the approach, intercept and approach portion. You can do just fine there. There's a slight increase in attention. I guess I'd probably go to a three here. Although, if we were doing half ratings, I think two and a half and two and a half would be more appropriate. For the landing task, for touchdown longitudinally along the runway, we never did get desired performance. So

that would put us in the five range. I think that's probably somewhat appropriate. To me I think the predictability problem right in the flare is worse. As I mentioned before, I think also being able to set up a stabilized approach for the last couple hundred feet to start your flare from, I think is difficult too. We're seeing the split cues again in the flare. Laterally, we did have one excursion while I was concentrating on pitch, when we drifted right outside the desired box. Even though I think I backed off on my gains some here, I don't think that this task is not particularly hard to do from a lateral perspective anyways. I am trying to get things stabilized a little bit sooner and making my inputs smaller. I think I would ... let me think about this for a second. I think I'd probably go with a three lateral-directionally for the landing. I'd go with a two for the CIR. Five, sorry. Yeah. Probably go with a four for the ride quality. This close to the ground, if this was just moderate turbulence I think we're bouncing around quite a bit. And no on the display question. I guess, we're bouncing around enough ... I kind of think that my threshold for noticing the turbulence through the week has kind of becoming ... I think my tolerance is coming up, I guess. I've become more tolerant of it but I think we're getting bounce around quite a bit and I think it effects the task. For this task I think the motions that we're getting are not good in my most technical terms. Anyways.

Exposure 25

DATE : 10Dec97

PILOT: F

TASK : 1023

CARD: Nominal Approach and Landing Task

Okay, again there's no problem with the DASE coupling into the control. I realize I am trying to be a little bit smooth but that's about all. And again the ride feels very rigid body. Maybe the frequency is just a little high for rigid body now that it seems apparent at the higher amplitudes. But approach, let's just give it a four, four. And ... ah shoot, don't like that ride. Deficiencies warrant improvement. Let's give it a six longitudinally. And laterally, let's give it a four for the landing. Okay and a two, five and yes with the QSAE on it.

Configuration 24 Damp7 with Heavy Turbulence (Sigma=6.0)

Exposure 26

DATE: 23Oct97
PILOT: A
TASK: 1024
CARD: Nominal Approach and Landing

Straight-in approach and landing rating. This was close to if not the worst configuration I've flown of the twenty-four in the matrix. In both lateral and longitudinal is very very lightly damped, I was talking eight to ten overshoots, large amplitudes to a pilot input. the rudder was more damped but you get two distinct motions separated by about a second or so it was exciting two different frequencies of the ASE motions for rudder inputs. Basically the fact that it is so lightly damped and the amplitude are so large makes this an awful configuration. So, however, the Cooper Harper's are not going to tell the full story because the performance is pretty good. Controllable for longitudinal approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? No. Give it a four, simply because the motions were so gross that the workload was higher and the same thing for the lateral rating. It has turbulence response that give you a lot of annoying motions and any kind of input you put in creates pretty large responses. It's not damped at all so it's just a real nasty configuration. Let's go with a four again for the lateral rating. For the landing, this is where this configuration is a little bit ironic because it had pretty good performance however it was felt like with any false move you could get a really bad performance. So let's say for the landing longitudinally; Controllable? Yes. Adequate? Yes. The first landing was slightly firm just a teeny bit long. The second landing was a proper H-dot and pretty close to the center of the box. However it took an awful lot of effort on that and I'm going to go ahead and rate that a five. And the reason being even though ... well actually I can legally do that quote unquote legally because I did have an adequate performance on the first one but I think even I didn't the fact of the matter is if you read the description; adequate performance requires considerable pilot compensation. I think the considerable compensation is the main descriptor there that applies. For the lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory without improvement? No and I'm going to go with a five also for the lateral rating, again because slight lateral inputs can create very annoying responses. Okay for the CIR; In this case this is one where I definitely had to alter my motions so number one does not apply. Number two, certainly true. Number three, cockpit vibrations impact precision of voluntary control inputs. For this task, since this is a fairly straight forward and not a real high gain task until the flare, I'm going to say this is kind of a borderline two-three. I think a more dynamic task at the offset of the flight director would show up a more clear cut CIR rating. But let's go with a three on this CIR. And again it's real borderline two-three for this task. For the RQR, with a three since the vibrations impact the precision, I don't like that at all, We'll skip on down to about number four. Warranted, objectionable, improvement required. I'm going to go with a five on this, for the fact that the ride quality is really poor and the fact that improvement is required whenever there is a configuration that effects your ability to make precise inputs. And no on the display question.

Exposure 26

DATE : 06NOV97
PILOT: B
TASK : 1024
CARD: Nominal Approach and Landing Task

Exposure twenty-six, longitudinal Cooper Harper approach. I guess I'd give it a two and a three for the landing. A two for the... Okay, the lateral-directional Cooper Harper would be, I think that was all desired as I recall, two and two. The DASE CIR rating, I'd give it a two and the ride quality a four with a yes in the display question.

Exposure 26

DATE: 13Nov97
PILOT: C
TASK: 1024
CARD: Nominal Approach and Landing

Okay this is exposure twenty-six, pilot C, nominal approach and landing. Okay I'm working harder during the approach and I think it's bumped the longitudinal over to level two during the approach. Lateral-directional is still okay throughout. I really took a close look at it on that last one. Very little of the workload is lateral-directional. It's predominately longitudinal. So for the approach, both axes is controllable, adequate performance is attainable. Now on the lateral-directional axis I'm gonna say it's satisfactory without improvement. On the longitudinal I'm not. So lateral-directional was a three, minimal compensation. Longitudinal was a four, moderate pilot compensation. That's predominately just to correct for the turbulence effects. The landing, same thing. Longitudinal was a four, lateral-directional is a three. For different reason. Now the predictability of pitch requirements to correct for longitudinal distance in sink rate is a little bit degraded because of the oscillations. So I'm seeing more of an effect of the oscillations. The oscillations were excited by turbulence and pilot input but I'm seeing more of an effect down low and up high it's predominately turbulence. CIR, let's give it a two. I think I'm being a little bit light on it. RQR is between a four and a five. I'm gonna give it a four, moderately objectionable. That concludes my comments. And no effect on the display, that does conclude my comments.

Exposure 26

DATE: 19Nov97
PILOT: D
TASK: 1024
CARD: Nominal Approach and Landing

Pilot comments for exposure twenty-six. Okay on the approach, the turbulence is keeping the workload pretty considerably higher than the ones with the lower turbulence. I don't notice as much in Lat. Dir. as I do in pitch. It definitely takes compensation to keep it adequate. Five and four for longitudinal/ lateral-directional. For the landing, satisfactory without improvement? I'm gonna say no. Although I had a couple of desireds in there, there's a certain amount of luck that gets into that I suspect. The fact that I can get it all squared up and almost let it do it's own thing on that. In order to get the performance I had, I was working pretty hard, particularly in pitch. I think I'll go with six on pitch. The Lat. Dir., I did see some compensation coming in that time a little bit. It still was desired so I'll go with four on that, so, six and four. CIR two, sounds familiar, and four for RQR. The displays moving around some. Enough that I'm beginning to notice it a little bit so I'll say yes but it's minimal, the perturbations are impacting the precision mildly. But if it's a digital world I'll say yes.

Exposure 26

DATE: 05Dec97

PILOT: E

TASK: 1024

CARD: Nominal Approach and Landing

Pilot E, exposure twenty-six, configuration twenty-four. Okay, I guess I've learned more about altering my technique for this configuration and of turbulence together as we've moved on. When we flew it in mild or light turbulence, I could still be somewhat precise with my control. I don't think as well as with a rigid airplane but enough where I could still correct at the last minute for my touchdown point. In this configuration with the higher level of turbulence here that we've had on the last runs, it's increasing difficult to precisely get the airplane in the slot for the last couple hundred feet and set up for the precision landing task. There were a couple times where I found that had everything set up exactly like I wanted it and then I would get a split at the last second or the airplane would drop out or float at the last second and I think that may be a function of the turbulence. Anyways, not being able to get stabilized as easy for the last couple hundred feet prior to starting the flare and predictability in the flare, I think is worse than it was with moderate turbulence for this configuration. I guess for the approach phase I would probably go with a three and a three. Like I said before, same comment, there's not that much compensation required. Probably be in the two and a half range actually. I guess one thing that I did see is more frequent and more prolonged splits in gamma during that part of the approach. For the landing phase, I think I'd go with a five in pitch. Although this high level of turbulence is worse than the five that I gave for the moderate level of turbulence. I think I'd still go with a three for the line-up. Although the line-up task is a little bit more difficult with this level of turbulence. I have to work on trying to get line-up set the best I can, as soon as I can and be a little bit patient with it. There's not a big, basically we're just kind of fine tuning the line-up portion of the task. I suspect that if we were doing an offset that we would see the lateral part of the task be a little bit more degraded. I think that we're probably at a three on the CIR. I think the vibration level impacts the precision of my control inputs. I would probably be, if we were doing half ratings, I would probably be at two and a half here, I think. Because I still don't think the vibration levels impacting the precision of my ... I think it's effecting the precision that I can get out of the airplane and the precision of the response that I get but I don't think that it's really effecting, that much, the precision of my input but probably a slight effect there. For the ride quality, probably be in a four and a half range. I'm going to go with a four. You could do this but there's enough turbulence that I think it would probably, you probably would think about maybe going around and worry about performance. Probably be looking at doing some speed additive to make sure that you had an acceptable margin above stall. The other thing that I mentioned about technique is ... I think I could probably go back at the moderate level of turbulence and get better performance. You're technique does grow. What I tended to do here was kind of just ... this is what I would do not trying to do a precision landing task but if I was just trying to land an airplane in turbulence anyways I don't really go for necessarily the most smooth touchdown I can get. I just go to make sure that I get a safe touchdown. I tend to try to average out my control inputs. Just try to fly an average pitch attitude that's gonna give me about what I get. Expecting that I'm gonna have some longitudinal excursions as far as my touchdown goes. I think that's really kind of how I would fly this, the same way. That's the change in technique that I made is, I just basically tried to average things out the best I could and be a little bit less aggressive at trying to really track a precise touchdown point. If we went back to the moderate level of turbulence I think I'd get better performance than I

did trying to actually track a precise touchdown point to really hit the target. Anyways, that's it.

Exposure 26

DATE : 10Dec97

PILOT: F

TASK : 1024

CARD: Nominal Approach and Landing Task

Okay, comments for the point five damping ratio DASE with six foot per second RMS turbulence. Again I don't think there's much coupling of the DASE into the rigid body as far as control goes although the ride was really getting bad on that one. And you could tell it was definitely a structural type of ride this time. It didn't feel rigid body with this level of turbulence, you could feel the whackety, whackety, whack going. And the ride gets poor enough during the flare that you almost feel like you kind of just want to push the reset button. But still the performance was pretty good. Let's try to rate it. Longitudinal for the approach, it's not too bad, the ride quality is not very good but the ... Let's go up the outside here and make sure we don't miss something. Is it adequate performance attainable with a tolerable pilot workload? I think definitely yes. Is it satisfactory without improvement? Definitely no. Let's give it a five both laterally and longitudinally during the approach. For the landing: is adequate performance attainable with a tolerable workload? I would almost say that's a seven, longitudinally. Laterally, not quite as bad, yeah it's hard to separate out the lateral and longitudinal there. Let's give it a five for lack of anything better. Okay, the control, cockpit vibrations impact, yeah. Yeah, they do, three for the control. Five for the ride and yes for the display and I think the wiggles are apparent here. The approach, lateral was a five.

Pilot A back to back

Exposure 27

DATE: 23Oct97

PILOT: A

TASK: 3012

CARD: Flight Director Tracking Task

Before I rate the longitudinal approach rating; this wasn't too bad a configuration. Longitudinally there are no appreciable effects from pilot input, aeroservoelastic effects. Lateral there was a kind of a well damped, one and half overshoots, small amplitude, effect which didn't really apply too much to this straight in task. We didn't do a whole lot of lateral work. The rudder was no real effect or very small. There was a turbulence response. It did kind of bounce around based on turbulence inputs and that was kind of ... that was fairly obvious in this case. Basically though, not bad overall. For the longitudinal approach rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, for a three. This falls in a general group of configurations that are fairly well behaved up and away with a gamma-dot-v control law and the P-beta law, it's just no real problem, even though it's an uncomfortable ride at times. Similarly lateral is also a three. Minimal pilot workload is the operative descriptor there. For the landing, longitudinally; Controllable? Yes. Adequate? Yes. Certainly a couple of nice landings and one just a little bit firm. I just didn't get quite enough flare into that one. So I'm seeing desired performance for landings but the workload seemed a little bit more than minimal, so let's go with a four for longitudinal. Lateral; Controllable? Yes. Adequate? Yes. Lateral performance was about a four also based on the workload. The CIR; since this was basically a straight-in task and I really don't count the up and away localizer capture because that's ... you can still be fairly aggressive there and get the performance you want. I don't think I really altered my control inputs as a result of this configuration, so let's go with a one, CIR. For an RQR, there was some annoying bouncing on the approach that is not really pilot input excited but more turbulence excited so anyway it's a little bit annoying. So certainly the first two don't apply. Number three, vibrations are mildly objectionable. I would say this is borderline three-four and let's go with a four on this. It could go either way so a borderline three-four and no on the display question.

Exposure 28

DATE: 23Oct97

PILOT: A

TASK: 3018

CARD: Flight Director Tracking Task

This is the longitudinal rating for the approach, Cooper Harper; First a couple of comments. Longitudinal axis seemed, medium amplitude, well damped but fairly abrupt. You make an input and you get a fairly abrupt response, aeroservoelastic response but it was well damped, one overshoot. Lateral axis was a medium amplitude also, not quite as abrupt and it was more lightly damped about five to six overshoots. The rudder had the interesting ... we've seen once before, where it tends to roll away from the rudder that you stepped on. So when you release it you tend to get a roll away from the direction you just stepped on the rudder. And that's kind of an interesting response from a rudder excitation. At any rate, up and away, no real problems, pretty much all the comments made before this configuration; Minimal compensation is required. You meet the desired criteria easily so it's a Cooper

Harper three without much question. Lateral is the same way, Cooper Harper three. For the landing; The landing is little bit more interesting. Laterally, I tended a couple of times to get into the loop laterally. A little bit of lateral response. Very high frequency. Short amplitude. Just kind of oscillating a little bit and made the desired criteria but it seemed like I was having to work a little bit hard. Longitudinally, It seemed to not flare in time on the second one a little firm, a little firm and long on the first one and the third one I kind of figured it out and it was much better. But it still tends to be almost to the long side so I didn't have quite the control I would like. And I think I was trying to be a little bit subtle with my inputs because I didn't want to trigger the fairly abrupt though well damped longitudinal response. So for the rating, longitudinally, landing; Controllable? Yes. Adequate? Yes. Satisfactory? No. The question here is whether this is desired or adequate and what I will probably do is for this particular set of numbers, I will probably go with a five and this is real borderline four-five. So let's caveat that. It could have gone either way I think. For the lateral rating, I'm going to go with a; Controllable? Yes. Adequate? Yes. Satisfactory? No, a four. Again workload and occasionally just a very very little high frequency, not PIO, just a little response here, I noticed on the last one especially. And it's not unusual because of the lightly damped lateral mode. Okay for the CIR; Yes I did have to tailor my responses to not trigger that abrupt longitudinal response, so number one does not apply. Number two, it's true. Number three, impact precision. It maybe did because it's so abrupt, so let's go with a three and this is borderline two-three. Depending on the day, I may go either way on that. Ride quality; There is a response to turbulence that's not too bad however the abruptness to longitudinal inputs and the lightly damped lateral make it not too good, so we can get rid of the first two. The third one, improvement desired. No. Let's go with four, improvement warranted. I'm going to say it's a four on this one. And that's a little bit different, typically when I give a three CIR, I go with a five because I don't like the fact that configuration impacts the precision of my inputs. However this is borderline two-three and for the straight-in approach, the motions aren't that objectionable so that gives us a four, probably with a offset approach, I think it would be a five on this RQR. So we're borderline four-five and borderline two-three on these ratings. No for the display question.

Exposure 29

DATE: 23Oct97

PILOT: A

TASK: 3019

CARD: Composite Flight Director Tracking Task

We're looking for CIR and RQR ratings. CIR is going to be one. Basically because I started out flying the thing to what ever degree I needed to, to complete the task within the proper desired tolerances and I did not get any kind of motions that required me to modify my inputs. So for the particular task, not knowing anything else before hand, I just went ahead and just flew it until I knew any better. And basically I never had to modify my inputs so let's go with a one for CIR. RQR; The thing does not really respond badly to my inputs, however it's just kind of a nuisance turbulence excited mode, that we need to get rid of, so one and two don't really apply. Three, moderately objectionable. I would think that this would get very tiring after a while, so let me go with a four on the RQR. The turbulence response is just a little bit too large to be left alone. It really needs to be fixed. Okay we're going to Cooper Harper rate this now. For the longitudinal task; Basically ... Okay I got my score here. It looks like a 97.8 and 100, so I did a pretty good job Cooper Harper. It's not a bad flying configuration as far as my inputs. So for the longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory? Yes a three. Basically pretty nice

longitudinally. The lateral, again and not necessarily because of the ASE but just because the lateral control law and the fact that it's difficult to ... the lateral control law, and don't get me wrong, is not bad at all, but you have to be able to fly an increasingly, a kind of step input, to a track crossing angle. And that is difficult to do in any lateral control law. So in order to laterally track this thing, you know, obviously that's one of the reasons why you don't bomb curving linearly, you want to bomb just on a vertical axis or a longitudinal axis. So the lateral task gets harder by nature so let's go with a four on that.

Exposure 30

DATE: 23Oct97

PILOT: A

TASK: 3013

CARD: Composite Flight Director Tracking Task

Much worse configuration. It appears to me just from the way it flew that the mode cancellation from the lateral and longitudinal axis was missing. Longitudinal axis, I was very reluctant to make aggressive inputs and part of that to be honest is the fear of the sim kicking off. It seems to me from my experience that I can be more aggressive laterally without getting the motion base to bomb than longitudinally. So I did definitely change my longitudinal inputs and kind of filter them a little bit. The lateral inputs I stayed fairly aggressive with and that certainly made the ride quality worse but allowed me to complete the task and obviously I am still task motivated to do desired. Since I did have to kind of tone down the longitudinal and I probably even without fear of the base which I would have done anyway, just because it was so annoying, it's definitely not a one for CIR. Two; I definitely modify the control inputs. Probably a borderline two-three. We'll go with three. I know you all can't put the caveat's in there so it's a three and for the ride quality, with a three, the fact that it effected my performance and they were pretty nasty motions, we'll go with a five. Okay I met the desired criteria for the Cooper Harper rating purposes but the workload was high we're going to go, the longitudinal; It was controllable. Adequate? Yes. Satisfactory? No, I'm going to go with a four. And laterally; Acceptable? Yes. Adequate? Yes. Satisfactory? No, a four also. This longitudinal could be a three because I really had no trouble maintaining the desired criteria longitudinally but since I ... again as this week has evolved since I toned down my longitudinal inputs, it made the workload a little bit higher then I've got to anticipate more. And so I want to show a break between this and the previous one, so we'll go with a four longitudinal.

Exposure 31

DATE: 23Oct97

PILOT: A

TASK: 3014

CARD: Composite Flight Director Tracking Task

This one was better than exposure 30, worse than exposure 29. It felt like to me the mode cancellation was still off but it felt like the damping had been increased. I would not say it was very lightly damped, I would say it was more on the damped category with maybe three overshoots or so or something like that and that made it a little bit better. Because it was better damped, in my opinion, the CIR is going to be back to a one. I pretty much did not feel that I had to modify my inputs at all and I think this is, at least my perception is, the better damped these configurations, the better I like it. However the RQR, it's still a crummy ride so let's get rid of the first two. Number three, mildly objectionable. No.

Number four, improvements warranted. Let's go with a four on this. This is tough because the ... I wanted to delineate, I want to indicate my preference. These ratings are going to come out the same as exposure 29 which is clearly superior. So we do have a slight problem here. I think the pilot comments are going to be essential for something like this. Cooper Harper ratings, longitudinally; I met the desired criteria fairly easily. Controllable? Yes. Adequate? Yes. Satisfactory? Yes a three. Laterally, again the workload, it's because of the nature of the task. Lateral tracking is harder than longitudinal tracking and we're going to go; Controllable? Yes. Adequate? Yes. Satisfactory? No, a four. So I really want to clearly indicate, these ratings are the same as twenty-nine but twenty-nine is far superior because of the mode cancellation, in my opinion. That's what happened. Again thirty-one is better than thirty, not nearly as good as twenty-nine.

Exposure 32

DATE: 23Oct97

PILOT: A

TASK: 3019

CARD: Composite Flight Director Tracking Task

This one it appeared to me, we lost our mode cancellation in the lateral axis. We still seem to have mode cancellation in the longitudinal axis and our damping still seems to be pretty good so what we've done here is kind of split the difference between thirty-one and twenty-nine. As far as the CIR, basically I didn't really feel the need to alter my inputs so it's going to be a one. For the RQR; It's better than the previous one I felt. Let's see, not objectionable ... This is a real toss up between a three and a four. I'm going to go ahead with a three which will probably mess up Dave's baby here. The ride just seemed to be better that time, just qualitatively. It appears to me that the longitudinal cancellation is back on. The damping is back up to one to one point five. That's what it appeared like. It appeared fairly well damped. The longitudinal axis had no problems. The lateral axis was not canceled but it was damped, so it just not too bad. The damping, I think, that it feels like to me, made it a little bit better than twenty-nine but it's a tough call. Cooper Harper wise; It is controllable in longitudinal. It is adequate. Satisfactory without improvement? I'd say yes. And the lateral task, again it's a harder task and it's just the nature of everything as I've said before, trying to establish a consistent track crossing angle, so that high workload supersedes all ASE considerations so we'll go; Controllable? Yes. Adequate? Yes. Satisfactory? No, for four. This one I didn't ... I kind of liked. I liked the damping and it seemed like longitudinal was much better than exposure thirty-one. So I would say thirty-two is better than thirty-one. And I probably need to see thirty-two and twenty-nine back to back to make a clear cut winner at this point.

Exposure 33

DATE: 23Oct97

PILOT: A

TASK: 3020

CARD: Composite Flight Director Tracking Task

This is an interesting one. It had good turbulence response which tends to make me think that the damping was improved but it seemed like mode canceling was taken off on both axes and it seemed like they were less damped than before. I guess the previous damping was point one five. It seemed like they were less damped than that however it flew better in turbulence. We didn't get nearly the uncomfortable ride for the fifteen seconds just flying

inside the inner flight director circle. So that's contradiction as far as I can see but at any rate as far as CIR; I would have to say it was a two because I did tone down my longitudinal inputs. I did not tone down my lateral inputs. And for the RQR; It's two different ... oh, man this is not an easy one. There are two different ways I can look at this. The RQR in turbulence is very good. The RQR during the task is not good. So I've got Mr. Raney here, how should I play this? Okay, I've been directed to rate the entire task. It seemed to be two different flavors to me but certainly it's not going to be a one or two. There were vibrations that were perceptible and objectionable. If I average out the entire task it is going to come in at a three. Just for the record, it would have been a four for the active maneuvering and probably a two for just quiescence, flying along inside the circle. Cooper Harper, I think I met desired criteria on both. Controllable? Adequate? Yes, for longitudinal. Satisfactory? I am going to say yes on this one, even though I did have to modify my longitudinal inputs. Laterally; Controllable? Yes. Adequate? Yes. And a four. For the same reasons that I have enumerated many times above. This was worse than thirty-two. Okay this thirty-three again. Upon further discussion about this, we're going to change the ride quality to a four. The way, I guess, we want to run this task is that the worst ride quality is the predominant. What I was doing was averaging because it flew so well in turbulence. So we will stick with a four vice a three for ride quality. The CIR stays a two and the Cooper Harper's remain the same. This is exposure thirty-three and exposure thirty-three was worse than exposure thirty-two.

Exposure 34

DATE: 23Oct97
PILOT: A
TASK: 3115
CARD: Composite Flight Director Tracking Task

Okay exposure 34, a little bit of confusion to me. It seems like that the longitudinal axis is well behaved. The lateral seems to have at least one overshoot but overall pretty good and better than thirty-three. For the CIR; I had no impediments, no self imposed restraints, that's a one. RQR; Overall, pretty good ride quality, all considered. I would say, probably, sum total a three. Cooper Harper is no problems. Longitudinal; It's controllable. Adequate? Yes. Satisfactory? Yes. Three. And lateral, same comments apply; Controllable? Yes. Adequate? Yes. A four for workload but no particular Cooper Harper problems as are the case with most of these.

Exposure 35

DATE: 23Oct97
PILOT: A
TASK: 3115
CARD: Composite Flight Director Tracking Task

This one flew very well on the task. The turbulence performance was not as good as I would like but the actual closed-loop task was very good. It seemed like we had cancellation on in both axes and we're fairly well damped. And it flew well but it just seemed to bounce a little more in the straight and level segment. I certainly did not in any way alter my control inputs, so let's go with a one for CIR. Ride quality, well this time the worst ride is the turbulence, straight and level portion as opposed to the actual task and I would say borderline three-four. I am going to go with a three on this. The Cooper Harper, one of the best scores that I ever got. In fact the best I ever got. Certainly it worked very

well there. Longitudinal; Controllable? Yes. Adequate? Yes. Satisfactory for longitudinal? Yes for a three. And since I got a perfect score on the tracking I cannot penalize lateral so for the first time ever in history; Lateral rating; Controllable? Yes. Adequate? Yes. Satisfactory? Yes, a three. The only thing that didn't seem as good about this one was the turbulence response straight and level. Performance wise, though it is slightly better than exposure thirty-four. Turbulence wise it's probably not as good. It is kind of a toss up. I guess intuitively I like thirty-five better but that's probably for performance, if nothing else. Okay, I have just been informed that I can have a same, let's put it this way thirty-five and thirty-four are little hard for me to tell the difference so if we had time to really wring these things out it would probably become a subtle difference but let's go same right now.

Pilot B back to back

Exposure 27

DATE : 06NOV97
PILOT: B
TASK : 3012
CARD: Flight Director Tracking Task

Exposure twenty-seven. We had desired performance. This is a flight director capture maneuver. Longitudinal Cooper Harper, I think is a two and the lateral is a three, I believe. The DASE CIR rating, a two and the ride quality was a bit, I'd say moderately objectionable, four and display impact was a yes.

Exposure 28

DATE : 06NOV97
PILOT: B
TASK : 3018
CARD: Flight Director Tracking Task

Exposure twenty-eight, the flight director tracking and capture longitudinal Cooper Harper. Actually it was desired, I'd give it a three I guess and lateral-directional a three. DASE CIR rating a two and a five for the ride quality. It's a little worse than before and yes on the display. Slightly worse than the prior configuration, primarily due to the pitch damping or the pitch mode, excitation from pitch inputs.

Exposure 29

DATE : 06NOV97
PILOT: B
TASK : 3019
CARD: Flight Director Tracking Task

Exposure twenty-nine, flight director tracking and capture. Longitudinal Cooper Harper, we had desired performance so think I'd give it a three and a three for lateral-directional Cooper Harper. DASE CIR rating of two and a ride quality of five and a yes on the display question.

Exposure 30

DATE : 06NOV97
PILOT: B
TASK : 3013
CARD: Flight Director Tracking Task

Exposure thirty. Longitudinal Cooper Harper, we'll call it a two and lateral, a two. DASE CIR rating, a one. There were some vibrations, I'll give it a two and a no on the display question. This is configuration or exposure thirty, I believe it is? Was better than any of the previous versions and better than the last one, last version, exposure twenty-nine.

Exposure 31

DATE : 06NOV97
PILOT: B
TASK : 3014
CARD: Flight Director Tracking Task

Exposure thirty-one, flight director tracking and capture task. Longitudinal Cooper Harper, a three, lateral a three. There seemed to be not a great deal of excitation due to turbulence but there is a very substantial excitation due to pitch inputs. Lateral inputs are not a big problem. They do not create large disturbances but DASE CIR influence, rating is a two. The ride quality, I would say highly objectionable, five. Primarily due to inputs, pilot inputs in the stick. It's kind of a galloping motion that's created. Aeroelastic display perturbation impact is yes, and as far as better or worse than the previous one. I believe this was worse than the previous one.

Exposure 32

DATE : 06NOV97
PILOT: B
TASK : 3019
CARD: Flight Director Tracking Task

Exposure thirty-two was better than the last one. Desirable performance, flight director tracking and capture. Longitudinal Cooper Harper, I'd call it a two and a two for lateral-directional. DASE influence was a one and a one for the ride quality and a no for the displays. One and a no. One for ride quality and no for the displays. Ninety-nine and one hundred percent pure.

Exposure 33

DATE : 06NOV97
PILOT: B
TASK : 3020
CARD: Flight Director Tracking Task

Exposure thirty-three, longitudinal Cooper Harper on the flight director tracking task. I believe I can call it a two and lateral was a two. DASE influence, DASE CIR rating is a one and DASE influence on ride quality... Ride quality was, there was some bumpiness perceptible but I think I'd give it a two with a no on the display question. Whether or not it was better than the previous one, as I recall, it was about the same, It might have been better, perhaps. You want a definite answer don't you? Okay, I'll call it better.

Pilot C back to back

Exposure 27

DATE: 13Nov97
PILOT: C
TASK: 3012
CARD: Composite Flight Director Tracking Task

This is exposure twenty-seven, Pilot C, flight director tracking task. Okay, much as in the baseline just working lateral-directionally. So I'm gonna give it a three for longitudinal, a four for lateral-directional. CIR is one, RQR is two but no display impact. Just a little bit of work just due to the slew rate on the flight director and a little bit of sluggishness in the lateral axis. Very similar to baseline. No major effect of the aeroelasticity.

Exposure 28

DATE: 13Nov97
PILOT: C
TASK: 3018
CARD: Composite Flight Director Tracking Task

Okay Pilot C, exposure twenty-eight, flight director tracking task. Okay performance was 100 and 100 on that one, on the last one. Just for the record. Very similar ratings to before. It's nice and crisp. If anything it's crisper than it was before but I'm still working laterally. So I'm gonna give it a three and a four. CIR is one, RQR is two and it's almost a one. They're perceptible but not objectionable, and they're barely perceptible. No display impact. In comparing this one with the last one, this one was definitely better. Less noticeable vibrations and if anything the handling qualities appeared to be a little bit crisper than they were last time. That concludes my comments.

Exposure 29

DATE: 13Nov97
PILOT: C
TASK: 3019
CARD: Composite Flight Director Tracking Task

Exposure twenty-nine, flight director tracking task, pilot C. Okay similar workload and ratings as before for the same reasons. Longitudinal, lateral-directional, a three and a four. CIR is one, RQR, three this time. A little bit more objectionable than before. No display impact and this was worse than the previous one.

Exposure 30

DATE: 13Nov97
PILOT: C
TASK: 3013
CARD: Composite Flight Director Tracking Task

Okay this is exposure thirty, pilot C, flight director tracking task. Okay very similar in terms of workload to what I've seen so far. Three and a four on Cooper Harper's. CIR

one, RQR, it's between a two and a three. Let's call it a three but it's a good three. It's on the borderline between two and three. This is better than the previous one. No display impact.

Exposure 31

DATE: 13Nov97
PILOT: C
TASK: 3014
CARD: Composite Flight Director Tracking Task

This is exposure thirty-one, pilot C, flight director tracking task. Okay Cooper Harper's, similar to what they have been for the same reasons, a three and a four. CIR, this time I'm modifying a little bit, CIR of two. RQR of four, moderately objectionable oscillations. No display impact and this is worse than the previous configuration.

Exposure 32

DATE: 13Nov97
PILOT: C
TASK: 3019
CARD: Composite Flight Director Tracking Task

Exposure thirty-two, pilot C, flight director tracking task. Okay the difference is between this one and the last one. This one seemed to dig in more. The last one was sluggish and this one kind of dug in. The oscillations were a little bit more objectionable. From a control performance standpoint, very similar. Longitudinal is almost degraded into a four but not quite, I'm still gonna call it a three with minimal compensation. So a three and four on the ratings. CIR's are gonna change though. CIR is four on this one. Occasional involuntary control inputs once or twice out of the two runs. RQR of five. I find the oscillations objectionable now, highly objectionable. No display impact. This one is very slightly worse than the last one. That concludes my comments.

Exposure 33

DATE: 13Nov97
PILOT: C
TASK: 3020
CARD: Composite Flight Director Tracking Task

This is exposure thirty-three, pilot C, flight director tracking task. Okay, similar ratings to before. I'm not seeing a big effect on the ratings. Ride quality changes with these configurations but the ratings don't seem to change a whole lot. So three and a four, longitudinal, lateral-directional for the same reasons. CIR, I'm gonna give it a one. I'm not really modifying my control inputs and vibrations don't seem to be impacting the precision a whole lot. Let's give an RQR of three, mildly objectionable. This one was better than the previous configuration and no display impact. That concludes my comments.

Pilot D back to back

Exposure 27

DATE: 19Nov97

PILOT: D

TASK: 3012

CARD: Nominal Approach and Landing

Okay pilot comments for exposure twenty-seven. The pitch, satisfactory without improvement? Yes. Three would be fine. It's a good three. Satisfactory without improvement for the Lat. Dir.? There's a certain amount of sluggishness there that still is detracting and that brings up the pilot compensation. Kind of brings it down to the four level. Although this was about as easy as any I've seen. I'll have to stick with longitudinal three and Lat. Dir., four. CIR of one, yeah, I'll stick with one. RQR, gee I hardly felt it but two. Displays? No.

Exposure 28

DATE: 19Nov97

PILOT: D

TASK: 3018

CARD: Flight Director Tracking Task

Okay pilot compensation for exposure twenty-eight. Well my first feeling was it was very similar to the other one. I could feel a little higher frequency oscillation. A little more noticeable. That by itself, I didn't feel as though it effected my ability to fly precisely and one them was very deeply entrenched in desired and the other one is just barely in adequate. Makes it a little bit tough. Every one I've done in all these days, it's primarily a lateral-directional problem. The pitch, I'm gonna leave at three. Lat. Dir., well, if you allow me a half a percent out still being desired. I guess I probably could ... was that moderate? Considerable ... that might have dipped down into the five. It's a borderline between four and five. It's easy to get adequate and difficult to get desired. Since we don't give half ratings I'll make that a five. Just to note that it's and awfully good five. CIR one. RQR, I'd probably still leave it two. No on the display. Oh, I think I'd take the first one given the choice. I would take the first one over the second one.

Exposure 29

DATE: 19Nov97

PILOT: D

TASK: 3019

CARD: Composite Flight Director Tracking Task

Pilot comments for exposure twenty-nine. In general the ability to fly it precisely, obviously can't be too bad. It wasn't a particularly high workload but the ride was definitely not as good. So as far as the performance and workloads probably down in the CIR's and RQR's it's gonna show a little degradation there. I think I'll pretty much stick with my longitudinal three and Lat. Dir. four on that one. Certainly got desired performance. The lateral-directional, I just have a hard time getting that better due to the, kind of a sluggish feel. As far as altering control inputs, no I don't believe I did, certainly not consciously. So, CIR a one. RQR, however, you're down to about a four on that. No take that back,

desired. Let's make it three. It's desired, probably could live with it the way it is but it would certainly be nice to fix it. Okay so RQR of three. I suspect this like all of the ones I've done before, display is going to be no. The controllability and that part of it I felt equal to the first one and the only thing that I would downgrade it on is the ride quality. It felt there were more oscillations there and the vibrations were more noticeable on this one than, actually, either of the other two I think, but certainly more than the first one.

Exposure 30

DATE: 19Nov97

PILOT: D

TASK: 3013

CARD: Flight Director Tracking Task

Pilot comments for exposure thirty. Well again, still possible to get desired performance all right. I did see a little more, looked like, a very low frequency oscillation. Left and right is what I noticed the most. It was enough that it did take a little more compensation than the others. Tough part is, when you're doing Cooper Harper's sometimes, if you try to show it in the Cooper Harper's you end up expanding, you know, exaggerating how much it was. Longitudinal I didn't see much difference. Didn't bother me much there so I'll leave that a three. The four, it was definitely more difficult than the last one in the lateral-directional. I seemed to go from one side of the target to the other side at about the same frequency. I feel as though that was a little more in. I think I'll probably drop that down to a five, considerable. It was borderline four and five but I'll leave it at five. I don't want you to think there was a drastic difference but there was a noticeable difference so I'll leave it at that. I did intentionally modify the control input. Cockpit vibration ... you know vibration implies a rapid oscillation. This is a low frequency, one side to the other that I felt. I think that probably got into the three. This oscillation I think impacted precision of my voluntary controls, wait a second. No, no I take it back. Two. I intentionally modified my control input to avoid it and reacted to it but I can't say that it effected, impacted my control inputs. I think that has more to do with coupling into it. That wasn't the case. Two on the CIR. RQR, wasn't horrible. I'll give RQR of three on that and no on the ... (it was worse than the previous one). Yeah, yes. For the ... like I say it was like a wallowing left and right more than I felt on the other ones.

Exposure 31

DATE: 19Nov97

PILOT: D

TASK: 3014

CARD: Flight Director Tracking Task

Okay pilot comments for exposure thirty-one. Okay well, not a huge, huge difference among these last couple three here. Longitudinal pretty much stays the same at a three. Lat. Dir. kind of varies. I'm not sure there's enough to make a difference in Cooper Harper's in here. I would say I certainly got the desired performance. It was certainly, at least moderate pilot compensation. Right in that borderline four to five range. I guess I'll go with four on that. That's a difficult one to call right there between the two, 'cause I want to show a difference and yet it wasn't hugely better. Even though I think the last one I gave five on the Lat. Dir. and this one I'm gonna give a four. It's slightly better than the one before. Go with a CIR of two and RQR of three. Display no. (And slightly better). Just slightly better not too much to add to that.

Exposure 32

DATE: 19Nov97
PILOT: D
TASK: 3019
CARD: Flight Director Tracking Task

Okay the pilot comments for exposure thirty-two. Okay on the first run it looked a lot better. I noticed more motion and pitch than I had on the previous ones. I thought that was ... it was gonna turn out to be fairly decent. Then the next one, boy, I got behind and really went from one side to the other and had quite a time. Still just barely got it into desired. The last time was somewhere between the two. If you put in some quick big inputs why you can get some low frequency left/right motion going fairly easily. Okay, so for the Cooper Harper's. Satisfactory without improvement? This time I'm gonna say in pitch, four. I got desired performance there but that was moderate pilot compensation. That was degraded from the previous one I felt. For lateral-directional, I think we're back to a five on that one due to the workload being more than moderate. I still could get the desired performance. CIR did modify, that would be two. RQR moderately objectionable? I guess I'll stick with a three on that and display no. (Is it worse than the previous)? It was just different. I'd almost say it was the same. It felt like different problems but I would say that about the same level of difficulty. We're talking fine differences here but I'd say very similar to the last one and difficult.

Exposure 33

DATE: 19Nov97
PILOT: D
TASK: 3020
CARD: Flight Director Tracking Task

Okay pilot comments for exposure thirty-three. That actually felt better than the performance would have shown compared to the other ones. Satisfactory without improvement on longitudinal? I think I'll go back to three on that. Lateral-directional ... yeah again, kind of borderline but I guess I'll go with four. CIR's two. RQR, I guess I'm gonna have to stick with three on it. These last few have been really tough to differentiate much. Improvement warranted? RQR of three and displays no. Better than the one before it if you're just doing a checking off. Better or worse I guess I'd have to give that one better than the one before.

Pilot E back to back

Exposure 27

DATE: 05Dec97

PILOT: E

TASK: 3012

CARD: Composite Flight Director Tracking Task

Okay this is Pilot E, exposure twenty-seven, December fifth, flight director tracking task. Okay, basically you could excite modes pretty easily laterally or longitudinally. Enough so that if I made a large input I could actually, it would make it difficult for me to make precise voluntary inputs. Is it satisfactory without improvement is a kind of a hard question for me to answer here. I'm kind of looking at the descriptors too and I don't know if I'd really say it's much more the minimal pilot performance. Although if you if you do get behind and become a little bit aggressive you get banged around. I guess I'd probably go with a four for lateral and longitudinal. CIR I would say, I don't think we got any involuntary inputs. It's close so I would probably go with a three and a half here. If I have to pick a three or four. Probably go with a three I guess. Ride quality? I guess I'd probably go with a ... I'd probably be at a four and half. If I have to pick between the two I guess I'll ... I could probably talk myself into a four and a five. I'll go with a four though and no on the display.

Exposure 28

DATE: 05Dec97

PILOT: E

TASK: 3018

CARD: Composite Flight Director Tracking Task

Pilot E, exposure twenty-eight, flight director tracking task. Okay basically this configuration compared to the last one, just the ride quality without any inputs seems to be slightly better. Less tendency to excite anything in the ... well less tendency to excite motion with either one of the axis. I think probably more of a tendency to excite things in roll here than in pitch. A perception, the roll control seemed to be slightly more laggy though than in the last configuration for some reason. That's just a slight perception that I have. I also didn't think capturing and tracking in bank angle was quite as easy here as it has been in some of the other configurations. That might be a function of that perceived laginess in roll. Again though that's just a slight perception. I like this configuration I think better than the last configuration. Not just for ride quality but I think I don't have to tamper with my inputs as much. I still feel that if I make a large sharp input though that I get some motion or at least the response that I get is abrupt in the airplane. It seems like there's a ... as long as I'm slow and smooth, I don't get any abrupt motion. There's kind of, maybe a little cliff there where I start getting abrupt motion with the larger inputs. If I was gonna come in here and rate this I would probably give it a three and a three for the Cooper Harper. Probably give it a two for CIR. I don't know, I'd be between a two and a three I'd probably go like a two and a half. I guess I probably, could probably talk myself into a two here I guess. No. Let's go with a three for the ride quality I guess and a no on the display question. I did want to make one comment just on the tape from the landing stuff. And that is ... and Dave you and I talked about this. I'm not so sure that the flare ... using a pitch flare is necessarily the most optimum technique like you had said. It would be nice to look at a lot different techniques as far as using power and pitch attitudes and other

techniques for the landing task. I think there's a lot of merit into looking at that. Especially for a backside airplane the typical flare is not always a desirable way to land.

Exposure 29

DATE: 05Dec97

PILOT: E

TASK: 3019

CARD: Composite Flight Director Tracking Task

Okay Pilot E, exposure twenty-nine, flight director tracking task. Okay, I guess overall I thought that this configuration was smoother and probably easier to fly than the last one. Although not by ... not as ... the change was not as large or as apparent as it was between the previous two configurations. I guess I'd have a tendency to probably go towards the two and a half range here if not the two. I didn't necessarily appear to get the abrupt, kind of what I was characterizing as a cliff before. Maybe a slight tendency towards that but I guess I didn't really see it that much, if at all. Think I'm probably gonna ... I would probably give it a two and a half. If I'm gonna go for integers I'd probably give it a two I guess. For the CIR I think I'm gonna go with a one. I don't really think I modified my inputs here. For the ride quality? Ride quality is actually pretty good. I think I might go with a two and no on the display. One other thing that I was gonna note is that the ability to capture and track a bank angle seemed a little bit easier this time.

Exposure 30

DATE: 05Dec97

PILOT: E

TASK: 3013

CARD: Composite Flight Director Tracking Task

Pilot E, exposure thirty, flight director tracking task. I don't like this configuration as well as I did the previous configuration. It's hard to remember back more than one configuration but I think I probably don't like this as well as the last two configurations. I can excite motion both laterally and longitudinally. Although there were a couple times for the roll control I went full deflection with the stick trying to catch up. I thought that during the task, I had more of a tendency to ... well I don't know if that's true or not. I was gonna say more of a tendency to excite things in pitch than roll but I don't think that's necessarily true. You can track the task. You do have to back off on your gains a little bit. The motion does effect I think the precision of the inputs or of the control that you have. I guess I'm looking at the question, is it satisfactory without improvement between the three and the four. Kind of trying to determine what I think there. I could probably talk myself, tell you the truth, to go either way. I think I'm gonna go with the four here. Just simply because I could excite the motion if I turn my gains up. There were a couple times though where, like I said, I did go full deflection with the roll trying to catch back up to the cue. For CIR, I could probably ... I would probably go two and a half. I guess ... I guess I'm gonna go with a three but it's a high three. Like I said I could talk myself either way I think. Let's see. Actually, I guess I would note that I would probably go two and a half but let's go with a two instead of three for the CIR. For the ride quality, I'm probably right around the four range. I'm gonna give it a four and no on the display.

Exposure 31

DATE: 05Dec97
PILOT: E
TASK: 3014
CARD: Composite Flight Director Tracking Task

Pilot E, exposure thirty-one, flight director tracking task. Okay, this is kind of a hard call, better or worse than the last configuration. I don't think it's as bumpy or as bouncy and I don't think I tend to excite things as much. I can be more abrupt or aggressive with the controls without getting a lot of motion I think. The other side of the coin is, for some reason I feel like ... not a big delta here. I just felt like I could get a little bit more ... a little bit quicker response with the other configuration than I could with this. I'd probably go with a three and a three on the Cooper Harper's here. I'd probably go like in the one and a half range. I'm still modifying my control inputs a little bit but I'm really not sure that I'm doing it that much to really avoid flexibility, probably just a little bit. So I'm going to go ahead with a two for CIR. For ride, you know, we're really not really getting bounced around like we were before, just a little bit. I would probably be in a two and a half range. I guess I will go with a three and no on the displays. (So is that better or worse or same?) It's not the same, it's different. Okay, I guess I have a hard time with the better or worse. It's not the same in that it has different characteristics than the other one did. As far as do I like one better than the other? I guess I would probably choose this one over the other one. Over the last one. Not necessarily ... like I said, for some reason I felt like it wasn't quite as responsive here as it was on the last one. Not a big delta in responsiveness but that's my perception. Just a slight change in that but you also don't pick up as much bouncing and the other thing here too, it seemed like capturing and tracking a bank angle ... you could do it but it seemed like bank angle I had to reverse the stick to get it to stop exactly where I wanted it to. I put in a stick to roll to the left and then in order to stop exactly where I wanted it rather than just putting the stick in neutral, I reversed the stick and then bring it to neutral. Maybe that was just because we weren't bouncing around as much, maybe I was just trying to be more aggressive or maybe I had a tendency to be more aggressive and wasn't getting the response out of the airplane and that might account for the perceived difference in responsiveness. Okay. (So very slightly better than thirty?) Yeah.

Exposure 32

DATE: 05Dec97
PILOT: E
TASK: 3019
CARD: Composite Flight Director Tracking Task

Pilot E, exposure thirty-two, flight director tracking task. Okay, I guess the airplane is very controllable here. It's very predictable in pitch. Less predictable in roll but not bad in roll. As far as delta between the last configuration and this one. Boy it's really tough. I would be real tempted to say the same. If I had to pick, I would probably say very slightly better for this configuration. I know, thanks. I guess I'm just trying to give you a perception. I think I'm gonna say it's ... they're not the same but they're ... as far as liking or disliking them I think I'm gonna say they're the same. My perception is, maybe, just very very slightly this one was better. I really, again I guess I kind of, I had a perception of sluggishness here. It's just a very slight perception, not anything I could put my finger on. I don't think I really had to alter my control inputs for the turbulence. The ride is fairly smooth as far as, you know even hands off in the turbulence I don't think I really had the tendency to excite that much. I'm gonna give it a ... you know I would probably go two and a half with this. I guess I probably am gonna say that I am gonna say that I think it's

slightly better than the last configuration instead of the same. I probably go two and half here but I think I'm gonna probably go two and two. I'm gonna come down and for CIR I'm gonna say ... I think for CIR I'm gonna say one and for ride quality I'm gonna say two. No on the display.

Exposure 33

DATE: 05Dec97

PILOT: E

TASK: 3020

CARD: Composite Flight Director Tracking Task

This is Pilot E, exposure thirty-three, flight director tracking task. All right, I guess I think this is slightly better than the last configuration. My perception is that the airplane is a little bit more responsive. Again, that's not a big delta. It's just kind of a feel and it's slightly more responsive here then it was last time. I don't think I'm tempering my inputs at all. I'd probably go with a two and a two on the Cooper Harper. I'd go with a one on the CIR. We can feel, you know just flying straight ahead you can feel just a few slight bounces. I would probably say two and no on the display. I guess my perception is again. This is not a large delta but I also thought, maybe just slightly more predictable in this configuration too.

Pilot F back to back

Exposure 27

DATE : 11Dec97
PILOT: F
TASK: 3012
CARD: Composite Flight Director Tracking Task

Okay, Pilot F on exposure twenty seven which was the point oh seven damping on the first four modes. Based on the previous experience you can tell just about that would have been my guess probably that it had a little bit of damping added to it over the basic. And the damping level was such that you really have to be smooth to keep from exciting the modes and that even in the turbulence though the ride quality is poor. So pilot ratings, for this task, which is kind of a hard task. Boy, you sure had a hard time. You know you get desired performance yet you say hey the thing has got to be fixed. You know that's almost a contradiction. You know performance is up in the level one and my feeling is that the darn thing needs fixing, it's down in level three. Is adequate performance attainable with a tolerable pilot workload? Let's follow the scale verbatim. Yes it is. Is it satisfactory without improvement? No, deficiencies require improvement and let's give it a six, longitudinally and laterally. And for the ride, correction for the control, on the DASE. Well for this task I don't think they're impacting the thing. So let's give it a two for this task. And the ride, let's give it a five and the display, no.

Exposure 28

DATE : 11Dec97
PILOT: F
TASK: 3018
CARD: Composite Flight Director Tracking Task

Okay, exposure twenty eight. It's obviously a much better airplane. There is almost no impact on to the control. I can almost control at will but if you're too sharp you can feel some bangs, initial bangs but they damp right out. And the ride quality is probably okay now. You would like to have it better but it's probably okay. And so, pilot rating, longitudinally, deficiencies still warrant improvement, let's give it a five, both longitudinally and laterally. And the DASE, for control, is, it's almost a one but let's give it a two just to be conservative. You have to be just a little little careful. And the ride quality now is better, let's give it a three. And no.

Exposure 29

DATE : 11Dec97
PILOT: F
TASK: 3019
CARD: Composite Flight Director Tracking Task

Okay, Pilot F on exposure twenty nine for the flight director task. Well this one felt very similar to the last one but a little better and it was very hard to do anything longitudinally. Laterally you could make it bang but longitudinally you could hardly do anything. So I think it's a little bit better. And the ride was, you're getting pretty acceptable. And again no impact on control that I could see. Okay, pilot ratings, yeah, let's give it a four

longitudinally. And five laterally as much for the rigid body task as for the DASE. You know, I just need some lead on when those turns are coming up. Okay, control for the DASE, I think it's almost a one. Let's give it a one just for kicks. And let's give it a three on the ride, like to have it better. And the display, no.

Exposure 30

DATE : 11Dec97

PILOT: F

TASK: 3013

CARD: Composite Flight Director Tracking Task

Okay, this is exposure thirty, and it's considerably worse than the previous one. There's quite an impact back onto the control. You have to be smooth. I was really aggressively trying to do the task there. We got a hundred and a hundred but in the process I was really getting a pretty bad ride. I would guess that it is not canceled but it appears to have pretty good damping. Wasn't much ringing, it was just the initial bang that was disturbing. And the ride in the turbulence seems to be okay, like to have it better obviously. The only ride problems we had were pilot induced. So the pilot rating, longitudinally, deficiencies obviously warrant improvement, don't like that. I'm going to give it a seven. Nay, this may be a bit strong. Yeah, it's a seven, I don't like that. Okay, lateral, a seven too. The DASE is two and the ride is five, when you take into account pilot activity, and no.

Exposure 31

DATE : 11Dec97

PILOT: F

TASK: 3014

CARD: Composite Flight Director Tracking Task

Okay, having a little hard time trying to figure out just exactly what we changed there but whatever we did it made it quite a bit better than the last one. Very little impact on the control. You can bang the modes but or it feels like I can bang the modes but the effect is very small and obviously we have lots of damping. In fact, the ride quality, hands off, is getting pretty good so I would guess that we have increased the damping but still have input to the modes. The pilot rating, longitudinally, is ... we could almost ... this is getting pretty good. Let's give it a four and laterally let's give it a five. And the lateral one again is the rigid body part, actually, as much as the flexible. Okay, the DASE, I don't really think I was modifying my inputs, let's give it a one. And the ride, well two is a little strong, let's give it a three. We can always like it better. And no.

Exposure 32

DATE : 11Dec97

PILOT: F

TASK: 3019

CARD: Composite Flight Director Tracking Task

Okay, pretty close to the last one. A little bit better maybe. But let's call it a little bit better. My guess is that it was identical to the last one but we canceled the longitudinal input maybe on the first mode or something. It was very hard to feel anything longitudinally but you could still excite the lateral one but it seemed very well damped. There was no impact on

normal control. And the ride is getting pretty good, similar to the last time. For the pilot rating, let's give it a four, five, one, three, no. Ditto last time.

Exposure 33

DATE : 11Dec97

PILOT: F

TASK: 3020

CARD: Composite Flight Director Tracking Task

Okay, not too bad. No impact on the control. I can just barely feel the lateral input but it doesn't ring or anything and it almost seems like it's impossible to excite the longitudinal. You just get a little bump and it's probably mostly rigid body. And the ride seems to be getting about as good as I have seen. I would have guessed that we got cancellation (and damping of) point three. Increased damping of point three. The pilot rating, let's give it a four, five, one, and three and no. So same on the pilot rating as the last one. Okay.

Pilot Comment Card -- Task ID: [] 4020 [] 4069 [] 3115

Pilot: _____ Configuration: _____ Date: _____

1. Adequacy of Roll Control Power? (Desirable - Satisfactory - Unsatisfactory)
2. Ability to Control and Track Flight Path? (Easy - Fair - Difficult)
Bank Angle? (Easy - Fair - Difficult)
3. Predictability of Response to Pilot Inputs in
Pitch? (Desirable - Satisfactory - Unsatisfactory)
Roll? (Desirable - Satisfactory - Unsatisfactory)
4. Were there any PIO tendencies in Pitch or Roll? ____ Yes ____ No
If Yes, was the task: ____ continued (with reduced pilot gain), or
____ abandoned (to prevent divergence)
5. Response Characteristics of the Pitch/Roll Inceptor and Rudder Pedals (indicate if used):
 - Force and Displacement Characteristics? (Desirable - Satisfactory - Unsatisfactory)
 - Pitch and Roll Sensitivity? (Desirable - Satisfactory - Unsatisfactory)
 - Pitch/Roll Harmony? (Desirable - Satisfactory - Unsatisfactory)
6. Any problems in Pitch or Roll during Glideslope or Localizer tracking/ capture?
7. Any problems in Pitch or Roll during Offset Corrections?
8. Any problems in Pitch or Roll during Flight Director Tracking (if applicable)?
9. Any problems during Flare and Touchdown?
 - Runway Line-Up, Sink Rate Control, Tendency to Float
10. Approach vs. Landing - Which was more difficult and why?
11. Effects of Wind/Turbulence?
12. Were the problems noted in questions 6-11 (if any) primarily a result of:
(Vertical Vibrations - Lateral Vibrations - Both - Neither - Can't Specify)
13. Summary - Good/Bad Features. Any special control techniques required?

08-Sept-97 DLR

Pilot Comment Cards, Configuration 01

Exposure 23

DATE: 23Oct97

PILOT: A

TASK: All three

CARD: Questionnaire, Pilot Comment Card.

Adequacy of roll control power? Desirable.

Ability to control and track flight path? Easy.
Bank angle? Easy.

Predictability of response to pilot inputs
Pitch? Desirable.
Roll? Desirable.

Any PIO tendencies in pitch or roll? No.

5. Response characteristics of the pitch/roll inceptor and rudder pedals:
Force and displacement characteristics in all axis? Desirable.
Pitch and roll sensitivity? Desirable in all, in pitch and roll.
Pitch/roll harmony? Desirable.

Any problems in pitch or roll during glideslope or localizer tracking? None.

Any problems in pitch or roll during offset corrections? None at all, a very nice configuration. The nicest I've seen of all the twenty-three so far.

8. Any problems in pitch or roll during flight director tracking? None whatsoever.

Any problems during flare and touchdown?
Runway line-up, sink rate control, tendency to float. No real problems, no tendency to float. From the performance, sink rate control, line-up control was very good, sink rate control was pretty good. I felt like there may have been just a little influence there from perhaps a little turbulence or something like that. Just kind of very subtle but basically a very good configuration.

10. Approach versus landing. The landings more difficult, it's just a higher gain task.

Effects of winds/turbulence? I don't know anything about the winds. Turbulence, I am assuming, it's light nothing else was said but it certainly, I don't know, I saw some airspeed deviations that made me wonder a little bit and there were a couple of times in the flare where it felt just a little bit odd. So I would have to say that was probably a turbulence effect but it's just difficult for me to completely say that. I did not think there were any DASE effects whatsoever to cause that.

12. Were the problems noted in question 6-11 primarily a result of:
Okay there were really no problems to speak of so I would say, if it's anything it's very very subtle and it may be just a misperception on my part but it just seemed to be a teeny bit of something unpredictable in the flare and I'm talking very subtle, still keeping it in desirable range but just something that made me feel a little bit ill at ease. And so that

would be it. I don't know if that is really a vertical vibration but it is certainly a longitudinal subtly that's difficult for me to quantify, so I think vertical vibrations are the closest there but basically it is more of a longitudinal oddity that is very very subtle.

13. Good/bad features. No special control techniques were used. It was very good. Good lateral-directional response, good vertical response except for in the flare occasionally it just felt a little odd but excellent flight director tracking and control, glide slope control felt good and a very nice configuration all the way around.

Exposure 15

DATE : 05NOV97
PILOT: B
TASK : All
CARD: Questionnaire

Exposure fifteen this a pilot comment card extended questionnaire:

Question number one, adequacy of Roll Control Power was satisfactory.

Ability to Control and track was actually easy. Both flight path and bank angle.

Predictability of pilot response was satisfactory, pitch and roll.

PIO tendencies in Pitch or Roll? Guess I didn't notice any specific PIO tendencies, answer's no.

Question five, response characteristics of pitch and roll inceptor and rudder pedals if used. Didn't use the rudder pedals that much.
Force and displacement was, I think probably desirable.
Pitch and roll sensitivity seemed satisfactory.
The harmony was satisfactory.

Any problems in pitch and roll during glideslope tracking and capture? No.

Any problems in pitch and roll during offset corrections? I had a little trouble spotting the touch down. From finessing the touch down sink rate and distance there. So, I guess I did have some problem getting in the desired range.

Any problems in pitch and roll during flight director tracking? No, we got desired performance there. Of course, there again the reversal of bank angles were usually where we lost the target. Gets more design of the test than anything else.

Any problems during flare and touchdown? No, trying to balance the sink rate and float was slightly difficult. Since we didn't get desired performance every time, got adequate usually.

Approach vs. Landing, I'd say the landing was more difficult where the high gain task was required. Especially, fine finessing the sink rate below ten feet Or in the area of below twenty feet.

Effects of wind turbulence, they seemed to be minimal.

Were problems noted questions 6 through 11. Primary result of vertical vibrations, lateral vibrations... Okay, actually ... the problems noted were not a result of any vibrations - Strictly pilot judgment and the fine control that you have and the inertia on landing.

Summary of the good and bad benefits. Certainly the structural damping seems to be quite reasonable. There's no special techniques required for this configuration, other than following, closely, the flare cue

Exposure 19

DATE: 13Nov97
PILOT: C
TASK: All
CARD: Questionnaire

Okay, roll control power, you can circle between desirable and satisfactory. Ability to control and track flight path. Relatively ... Let's see this is based on just the last task, is that correct? Okay, flight path control is easy. Bank angle control is fair. Okay, let's back up then, it's the configuration as a whole. Roll control power, between desirable and satisfactory.

Flight path between easy and fair.
Bank angle between easy and fair.

Predictability and pitch is desirable.
Roll is between desirable and satisfactory.

No PIO tendencies.

Number five, force and displacement characteristics, all three of these you can circle between desirable and satisfactory.

No problems in pitch or roll during loc(alizer) or glideslope capture.

No problems in pitch or roll during the offset corrections.

No problems in pitch. Small problem in roll during flight director tracking. Just a little bit sluggish in getting the slew rates established.

Flare and touchdown was a little challenging as it normally is with sink rate control and a small tendency to float.

The landing was more difficult than the approach and that's just the issue of trading sink rate vs. longitudinal distance.

I didn't notice any effects of wind and turbulence at all.

The problems noted were a result of neither vertical or lateral vibrations.

In summary this is the baseline configuration. For all practical purposes from what I can see. No major problems except maybe a small problem with sink rate control down low. That concludes my comments.

Exposure 14

DATE: 18Nov97

PILOT: D

TASK: All Three

CARD: Comment Card

Okay, adequacy of roll control power? That depended on what I was doing of course. For all the small things for the initial ILS and so on. It was fine. I'd give it desirable but I would drop it down to only satisfactory for the offset landing and for the up and away maneuvering satisfactory. So if I had to give one overall, I would say satisfactory for that one.

Ability to control and track the flight path. Strictly flight path were not talking about the landing part in that. Flight path, we're talking up and away on the approach or are you talking about the flare. Not the flare. (In total, you can lump them together). That's gonna be tough. If it wouldn't have been for those long and hard landings it would have been easy. I guess I'll have to go with fair due to landing. The most important thing that we're doing here. So, in pitch I'd say fair. In bank angle, I'll give it easy. The only thing is in the offset. I was almost against the stop and I really didn't have the tight feel that I'd like. Probably go closer to easy. As far as ability to get to any of the small ones and stop it where I wanted to, for sure was easy. So I guess I'll stick with that. It's hard to do a rating that goes across three tasks that are everywhere from aggressive to fairly subtle. I'll stick with that, fair and easy on those.

Predictability, response to inputs? In pitch, satisfactory and roll, satisfactory. I just can't go with desirable as far as getting what I wanted, rolling out when I wanted.

Where there any PIO tendencies in pitch or roll? No, in neither one.

Response characteristics, inceptor rudder pedals.

Force and displacement. I don't have any problem with those. I can feel some of the detent and all that, but I don't think that that caused me any problems. So, I'd say desirable on that.

Pitch and roll sensitivity. I'd have to drop it down to satisfactory due to the roll sensitivity on that one.

Pitch and roll harmony, that was desirable. (Did you use the rudder pedals at all?) No, no, at least not intentionally.

Any problems in pitch or roll during glideslope or localizer, tracking and capture? No, just through the capture it felt fine.

Any problems during offset corrections? During the correction itself is the roll. Obviously it's a big airplane, you can't roll it real fast. There's a limit to how much you can get. So, it certainly was no large problem. It might have been a minor problem in the roll as far as the offset correction.

Pitch and roll during a flight director tracking. That's a rather aggressive roll task. Yes, I just couldn't get it to go fast enough to track. Especially once you get off it's hard to get it back. Once you get behind the motion it's pretty tough to get back. That's primarily a roll problem that I had.

During flare and touchdown, line-up was easy enough. Given all that, sink rate control is where I had some difficulty. Tended to be only adequate on the touchdowns. Tendency to float, no more than normal. I didn't always do the throttle the same way. If I left it on a little longer, naturally it floated. But as far as problems go, the biggest problem, I'd say, was the sink rate control. That ties into where down the runway it's touching of course.

Approach vs. Landing. The landing was harder for the reasons I said. Trying to get it to touchdown smoothly was tough. The only way I was gonna get in the box, I would have touchdown even harder. So, I'd say the landing was more difficult.

Effect of wind and turbulence, almost negligible. I mean I can feel it but it wasn't causing problems of any type that I could see.

Problems noted in six through eleven and result of. They weren't vibrations. Neither. They weren't a vibration problem at all.

Good and bad features. One thing in special, it's not a real control technique but one technique I was using was starting a little bit low on the glideslope so I had less of a correction to make in the flare. That's kind of a special technique. I'm not holding the stick very tightly on purpose because some of these do cause problems. I tend to back out to get better performance out of it. That carried over to this one to. I just held the stick very lightly. As far as good features, most of the displays are a good feature in my mind. They are very helpful in getting through the majority of things. Bad feature on this particular one, I would say is roll control. I don't have enough roll power there to perform all the tasks the way I would like to. If those are legitimate tasks than it needs more roll power to do them. Even though in most of them I was getting some desired performance. I just had the feeling that it really didn't quite have enough roll power.

Exposure 4

Pilot Comment Card
DATE: 03Dec97
PILOT: E

For the questionnaire:

Adequacy of Roll Control Power? I would say it is somewhere between satisfactory and desirable. I know you guys are probably looking for a clear cut ... Now this is for all three tasks, right? I would probably go with satisfactory. I guess ... for the tasks that we are doing I wouldn't actually mind it being a little bit crisper, I guess. Although, I think its very good compared to a lot of current transports today. It's just the tasks that we are doing do require precise and fairly timely inputs and so, I guess I would probably be somewhere between satisfactory and desirable. Picking one if I had to pick one ...I would probably pick satisfactory just because of our particular tasks and my particular tastes. I would like it to have a little bit more crispness.

Ability to Control and Track Flight Path and Bank Angle? I would probably go easy, easy.

Predictability of Response to Pilot Inputs in pitch and roll? I think pitch is probably just slightly more predictable than roll is for me and I'd probably go with satisfactory and satisfactory. Again, I tend to be somewhere between satisfactory and desirable. But basically the same comment, Although, I do think that pitch is a little bit more predictable and a little bit more responsible than the roll is.

I didn't see any tendency to PIO for number four.

Response characteristics of the Pitch/Roll Inceptor Rudder Pedals -- indicate if used? I'm using little or no...probably no input on the rudder.

I guess force and displacement characteristics...I would probably say they are desirable. Pitch and Roll Sensitivity? I would probably say this was satisfactory just because I would like to be just a little more crisper, particularly in roll. Although, like I said, I think it is very good and I would probably be between satisfactory and desirable on that.

Pitch and Roll Harmony? Actually I think it is fairly good if anything I would bring up the roll just a little bit. Again, I would probably be somewhere between desirable and satisfactory if we were doing it between ratings. Harmony is actually pretty good, I guess I'm going to go satisfactory on that, although, it's real close to being desirable.

Any problems in pitch or roll during Glideslope or Localizer tracking/capture? No, and I think the gains and the sensitivity and everything are fine for that task.

Any problems in pitch or roll during offset corrections? I think that one is a display issue. I think it is harder for me...not having a nose out there in front of me and at least if I understand it right to flight path vector being a function of where the CG is going. Rolling out and kind of tracking down the center line is not as easy for me to see as it is in some airplanes. Particularly an airplane where I have a nose out in front of me that I can see. As far as actual control ability again the biggest thing I can say is I would like a little more crispness in roll. Sometimes when I bring the stick up, or when I go and try to stop a roll or set the bank angle precisely, it's not as predictable as I would like. It kind of coasts to a stop. Again, I don't know if that's really...if the gains were probably set pretty good for a transport type airplane compared to the transport out there. For these particular tasks, especially the offset, a little bit more crispness would suit me.

Any problems in pitch or roll during flight director tracking? I think I would just mirror the same comments I made for number seven. Again, it's a display issue for the roll. Like I talked about in the past, it's kind of a second order ... kind of response in that I have to look at the rate of the flight director moving left or right to determine the closure in the bank angle. I also think there was a little bit of a lag between the desired bank angles once you attain it and the flight director actually zeroing out. At least, that is my perception, I don't know if that's true or not.

Any problems during Flare and Touchdown? Big learning curve today, instead of trying to correct this rapidly to the glidepath which I would overcorrect in the past. I tried to tame that down a little bit today and I think that helps performance wise a lot and I have already talked about the lineup. The Flare cues are real helpful in stopping a tendency from floating. The display, because of where the flare cue goes or where the horizon line is and that, I'm not sure that everything ..., I guess for these particular tasks I tend to disregard parts of the display that I probably wouldn't do if I was flying the airplane on an overall mission, day-in and day-out. Even in the landing tasks so, anyway that's something to

think about ...about the display. The tendency to float is cut down drastically by the flare cue, that's very helpful.

Approach versus landing - which is more difficult and why? The landing, I guess it depends on where you stop the approach. On the offset landing task, I personally would recommend starting the landing phase at 250 feet because I think that below 50 feet and above 50 feet are effected so much by the offset maneuver. Generally I would say the Landing Task because it requires a higher gain to do.

Effects of Wind and Turbulence? I really saw little, I don't think we have any crosswinds on anything that we have done on this. I really could not see much turbulence at all in this particular model and I think it had negligible effects.

Were the problems noted in questions 6-11 (if any) primarily a result of Vertical Vibrations - Lateral Vibrations - Both - Neither - Can't Specify? I guess I would probably go with neither, again maybe I'm missing something here but I did not really see that much of an effect of vibration.

Summary - Good/Bad Features. Any special control techniques required? Again, I think I pretty much covered this but the only thing I'd really like to see is a little bit crisper roll control and I think the flight director for the flight director tracking test could be a little bit ... I think you are going to see a skewing towards better pitch performance versus roll performance in that, simply because of the flight director makeup.

Exposure 5

DATE: 09Dec97
PILOT: F
TASK: All three
CARD: Questionnaire

And just for the record, my interpretation is that we didn't have any flexible body effects that time. It was a rigid body airplane.

And roll control power is desirable.

Ability to control and track flight path is easy.
Bank angle is easy.

Predictability of response to pilot inputs in pitch? Desirable.
Roll? Desirable.

Were there any PIO tendencies in pitch or roll? No.

Response characteristics of the pitch/ roll inceptor and rudder pedals: This card looks familiar.

Force and displacement characteristics? So let's do the pitch/ roll inceptor first, force and displacement characteristics are desirable. Sensitivity is desirable. Pitch and roll harmony? I think the force and displacement characteristics made be just a little bit light. So it's kind of desirable to satisfactory. Let's not make it desirable.

Sensitivity is desirable.

Pitch roll harmony, pretty good. Let's give it a desirable.

Rudder pedals are not used so I will not give you any ratings there.

On to item number six. I think the only thing that was significant there was, I think the forces are just a little bit light on the controller for such a big airplane.

Any problems in pitch or roll during glideslope or localizer tracking? Pitch and roll ... no, not during the capture turn. No.

Any problems in pitch or roll during the offset corrections? Not really, no. The problems I'm having are not associated with the control system too much. It's just figuring out what to do.

Any problems in pitch or roll during flight director tracking? Yeah, the band pass on the lateral task is just a little bit high to keep up with sometimes so that I tend to pop out on the edge of the small circle occasionally.

Any problems during flare and touchdown?

Runway line up, yes on the offsets.

Sink rate control and tendency to float? I still have a big problem as most people seem to with trading these two off. The sink rate control and the longitudinal touchdown distance, although it looks like I got sink rate control pretty good today.

Approach versus landing? And the approach is the most difficult for the offset task otherwise the landing is the most difficult. I guess the way to summarize that is if the ILS tracking is easy, the offset approach is very difficult and the landing is kind of next in order of difficulty.

Effects of winds and turbulence? Not much effect with this configuration.

Were the problems noted in questions six through eleven? Hey this is a new one isn't it? No of course there were no vibrations so no problems. Neither.

Summary, good bad features. Any special control techniques required? Yeah good bad features, good features is, the control system is really getting pretty good now. Bad features I think here are the difficulty of the offset landing task. The poor visual cues, or semi poor visual cues, making it just a little bit hard to time the touchdown. I think if we had better visual cues it would help on the touchdowns. Any special control techniques required? Yeah, the offset landing really requires, it is kind of a precognitive type maneuver. You have to do several of them just two figure out what it takes to do it. And you really have to concentrate on the line up, at least I do.

Pilot Comment Cards, Configuration 20

Exposure 1

DATE: 20Oct97
PILOT: A
TASK: All three
CARD: Questionnaire

This will be the comment card for exposure one for the entire sequence of tasks.

Adequacy of roll control power, desirable there were no problems there. It responded well and did great. No rate limiting or control saturation.

Ability to control and track flight path, easy.
Bank angle, easy.

Predictability to respond to pilot inputs in pitch, desirable except in the flare where we know we have some unpredictable responses.
And roll, desirable, no problems there.

Were there any PIO tendencies in pitch and roll? No.

Response characteristics of the pitch-roll inceptor and rudder pedals? I didn't use the rudder pedals. Actually I did use them slightly on the off-set landing but not enough to make a comment on them.

Force-displacement characteristics? Desirable.

Pitch-roll sensitivity? Desirable, no problems there.

Pitch-roll harmony? Desirable also. Good harmony, everything is working very well.

Any problems in pitch or roll during glide-slope or localizer tracking capture? None at all.

Any problems with pitch or roll during off-set correction? None there either.

Any problem in pitch or roll during flight director tracking? I tended to over control the lateral axis, basically when the lateral task ... or when I went rapidly from a longitudinal to a lateral task in flight director tracking, I did tend to over-control the bank angle and it seemed to me that at times I would have liked a more responsive roll axis capability. However I was fairly aggressive on this one with no problems. I didn't have any fear of stopping the motion base or having any ASE problems that would effect it. So I really can't say that there were any ASE problems with this at all. It is just part of the task, I think, sometimes the roll changes, the lateral changes, came very quickly and with a large aircraft with all the inertias involved and all, it just didn't seem to move around as well as you would like it to. But I did have more of a problem in roll than pitch in these flight director tracking tasks.

Number nine. Any problems during flare and touchdown? I did have a tendency to float on the off-set approach. There are just a lot of corrections going in there and you have to take them all out at the end at about inside fifty feet above the ground. If you don't get everything out, you tend to float a little bit. No real problems with line-up even on the off-set one. I did get outside the desired box once on the off-set but in general, not a problem. And certainly it was very tight control on the straight-in approaches. Sink rate control has worked out fine today. The flare cue has really helped. I think the highest sink rate I've

had today was four feet per second. So basically, the flare is still unpredictable because of Dynamic Ground Effects. I did float a little bit on the off-set approach and otherwise everything is normal and basically I can not attribute any of that to ASE effects. This is all just basic REFH effects.

Approach versus landing? The landing is more difficult for a whole host of reasons including lack of predictability in the flare. The flare cue does help a lot but still it does (not) seem to be quite as predictable as we would like. It is just a harder task and approaches pretty much with the gamma-dot-v is a non-issue.

Effects of wind turbulence? Nothing to ... the turbulence did slightly seem to excite a very very tiny ASE mode on that exposure one but nothing to really be alarmed by. Nothing to cause any problems.

The problems noted in questions 6 to 11 were primarily the result of ... no problem noted had anything to do with vertical vibrations or lateral vibrations. So there were no problems with vibrations. It was just basically REFH problems.

Summarize good-bad features or special control techniques? No special control techniques. I was very aggressive, had no fear about being aggressive and it was pretty much a non-issue all the way around as far as the ASE effects.

Exposure 18

DATE : 05NOV97
PILOT: B
TASK : All
CARD: Questionnaire

Okay, this is exposure eighteen you said? This is the detail questionnaire:

Adequacy of roll power, it's satisfactory.

Ability to control and track flight path angle, flight path and bank angle are easy I would say.

Predictability of pilot inputs is satisfactory in pitch and roll.

Were there any PIO tendencies? No. Neither in pitch or roll.

Response characteristic, pitch and roll inceptor and rudder pedals. Didn't use rudder pedal much.

Force and displacement characteristics were satisfactory.

Pitch and roll satisfactory.

Pitch and roll harmony satisfactory.

Any problem in the pitch and roll during the glideslope tracking and capture? No.

Problems with pitch and roll during offset corrections? Just a slight amount of inability to finesse the touchdown precisely at sink rate and distance. Any problems, other than that, no problems.

Any problems during flight director tracking? Well the start and stop of the roll component on the tracking was quite difficult because the cues were a little late on that. It took full deflection to keep it in the small circle.

Any problems with flare and touchdown?

Line-up, sink rate, tendency to float. There were some minor problems that kept us out of the desirable range. In pitch, I think to some extent, it may have been just a tentativeness problem but the fine tuning of pitch in the last part of the float was slightly difficult.

Approach vs. Landing, I'd say approach is quite easy while the landing is a little more difficult. That is because you're in a higher gain mode and responses are not exactly, there's a lot of inertia... The response is not real precise.

Effects of wind and turbulence were pretty mild or almost negligible. Did produce some reaction but it was minor.

The problems noted in 6 through 11, the result of vertical vibrations? No, Lateral vibrations? No. Both? No. Neither? I'd say neither and the problems are basic flare capability for the airplane. I think maybe there's some fine tuning that could be done with the gamma law. Or some law changes to improve the flare. Preciseness.

In summary, good and bad features? Damping was good and no special control techniques were really required. End of Comments.

Exposure 3

DATE: 12Nov97

PILOT: C

TASK: All three

CARD: Questionnaire

Okay, pilot's C, pilot C exposure three.

Roll control power is satisfactory. It's hard, I know I'm not really ... what I'm responding to here is really roll control, not roll control power because I never did go to the stop on roll control. So, I don't really know what roll control power was. But roll control in general I'm gonna say was satisfactory. I caught myself oscillating back and forth, over controlling occasionally. Minor deficiency, nothing that would bump you out of level one but that basically resulted to some extent in the three.

Flight path control, let's call it easy to fair.

Bank angle control is fair.

Predictability in pitch, between desirable and sat.

Roll satisfactory.

No PIO tendencies on this configuration.

Force and displacement characteristics for the inceptor, I did use the rudder pedals occasionally. Call it desirable, I didn't have any problems with that at all. It's kind of hard to isolate this from control but I didn't find the forces objectionable or any hystorisis or friction, or anything like that. So let's call it desirable.

Pitch and roll sensitivity desirable.

Pitch and roll harmony desirable. No problems with this at all.

No major problems in pitch/roll during glideslope or localizer tracking or capture.

No major problems in pitch or roll during ... Oh, hang on. No inordinate problems.

There are problems in pitch and roll during the offset corrections just due to the nature of the maneuver. Now the predominate problem is lateral and it's controlling lineup. Longitudinal is a minor problem but lateral it's a tough task.

No problems in pitch or roll during flight director tracking.

Flare and touch down is predominately longitudinally driven. The issue here is a tendency to float. To control sink rate with respect to that . Where I'm correcting for distance, it's typically correcting for a perceived long distance. To where I'm trying to set the airplane down to prevent it from floating. So there is a tendency to float. Lineup is a problem prior to the flare normally in this configuration that is.

Which is more difficult depends on the task in terms of approach and landing? In the straight in task the landing is more difficult than the approach. In the offset approach, the approach portion is slightly more difficult than the landing.

Winds and turbulence tended to, I think, exacerbate that background oscillation. So it didn't effect the precision, I don't think, of the task, a whole lot.

I don't think that any of the problems I noted in 6-11 were really as a result of oscillations. I think the oscillations effected my perception of ride quality and not the difficulty in control or the work load associated with that control. I felt like the vibrations were isolated in terms of their issue and their effect on the overall acceptability of the configuration.

In summary, I think we're looking from a control standpoint at very close to the baseline airplane. And from a perception standpoint a slightly degraded configuration based on those vibrations. And that concludes it.

This concludes the comments for Pilot C on November 10th.

Exposure 15

DATE: 18Nov97

PILOT: D

TASK: All Three

CARD: Comment Card

Adequacy of roll control power ? with the exception of the one task and the up and away, it would certainly be satisfactory. Borderline unsatisfactory on the one pass that I had up and away. The other two were satisfactory. So if I have to give one rating, satisfactory it is.

Ability to control and track flight path? I'd say fair. Bank angle for the offset and the up and away? I guess in order to give that a decent rating I'd have to say fair on that also.

Predictability of response to pilots input in pitch? satisfactory, and roll? satisfactory. Again I've got to give one rating across three, real big different tasks, it's difficult.

Any PIO tendencies? I didn't see any in either one, so no.

Response characteristics? Well that's gonna stay pretty much the same.

Force and displacement characteristics? I don't know, they're fine. They're desirable as far as I'm concerned.

Roll sensitivity? Well, kind of gets into the power and the sensitivity areas as to which one was causing me the trouble but certainly at least satisfactory.

The harmony was desirable.

Any problems in pitch or roll during glideslope/localizer tracking? No.

Any problems during offset corrections? Rolls a little sluggish would be the only problem. Other than that, no.

Flight director, same comments. Pitch was fine, roll was a little sluggish and if you let it get too far away it's a lot sluggish. Some of that I just felt that it wasn't coming as fast as I would have liked is the problem. As far as translating, getting it back left and right to the target.

Any problems during flare and touchdown line-up? No, not really. Sink rate control, actually it was better on this. I was always long and tendency to float isn't any worse than any others that I've seen. There might be a little tendency to float on that. I don't know how else to explain being a little bit long.

Approach vs. Landing? Again, the landing was harder than the approach.

Effects of wind and turbulence? Practically zilch. I could see a little more turbulence. A little sharper reactions to the turbulence on this one but it was still very minor.

Problems noted/result of? Well, they weren't a problem with that and I'd say neither.

Good and bad features are about the same as the ones before. Didn't use anything special on this control technique that I didn't, in the other one. If anything I was getting better touchdowns. The thing that comes to mind first off is the roll response as far as the bad feature. Good feature, I like the displays and the control laws in general, I think, work very well for airplane of this size. I wouldn't want it for a little airplane but for a big airplane I'm pretty happy with it.

Exposure 12

Pilot Comment Card

DATE: 03Dec97

PILOT: E

Adequacy of roll control power? I guess the same general comment that I had before, I would probably be somewhere between desirable and satisfactory. I would not mind it being a little bit crisper and I'm going to go with satisfactory but this was probably one of the better configurations and predictability in roll was a lot better this time I thought, than some of the other configurations that we have flown.

Ability to control and track flight path? I think is easy to fair. I would probably go with fair there just because of the splits that we see at times and I think flight path and the landing task was a little bit harder to deal with in the bank angle stuff. Tracking a bank angle, once I had established it, tracking it, I think, was actually pretty good and I probably would really be between easy and fair but I'm going to go ahead and say it's easy this time. I thought it was easier once the bank angle was established. I realized that most of the time you could just let go but as far as really trying to track a fine bank angle, this was one of the better configurations that I have flown for making real small, fine inputs, comparative to some of the other configurations.

Predictability of response to pilot inputs in pitch? I think probably, I am going to say satisfactory there. Again I probably would be close between desirable and satisfactory.

The roll, I would be even closer to desirable but I am still going to ... predictability, actually I am going to say desirable in roll. And almost desirable in pitch but if I have to pick one or the other, I would probably say satisfactory.

PIO tendencies? No.

Number five. Response characteristics of the pilot roll inceptor and rudder pedals: I didn't really use the rudder pedals in any of the tasks. I might have used them just a little bit on the offset task, I don't remember. But almost none, it was just squeezing it a little bit either right after or just before touchdown and I didn't see any problem there.

Force and displacement characteristics? I think are between desirable and satisfactory. I guess I would probably say desirable.

Pitch and roll sensitivity? I would probably be between desirable and satisfactory but I would probably go with satisfactory. Again just a personal preference, I would kind of like the roll to be a little bit more responsive although for a big airplane it really rolls quite nicely.

Pitch and roll harmony? I think is desirable.

Any problems in pitch or roll during glideslope or localizer tracking / capture? No except for the noted gamma splits that we saw and that's just a little bit distracting. It really didn't effect the tracking task ... well, it does because you have to make a few additional inputs but it really not a big deal at all.

Number seven. Any problems in pitch or roll during the offset correction? Yeah, that is a pretty good task for an airplane this size. I think probably the biggest thing I would say that in pitch, I did have problems making my touchdown point and so it could be a function of me being tired. It could be a function of predictability a little bit but as far as predictability goes for all the configurations that we have flown, I think this is one of the better ones.

Problems with pitch or roll during flight director tracking? Actually, again, I think this is one of the better configurations for that. You know, particularly I thought the roll was better than a lot of the other configurations that we have flown.

Problems during flare and touchdown?

Runway lineup, sink rate control, tendency to float. Just what I have noted before, I was having a little bit of a problem either floating or touching down hard to try to get into the box longitudinally down the runway.

Approach versus landing, which was more difficult? The landing is.

Effects of wind / turbulence? I guess we had mild turbulence or light turbulence, however you want to say it. I don't think we had any crosswinds. I think it had negligible or minimal effect on this configuration.

Were the problems noted in six through eleven primarily a result of: vertical vibrations, lateral vibrations, both, neither, can't specify. Let's see. I really wouldn't attribute much if anything to the vibration. Like I said, I noted that little bit of ringing, what I would characterize as ringing, with the abrupt control inputs and that was a little bit distracting but I don't think it's a real big deal.

Summary—good / bad features. Any special control techniques required? And I think we pretty much covered everything in one through twelve as we get wrapped up in thirteen there. Like I said, it's just a qualitative impression, it's towards the end of the day but I kind of thought this was one of the better configurations that we've seen.

Exposure 18

DATE: 10Dec97

PILOT: F

TASK: All three

CARD: Questionnaire

Adequacy of roll control power? Is desirable.

Ability to control tract flight path is easy.

Bank angle is easy / fair.

Predictability of response to pilot inputs in pitch? Is desirable.

Roll? Is desirable / satisfactory.

Were there any PIO tendencies in pitch or roll? I think no.

Response characteristics of the pitch / roll, I didn't use the rudder pedals:

Force and displacement characteristics are slightly light so you can give it desirable / satisfactory.

Pitch and roll sensitivity are desirable.

Pitch / roll harmony is desirable.

Any problems in pitch or roll during glideslope for localizer tracking or capture? No.

Any problems in pitch or roll during the offset corrections? No.

Any problems in pitch or roll during flight director tracking? No.

Any problems during flare and touchdown? Yes I'm having the old problem of getting the X and the H dot in.

And no problems with the runway line up, I'm getting that task down pretty good.

Approach versus landing—which was the more difficult? The ... you know it's kind of a toss up. The offset task is probably the most difficult.

Effects of wind and turbulence? Are not a big effect this time.

Were the problems noted in questions six through eleven primarily a result of: yeah, I really didn't have any problems in six through eleven.

Summary—pretty nice basic control system on the airplane. And on this one the structural modes weren't too bad. Special control techniques required? Yeah, that offset task, it really requires a lot of feed forward in learning and I think that's about it.

Pilot Comment Cards, Configuration 02

Exposure 19

DATE: 22Oct97

PILOT: A

TASK: All three

CARD: Questionnaire, Pilot Comment Card.

Adequacy of roll control power? Desirable.

Ability to control and track flight path? Was fair based on the ASE responses.
Bank angle? Again fair based on the ASE excited -ASE modes.

Predictability of response to pilot inputs in pitch? Satisfactory, basically I can't say desirable because at times, if you excited the pitch mode, I would not have total predictability of exactly how much of an amplitude in pitch response I was going to get and similar in roll. So for roll we'll say satisfactory also.

PIO tendencies in pitch or roll? I didn't couple this time, I didn't notice any PIO tendencies. The frequency of the ASE motions were such that they just didn't couple with me and based on my very very moderate inputs. I was very very easy and smooth on the control inputs.

5. Response characteristics of the pitch/roll inceptor and rudder pedals:

Force displacement characteristics? Okay for the force and displacement characteristics. I'm trying to see what they are really getting at in this question. I guess desirable. The force and displacement characteristics seemed fine to me, I had no problems.

Pitch and roll sensitivity? It typically was ASE motions -it was appropriate sensitivity. If you add the ASE motions, if I did any kind of an abrupt input, I got a very very adverse response -large amplitude, lightly damped and the frequency was very annoying. So, I guess the pitch and roll are both sensitive to ASE problems.

Pitch/Roll Harmony? The harmony actually was okay because for one thing the harmony on the basic airplane is pretty good and the ASE harmony wasn't bad either. Both longitudinal and lateral axis had the same large amplitude, lightly damped motions to them and I do notice that. I would say pitch/roll sensitivity including the ASE effects and pitch/roll harmony is desirable.

Any problems in pitch or roll during glideslope or localizer tracking/capture? Not really, other than the fact that you're getting constantly bounced around with really obnoxious motions there. Still I met the desired criteria although it was the worst approach ratings I gave which were four's because of the workload due to all the motions that were both excited by turbulence and by my inputs.

Any problems in pitch or roll during offset corrections? Mainly I was very very smooth with those corrections and in the rolling to the center line after the second correction ... I would correct then a right turn back to centerline, I did get some ... I hit the beat frequency in the pitch axis and I did get some kind of high frequency ... I say high frequency -maybe two Hz, pitch motions that were high enough amplitude to be really noticeable. So that's the main comments there.

8. Any problems in Pitch or roll during flight director tracking? I was very very smooth. I accepted errors in order to not excite the motions. I felt like I was really on the edge of

getting kicked out of the motion base parameters, so I really did try to be smooth to avoid that.

Any problems during flare and touchdown?

Line-up; the only problem there was that we would get these ... turbulence was just causing me to be a lot of lateral motion so it would cause the airplane to drift right or left. So that just takes higher workload.

Sink rate control; same thing if you put in some input you get some fairly hard, large amplitude inputs and that can effect your sink rate control depending on where you are in the bending motion.

Tendency to float; Not a real tendency to float, in the offset more so than the regular straight-in approach but not too much more than the other ones.

Approach vs. landing? The landings more difficult. Why? Because of the higher gain task especially the offset. The flare is the high gain maneuver. Anytime you get high gain and you get abrupt high frequency inputs, you are going to trigger these modes. The approach with the flight controls we have, is a fairly hands off task.

Effects of wind/turbulence? Yes the light turbulence, 3 feet per second, excited continuous aeroelastic modes that were large enough amplitude to be very annoying.

12. Were problems noted a result of vertical vibrations? Both. Certainly in this one both the vertical and lateral vibrations were about equal and about as obnoxious. And that's because of longitudinal and lateral axis both were lightly damped and high amplitude motions.

Summary - Good/bad features. No good features, all bad features. Special control techniques required? Without a doubt, you had to be extremely smooth and slow on your inputs. You had to kind of anticipate a correction and make a smooth slow input. You can make a large amplitude input but you have to do it slowly, you can't do it abruptly and so those are the special techniques I used.

Exposure 9

DATE: 20Oct97

PILOT: B

TASK: All three

CARD: Questionnaire

This is the questionnaire for exposure nine.

Adequacy of Roll Control Power. Well the power is probably satisfactory but the result and oscillations that it creates is unacceptable, especially in combination with flight path and combination with pitch.

Ability to control and track flight path, is difficult.

Bank Angle control is, well if you're willing to accept a very obnoxious ride, it's fair to easy to control bank. Actually, let me back up a little bit, the ability to control and track is not a problem. It's fairly easy on both flight path and bank angle but the associated oscillations that you get along with that are very obnoxious.

Predictability and response to pilot inputs in pitch, the overall pitch changes, in other words the general direction in which the airplane's going, can be controlled reasonably well. I'd call it satisfactory but, the thrashing of the cockpit is really unacceptable.

Any PIO tendencies in pitch or roll? I guess, I can't say that there's any PIO tendencies that I saw that were very obvious. If you look at the data you may see some indications, especially in roll of PIO that were difficult for me to assess. From my view point I didn't see any obvious PIO's but it was just a matter of in this case, in this configuration of backing off to the point where you have to minimize your control inputs. Especially in combination to separate out pitch and roll inputs so that they didn't occur simultaneously in order to count them reasonable cockpit motion.

Response Characteristics of pitch and roll inceptors and the rudder pedals indicate if used, I really didn't use the rudder pedals all that much, if any at all.

Force and displacement characteristics, they were satisfactory.

Pitch and roll sensitivity is probably satisfactory.

Pitch and roll harmony was, I think probably satisfactory. Like I say, the result of simultaneous pitch and roll were quite obnoxious in terms of oscillatory cockpit motions.

Any problems in pitch and roll during glideslope and localize tracking and capture, No.

Any problems with pitch and roll during offset corrections, yes. Especially where pitch and roll corrections were required. Probably the worst situations were where you're reversing a roll, roll in and roll out and pitch change pitch at the same time. That's the worst possible situation. So I guess the answer to that question number seven was, yes, there were problems.

Any problems in the pitch or roll during flight director tracking (applicable)? Yes there were. And that goes back to the simultaneous use of pitch and roll. We had trouble with this computer bombing out, this motion system bombing off the line. And so complete evaluation is probably not possible.

Any problems during flare and touchdown? Yes, we had to, I guess the answer to that is yes.

Runway line-ups, sink rate control, tendency to float, the amount of controls used had to be, especially had to be minimized and so the aggressiveness had to be held back. You can not be very aggressive. This is also a case where the computer would tend to bomb out early in the motion system. It's not capable simulating what would happen with simultaneous use of the controls.

The approach and landing, the approach vs. landing, the fine and quick, and the reversing controls especially ailerons was a difficult problem on landing. On approach it's not a particular problem because of just fine tuning and not very much aggressive maneuvering was required.

Effects of wind/turbulence, they tended to produce objectionable bouncing.

Any problems noted in questions 6-11? ... result ... Were the problems noted in 6-11 primarily a result of vertical vibrations, lateral vibrations, both, neither, can't, well okay. It was both. Problems came in with vibrations being induced by control inputs, especially lateral, but also vertical.

Summary, good and bad features. I don't know of any good features. Any special control techniques required? Yes there are techniques required. That was that we had to, minimum, separate out the lateral from the vertical. In other words make a vertical correction, wait a while and then make a lateral correction. That minimized amount of bouncing but that was a technique that is strictly used to prevent the motion system from bombing out. That also minimized the amount of vertical, the amount of cockpit motion. Made it a little easier to fly the airplane. Okay, that's it, the end of comments.

Exposure 6

DATE: 12Nov97

PILOT: C

TASK: All three

CARD: Questionnaire

Now you want the questionnaire.

Okay the mechanical control system characteristics are so much overcome by deficiencies elsewhere that what you're gonna hear is a lot of satisfactoriness. I can't call it desired, 'cause I really never got that. I was never able to evaluate it to that extent. The real answer to the first question is I don't know, 'cause I never got the full lateral control. I'm assuming what I've answered this before, is assuming by roll control power you mean sensitivity. Yeah, that's what I've assumed in the past, so that's satisfactory.

Ability to control and track flight path, difficult, bank angle difficult and that's because of the vibrations.

Predictability and pitch, unsatisfactory and roll unsatisfactory, and that again is because of the vibrations.

There were PIO tendencies in pitch and roll. The task was continued with reduced pilot gain. I'm evaluating all three task here right? Okay you can put X's in both because at one point I abandoned the task or would have abandoned the task. At other points it was continued.

Response characteristics of the control inceptor were satisfactory across the board. No real problems there but again, I think all that was overcome by other events.

Definite problems in pitch and roll during glideslope or lock tracking and again it was caused by vibrations and inadvertent inputs and having to relax your hold on the control inceptor.

The same thing during offset corrections. Both pitch and roll problems got caused by the vibrations.

Problems in pitch and roll during flight director tracking. Same thing. Back to back opposing inputs seem to be the primary culprit. If you make a relatively large input that being on the order of an eighth to a quarter stick and then immediately follow it up by a correction in the other direction. At about the frequency that you'd want to do that you immediately excite the axis. That's true either longitudinally or lateral-directionally. It's true laterally I didn't try directional inputs back to back, didn't need them. Occasionally I

was making rudder inputs. They didn't seem overly objectionable in terms of exciting the mode.

Problems during flare and touchdown, big time. With line-up, sink rate control, the tendency to float was self imposed. There were times when I wanted to avoid a very hard touchdown, so I would stretch it deliberately to do that. So definite problems there, again caused by the vibrations.

The approach and landing were about equally difficult. Anytime the task required precision or abruptness in the inputs, I had problems.

Turbulence excited the modes and just made it that much more difficult I believe.

The problems were as result of both lateral and longitudinal vibrations.

In summary, this is an unacceptable configuration. There's no way you're even beginning to field this for certification or customer acceptance. Either from the standpoint of the pilots or the passengers. That concludes my comments.

Exposure 16

DATE: 18Nov97

PILOT: D

TASK: All Three

CARD: Comment Card

Okay, for the general pilot comment card.

Adequacy of control power? Satisfactory.

Ability to control flight path? Fair that time. In the actual landing it was approaching the difficult because I was getting kind of a heave right after I flared I would then get a heave that would then put me long. In general across the board, I would give it a fair. Bank angle control? Fair would be the best I could do on that.

Predictability response in pitch? No more than satisfactory again due to this anomaly that I saw. Particularly right after the flare and that was big enough that I think would effect that one. In roll, again, satisfactory but definitely need some help there.

Were there any PIO tendencies in pitch or roll? No I don't think so. I saw some oscillations but I don't think I was coupled into them. I think they were outside influenced.

Response characteristics? Same thing I think will be true in the one that I've given before.

Force and displacement? That's desirable.

Pitch and roll sensitivity satisfactory.

Pitch and roll harmony desirable.

Any problems in pitch or roll during glideslope or localizer tracking and capture? No, not that I saw. That was more a comfort thing than a precision problem. I was just very uncomfortable, any roll outs or roll ins if I did them quickly.

Offset corrections? Yes. This one was primarily roll get a oscillation going left or right. It was on the edge of putting in some uncommanded inputs here. Involuntary inputs might not have ... If it put any in they were small but it for sure was very uncomfortable and it took a lot of concentration to see through this oscillation and be able to concentrate on putting the airplane where I wanted it.

Any problems in pitch or roll flight director tracking? Yeah, this was horrible. It just exaggerated, especially the left right oscillation. every time I changed direction or something it would set up an oscillation. Rather higher frequency oscillation and that was definitely a problem.

Flare and touchdown? Runway line-up? Other than the oscillation that I was having to see through in order to line-up, I could get lined-up each time. So the line-up itself wasn't a huge problem. Sink rate control? That was the big one. Tended to get this one big heave after I flared. I was kind of surprised to see it. That would also lead to a tendency to float some.

Approach vs. Landing? Landing again is more difficult. As far as precision goes it was due to the kind of, heave at the end. Yeah, that's good enough.

Effect of wind and turbulence? Very definitely. It was very evident throughout. Once I put an input in (I'd) get an oscillation going if the turbulence was just right it would even be worse. So that was definitely degrading element in these.

Problems noted/ result of? Well you gave me a primarily there. The one that was most obvious and the one that I was most upset with was the lateral vibrations. The vertical wasn't as much a vibration as it was just a one time sort of a heave at the end after a pitch input. The problems that were noticed would be lateral vibrations.

I didn't see anything that was particularly good on this one that I haven't discussed before and no sense of just repeating them each time. The bad feature was the left-right oscillation. Fairly high frequency, left/right oscillation and the heave after the flare. Any special control techniques? I didn't find anything that worked particularly well. The only thing on the roll, and this is true of most of them. I have to kind of blend in any roll inputs. Start it slowly and build it up. As opposed to putting in a quick ..., just stay away from jerky controls. I just knew that was going to drive it bonkers. So kind of a smooth blending in of roll control in particular, was the only control technique. It was different on that one then on some of the other ones. It's more pronounced on this one I should say.

Exposure 17

DATE: 04Dec97
PILOT: E
TASK: All three
CARD: Questionnaire

Oh, I surprised I'm doing a questionnaire on this because my recollection is the other two that we did the questionnaire on were kind of nicer configurations, I guess.

Okay, number 1--adequacy of control power...I'm going to say satisfactory. I would like have more roll control power and have a little bit crisper roll, but I never can turn my gain up with all the motion to really require that or warrant that with this configuration.

Number 2--ability to control and track flight path? Is fair.

Bank angle? I would be fair to difficult on the bank angle. I'm going to go with fair, I guess, but it's about the lowest fair that I would be willing to give.

Predictability of response to pilot inputs and pitch? I would be, I'm going to say satisfactory, but it's a low satisfactory, actually I'm going to say unsatisfactory. I'm not sure how much I interpret to myself and how much I interpret to the airplane but I thought predictability in the landing tasks suffered a lot.

And in roll, I'm going to say unsatisfactory also because the predictability not so much in the landing task, but in the tracking task really showed up to me. And like I said, I thought it was hard to track a bank angle real well.

I didn't see any PIO tendencies, so no for number four.

Number 5--response characteristics of pitch and roll and sector inceptor and rudder pedals? I didn't really use the rudder pedals except for either right at touch down or right after touch down.

Force and displacement characteristics are satisfactory.

Pitch and roll sensitivity is satisfactory.

Pitch and roll harmony is satisfactory. The thing that I would note is that it's satisfactory only because the motion that's your perturbing in the airframe is ... forces you to reduce your gain so its good enough, I guess. If you were really trying to fly the precision tasks, I think my comments I made before, apply but, I don't think you'd ever get to the point where you could use those gains here.

Number 6--I did not see any problems in pitch or roll during glideslope or localizer capture except that you do have to reduce your gains a little bit.

Number 7--any problems in pitch or roll during offset corrections? I reduced my gains during those tasks to try and excite the minimum level of body motion, I guess, that I could, so I think that's a problem. As far as making the airplane do what I wanted it to do, in the flare, I didn't think I got what I wanted to and I had to work really hard to get, especially in the end portion of the flare, to get the airplane to do what I wanted it to do.

Any problems in pitch or roll during the flight director tracking approaches, number 8, and I think I've already pretty much covered it, if you used the sharp-edged inputs even if they're pretty small, you tend to excite something. If you were smooth in pitch, you could get the airplane to respond fairly well as long as you didn't use a sharp-edged input or you didn't use a large input and roll, it seemed like even in small roll inputs that weren't really that sharp, would tend to get things excited. So, I had more of a problem in roll during the flight director tracking task than in pitch.

Number 9--any problems during flare and touchdown? I think we've already discussed that. Mainly the predictability problem ... the other thing is during the offset approach exciting the structural modes made it very uncomfortable, made it more difficult to do the task and just really kind of line everything up and also I had a tendency to reduce my roll inputs to try to not excite the structural modes and in doing that, I lost a lot of ability to make last minute corrections or to really fine tune things. I had to try to hit the center line exactly right the first time, or on the first attempt.

Number 10--approach versus landing, which is more difficult? The landing phase is more difficult. It's a higher gain task to begin with and because it's a higher gain task, I think there's, you tend to excite the modes a little bit more and then also the pitch predictability problem because it's a higher gain task that shows up more in the landing task than it does in the approach phase.

Effects of wind/turbulence? Obviously the turbulence caused the airframe to bounce around a lot without any pilot input at all and we saw a fair number of splits and gamma without any control inputs at all.

Number 12--were problems noted in 6-11 in primary result of vertical vibration, lateral vibration, both, neither, can't specify? I think we kind of covered that ... the structural modes do affect task performance and we kind of talked about it as we went along. The lateral vibration is more of a bother to me ... I'm less tolerant to it than I am in pitch.

13-Summary, good, bad features, special control techniques? I guess I don't like the lurchiness of the airplane and I guess special control techniques are just the reduction of pilot gains and trying to make very smooth inputs and I guess that's it.

Exposure 11

DATE: 09Dec97

PILOT: F

TASK: All three

CARD: Questionnaire

Okay, exposure eleven pilot comment card, Pilot F:

Adequacy of roll control power? It's desirable.

Ability to control and tract flight path? Is easy.

Bank angle? Is fairly easy. The thing is not perfect laterally that's for sure. It's a little bit loose but I don't think it's really impacting the task here.

Predictability of response to pilot inputs in pitch? Desirable.

Roll? Is desirable to satisfactory.

Were there any PIO tendencies in pitch or roll? Yes. I kept kind of intentional induced coupling into the longitudinal structural modes on the first evaluation. That was this one wasn't it? (Yes). Okay the task was abandoned because we bombed the simulator, I could have just let go of the stick and continued. But we bombed the simulator.

Response characteristics in the pitch roll inceptor. We really didn't use the rudder pedals so it will just be the pitch.

Force and displacement characteristics, as I indicated earlier, are a little bit on the light side. Let's make desirable to satisfactory. Same on the roll.

The sensitivities seem desirable in both axes.

And the harmony seems desirable.

Any problems in pitch or roll during glideslope or localizer tracking or capture? Yes, you have to be very gentle with the thing or the ride quality just deteriorates to unacceptable.

Okay, seven. Any problems in pitch or roll during offset corrections? Yes with the roll not really any ... well again you have to be smooth in pitch but it wasn't impacting control whereas the lateral almost caused us to have to abandon the approach.

Number eight. Any problems in pitch or roll during flight director tracking? Yes, again lateral was giving me a little bit of a problem. I was banging it a lot harder than ... the DASE a lot harder than I intended.

Okay, nine. Any problems during flare and touchdown?
Runway line up, I don't think we had any problem. And we're having just a little bit of a problem with getting into the box, not bad.

Approach versus Landing. Which was more difficult and why? Now again, I'm going to break this down, a little bit. The glideslope tracking is not, and localizer tracking is not too bad. That's very easy. The offset maneuver is probably the most difficult maneuver so if you count that as an approach or landing, I'm not sure. And the landing is right behind it as far as difficulty.

Effects of wind and turbulence? Very pronounced on the structural modes.

Were the problems noted in questions six through eleven primarily a result of: mostly lateral vibrations.

Summary—good bad features. Yeah the basic control system is pretty good, if we could just get rid of this ... just stiffen up the body a little bit. That's the good features. The bad features is the body isn't stiff and it really whacks around. Special control techniques required? Yes, you have to be very very careful, particularly laterally.

Pilot Rating Cards

CIR DASE INFLUENCE ON PILOT'S CONTROL INPUTS

- 1 Pilot does not alter control inputs as a result of aircraft flexibility.
- 2 Pilot intentionally modifies control inputs to avoid excitation of flexible modes.
- 3 Cockpit vibrations impact precision of voluntary control inputs.
- 4 Cockpit vibrations cause occasional involuntary control inputs.
- 5 Cockpit vibrations cause frequent involuntary control inputs.
- 6 Cockpit vibrations cause sustained involuntary control inputs or loss of control.

RQR

DASE INFLUENCE ON RIDE QUALITY AND DISPLAY LEGIBILITY

- 1 Cockpit vibrations do not impact ride quality or display legibility.
- 2 Cockpit vibrations are perceptable but not objectionable.
- 3 Cockpit vibrations are mildly objectionable - improvement desired.
- 4 Cockpit vibrations are moderately objectionable - improvement warranted.
- 5 Cockpit vibrations are highly objectionable - improvement required.
- 6 Cockpit vibrations cause abandonment of task - improvement required.

08-Sept-97 DLR

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