Egyptian Delegation Presentation

for

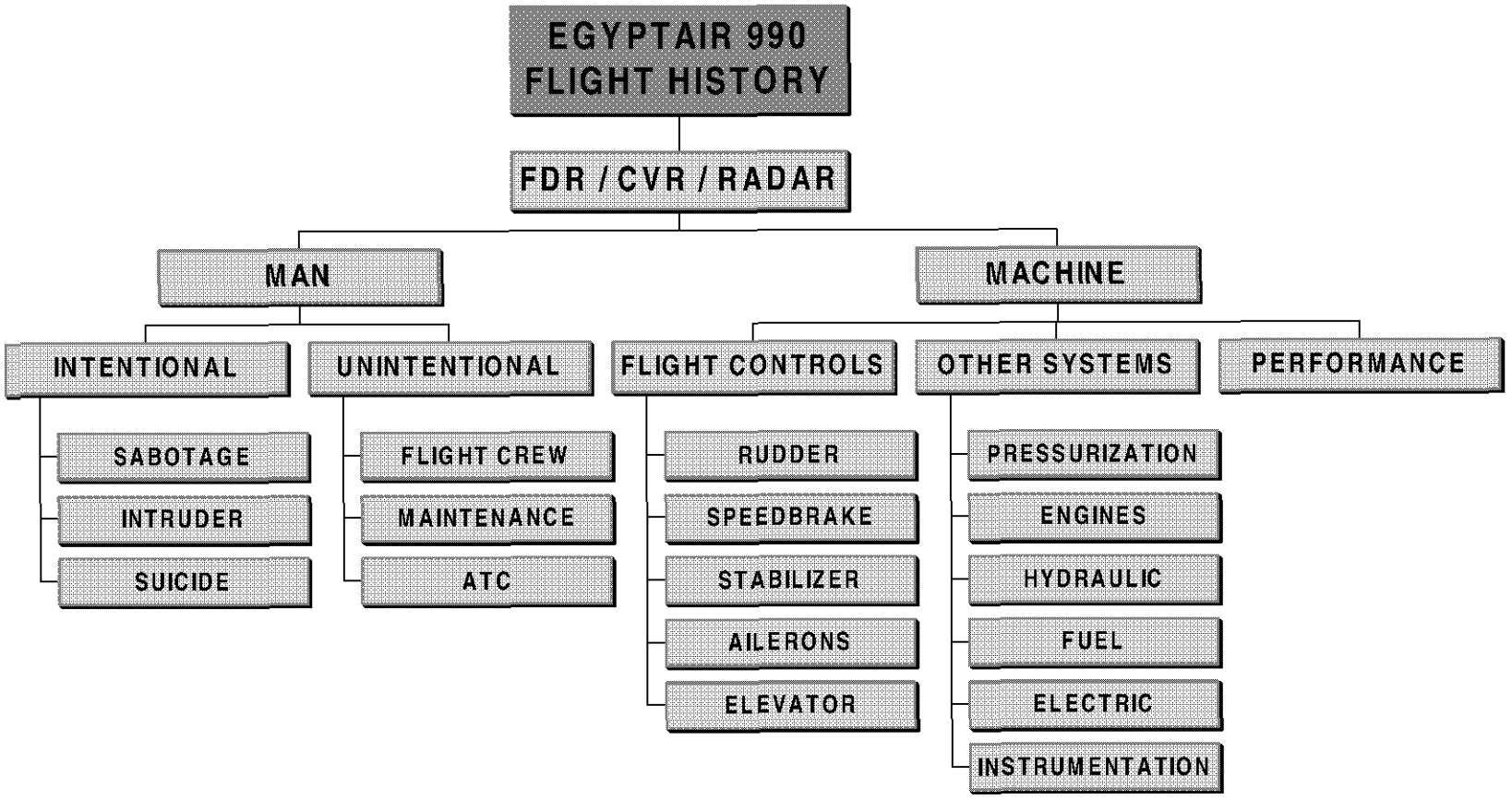
Flight MS 990 Accident

April 28, 2000

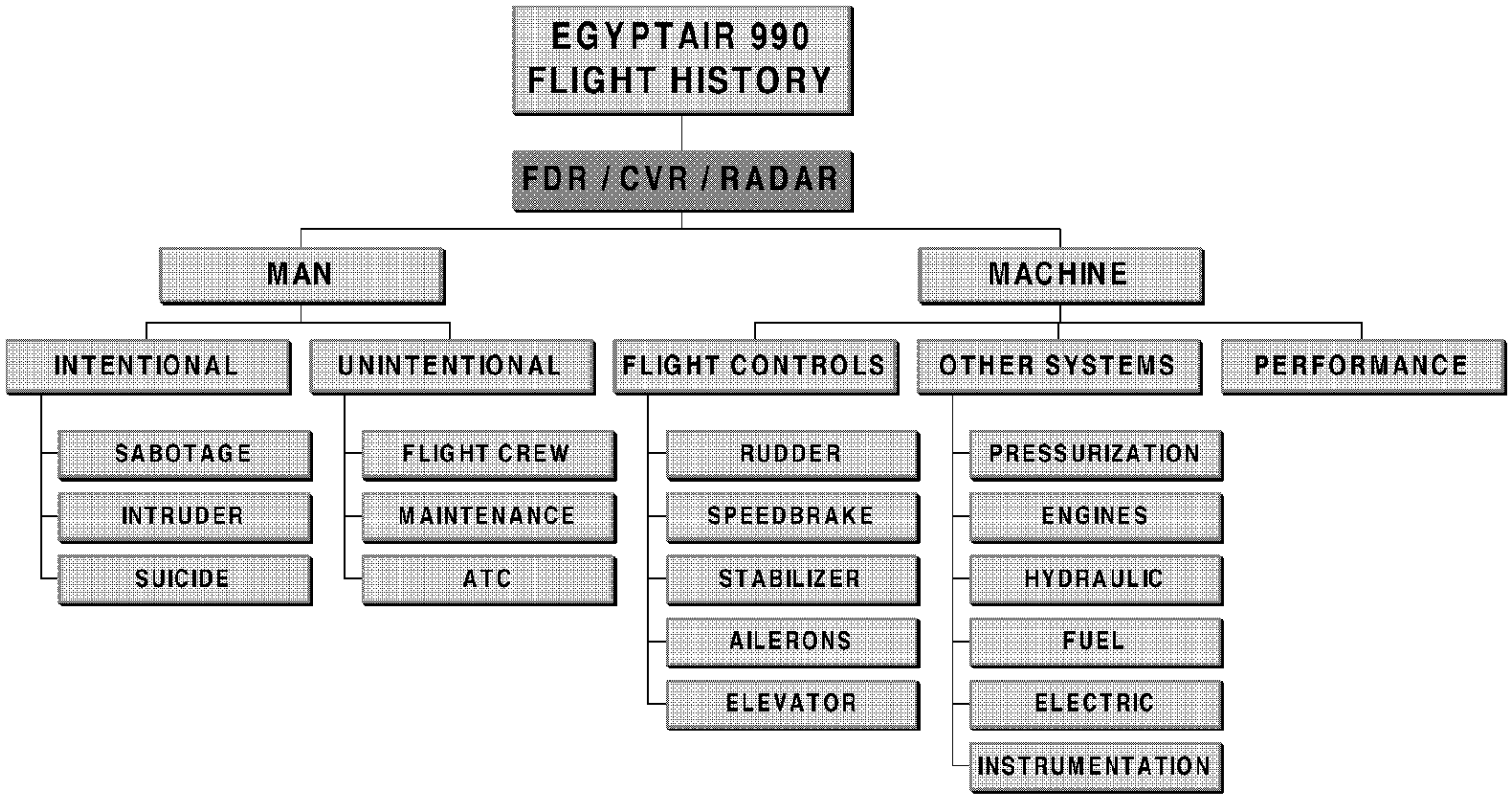
Introduction

The Objective of this presentation is to

* Confirm that the F/O did not commit suicide and murder
* Present evidence of possible elevator failure which is consistent with the accident data
* Present a flight safety issue concerning the elevator PCA jam dual failure
* Present ATC information which may lead to a deliberate act by one of the pilots

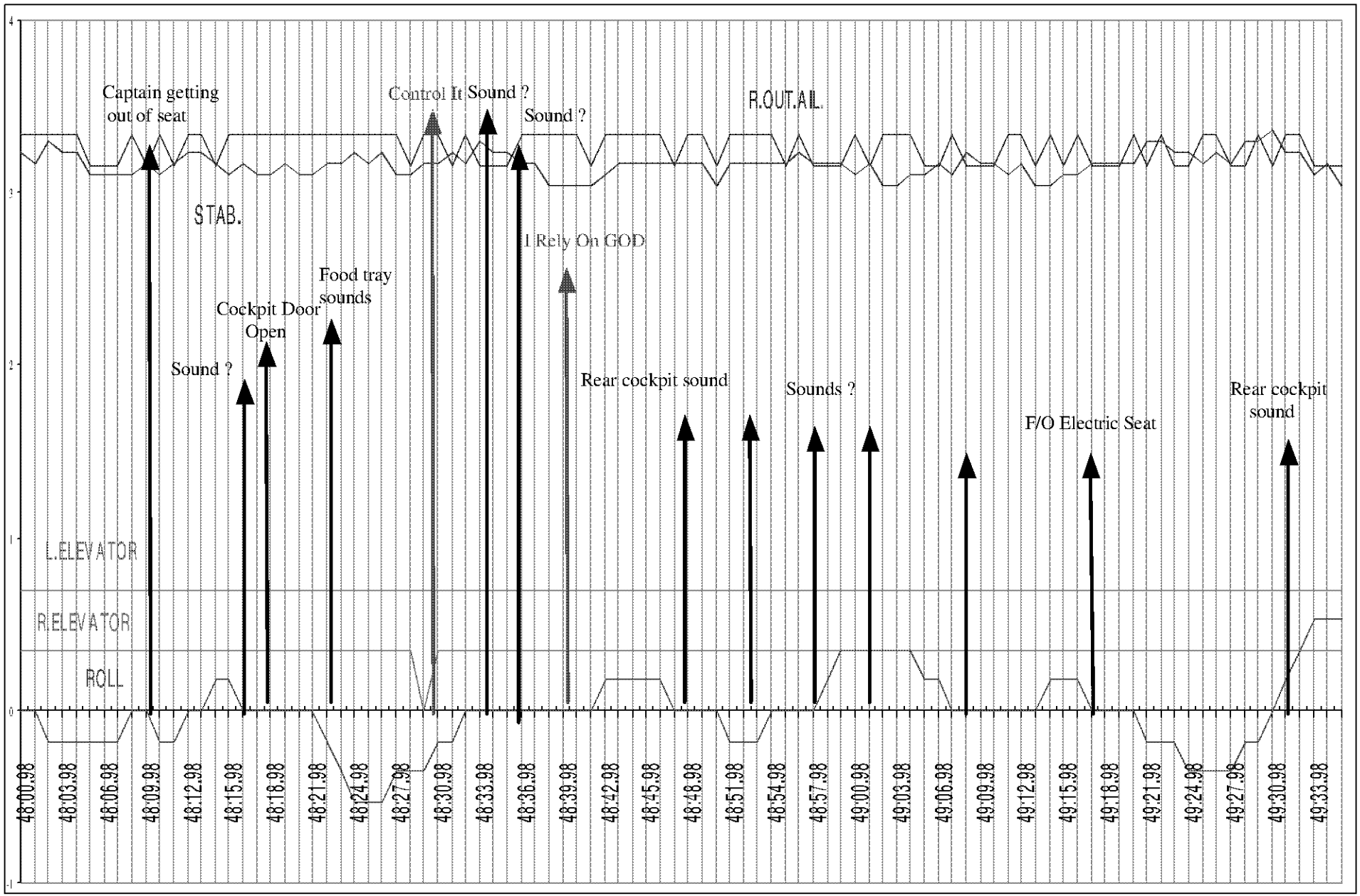


We will not go into the complete history of the flight except to say that the status of the airplane, the pre-flight preparation and the qualification of the flight crew and ground crew were proper and in accordance with regulation.



We will specifically focus on the events of approximately the last 3 minutes of the flight.

KEY EVENTS


Captain getting out of seat
Control It Sound ?
Sound ?
R.OUT.AIL.
STAB.
I Rely On GOD
Food tray sounds
Cockpit Door Open
Sound ?
Rear cockpit sound
Sounds ?
F/O Electric Seat
Rear cockpit sound
L.ELEVATOR
R.ELEVATOR
ROLL
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48:03.98
48:06.98
48:09.98
48:12.98
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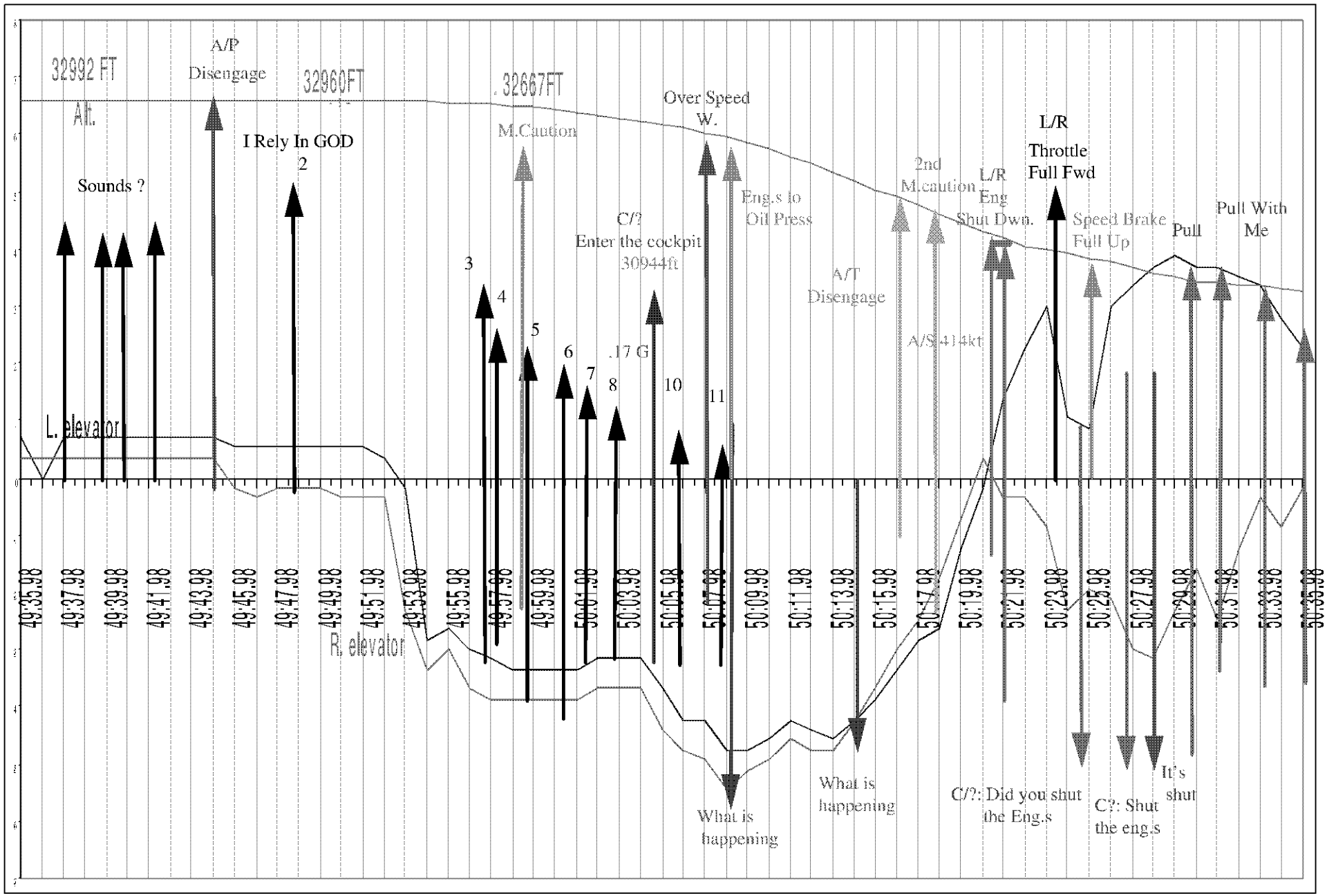
KEY EVENTS


32992 FT
Alt.
A/P
Disengage
32960FT
32667FT
M.Caution
Over Speed
W.
L/R
Throttle
Full Fwd
I Rely In GOD
2
Sounds ?
Eng.s to
Oil Press
2nd
M.caution
L/R
Eng
Shut Dwn.
Speed Brake
Full Up
Pull
Pull With
Me
C/?
Enter the cockpit
30944ft
A/T
Disengage
A/S 414kt
3
4
5
6
7
8
.17 G
10
11
L. elevator
R. elevator
What is
happening
What is
happening
C/?: Did you shut
the Eng.s
C?: Shut
the eng.s
It's
shut
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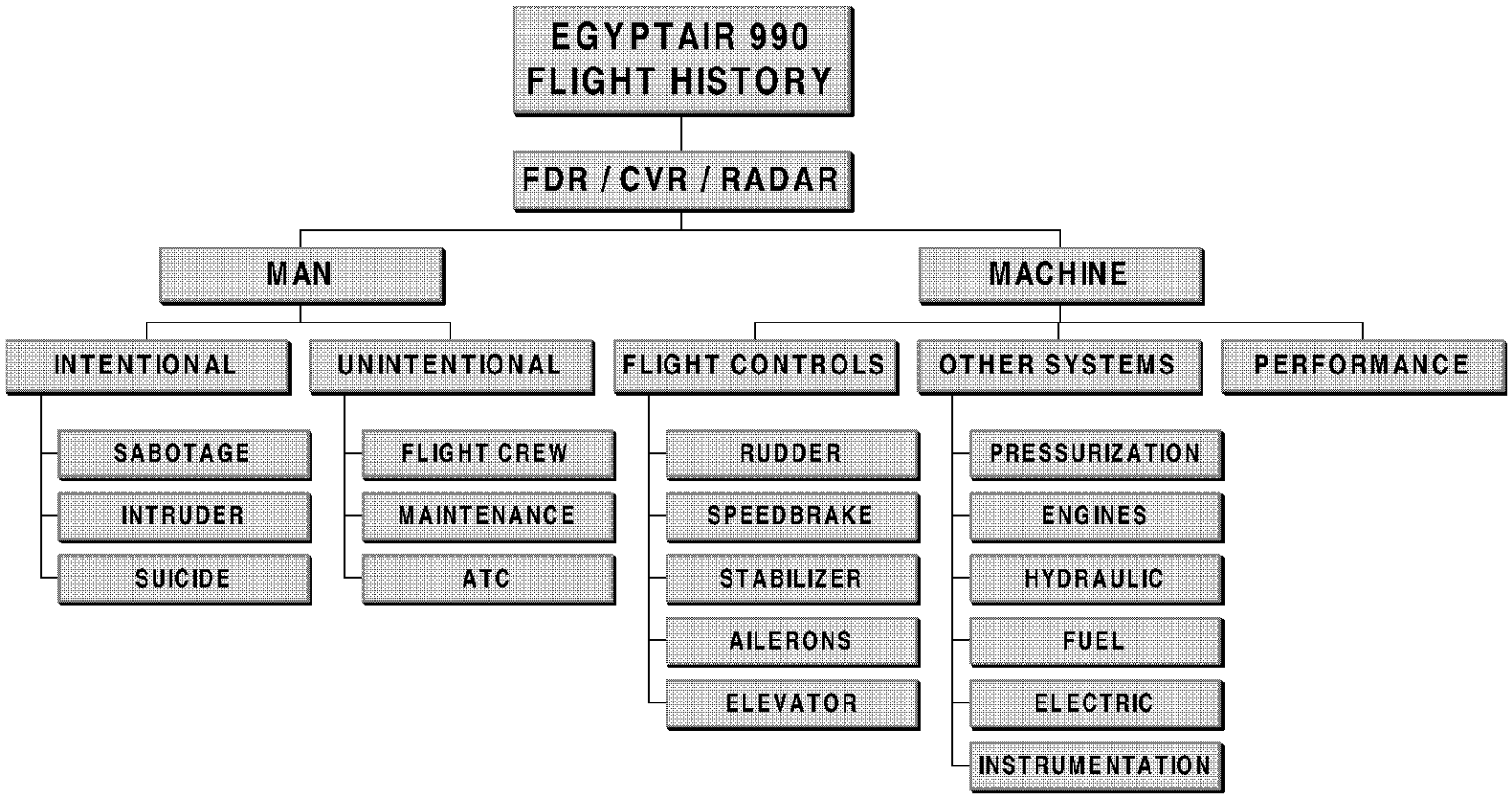
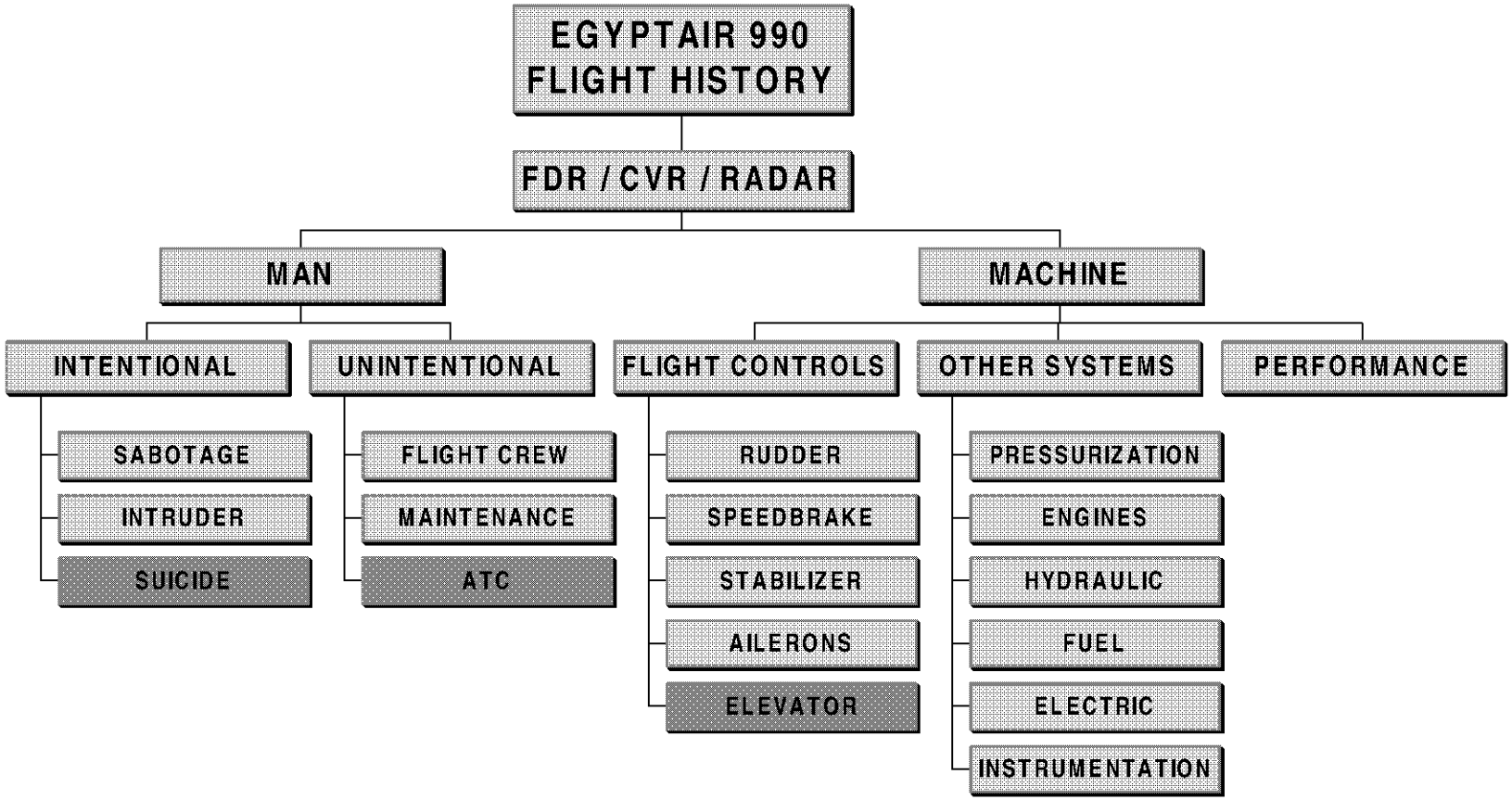


Our work on some issues has not been completed, so we will focus, in some depth, on three issues where we have specific factual data that presents either a clear conclusion or supports the critical need to conduct further investigation



The three issues we will address are:

– An intentional act (Suicide).

–Elevator position and data.

–Air traffic issues (Radar and controller issues).

Suicide Analysis

- The following presentation is intended to Confirm that the F/O did not commit suicide and murder
- The analysis is supported by:

  CVR data

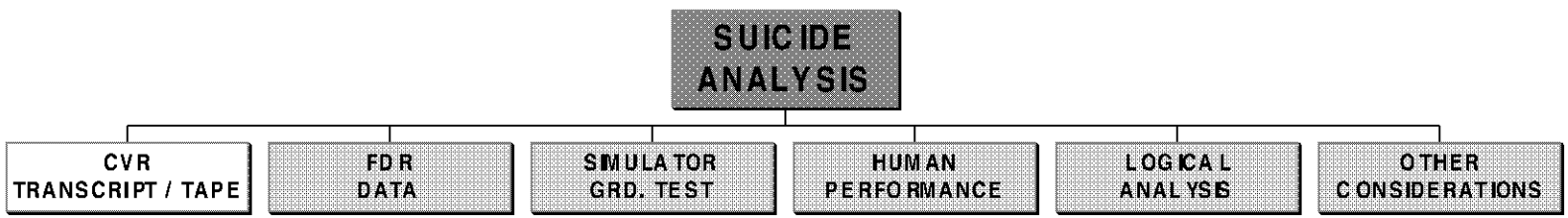
  FDR data

  Simulator, ground test preliminary data

  Human performance analysis

  Logical Analysis

  Other considerations


SUICIDE ANALYSIS
CVR TRANSCRIPT / TAPE
FDR DATA
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OTHER CONSIDERATIONS

CVR

(1)

- In November 1999, the phrase ”Tawakkalt Ala Allah” was improperly interpreted as “I place my fate in the hands of God”
- The correct interpretation, certified by Sheik Al Azhar, and now contained in the NTSB CVR report, is “I rely on God”. This expression is very often used by the Egyptian layman in day to day activities to ask god’s assistance for the task at hand (Exhibit # 1 Sheik Al-Azhar report,# 2 Dr. Adel Fouad report)

Exhibit #1

Embassy of the Arab Republic of Egypt

March 11,2000

In the name of Allah

Most merciful, most compassionate

His Excellency Prof. Dr. Ibrahim Ahmed El Demiry

Minister of Transport

Peace be upon you

Concerning your letter in which you inquired about the meaning of the expression "Tawaklt ala Allah" in Islamic theology and the situations in which it is used by the Egyptian layman.

I would like to inform your Excellency that the meaning of this expression is that, "I depend in my daily affairs on the Omnipotent Allah alone." This expression is very often used by the Egyptian layman in his day to day activities, such as when he goes out of his home, or while he is doing his work whether it is commercial, industrial or agricultural activities etc.

Peace be upon you

Sheik Al-Azhar

Exhibit # 2

Further to our telephone conference on 20/1/2000

Arabic: توكلت على الله

Pronounced: " Tawakalt Ala Alla"

Dictionary meaning: " I rely on God " or " I put my trust in God"

This short sentence is very commonly used in Egypt. To know the exact meaning and uses of this sentence a western person should understand 1st the underlying Eastern religious background.

A basic Islamic belief is that during life humans are continuously supported and controlled by God. A religious person believes there are limitations to all his abilities. Consequently in any act he needs the support of God so as to be successful. The more the person is a believer the more common that he uses this sentence, so much so that many people may use it during routine minor acts like starting his way to work every morning.

Another important point about the use of this sentence, it is used only when one embarks on a good action and not a bad one. Good & bad as seen by his own society. Examples of good acts where this sentence could be used e.g. Major one like trying to save a person from drowning e.g. minor ones like starting a journey by bus or train.

Examples of bad acts where this sentence could never be used. e.g. major acts like killing somebody or planning to rob a house ...etc e.g. minor acts like intending to hit his son or to quarrel with somebody.

Dr. Adel Fouad

CVR

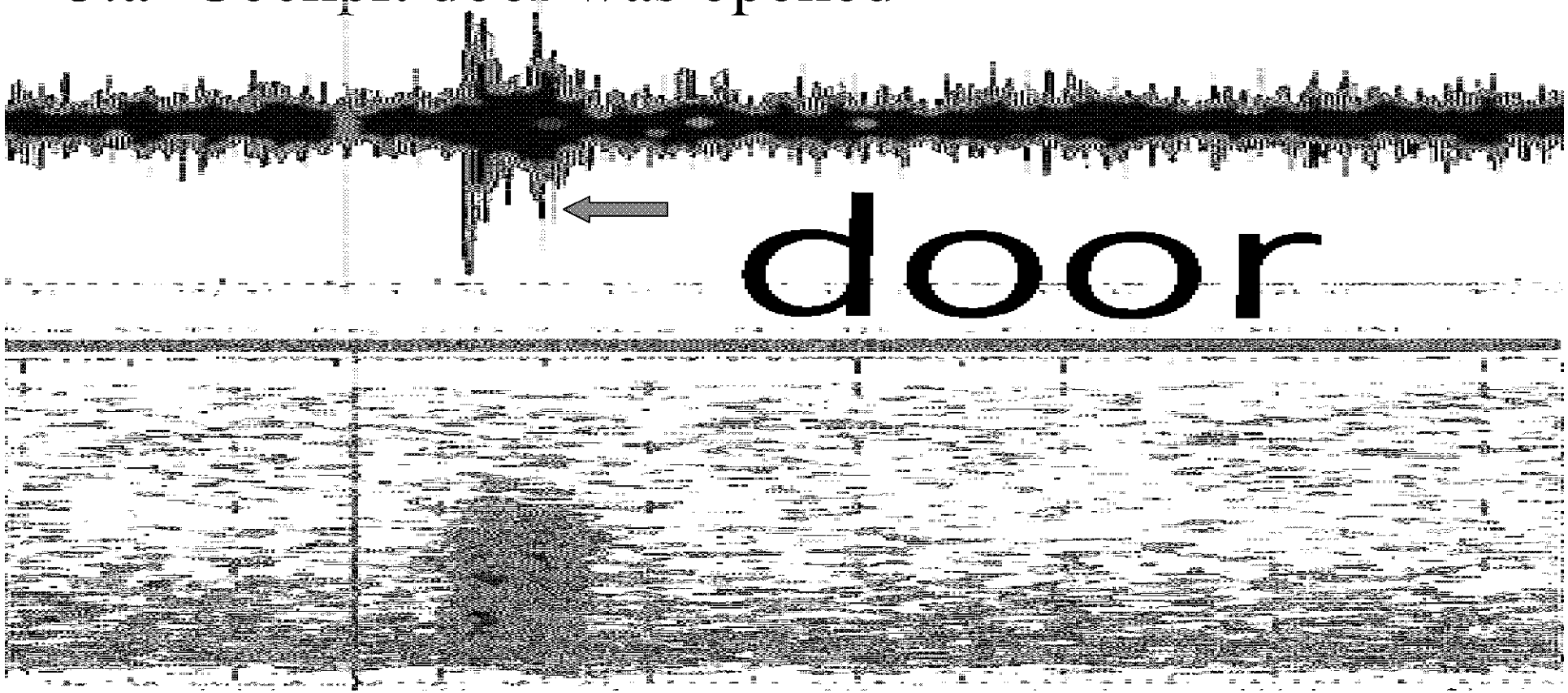
(2)

Repetition of the phrase indicates that the F/O was facing danger, for example it equates to saying Oh my God, Oh my God

CVR

3- There is no evidence that the F/O was alone in the cockpit before or during the dive, based on the following

3.a- Cockpit door was opened



CVR

3.b- According to sound spectrum study, the phrase “Control it” is a human voice and was announced in the cockpit at 6:48:30.4 UTC (6 seconds before the phrase “Tawakalt Ala Allah”, 75 seconds before Auto Pilot disengagement). This voice is unidentified

CVR

3.c-At least two persons were present in the cockpit shortly after the dive started

(James R. Cash Report)

It should be noted that there are several statements during the last several minutes of the CVR recording that could not be positively associated with either Capt. Habashi or 1st Officer Batouti. This opens the possibility that additional people were speaking in the cockpit during the last few minutes of the CVR recording

James R. Cash
Electronic Engineer

CVR

(4)

•During the dive, there was no indication of struggle or verbal disagreement between the Captain and F/O.

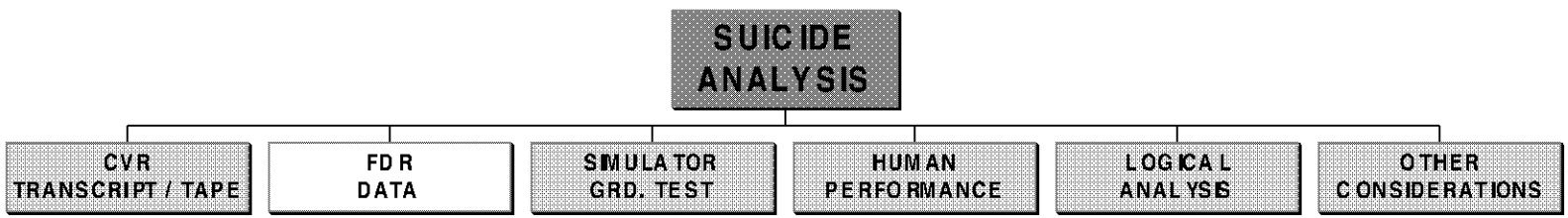
Psychiatric Report Re: Captain Gamil El Batoty
EgyptAir Accident Flight 990
Final stages of trouble -

Here there are many anxious voices. The way the voices address Capt. Battoty and the way he answers them, shows that Battoty was responding and cooperating with them.

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist

CVR Conclusion:

- the phrase ”Tawakkalt Ala Allah” was improperly interpreted, repetition of the phrase indicates facing danger
- The F/O was not alone in the cockpit before the event
- No struggle or verbal disagreement in the cockpit


SUICIDE ANALYSIS
CVR TRANSCRIPT / TAPE
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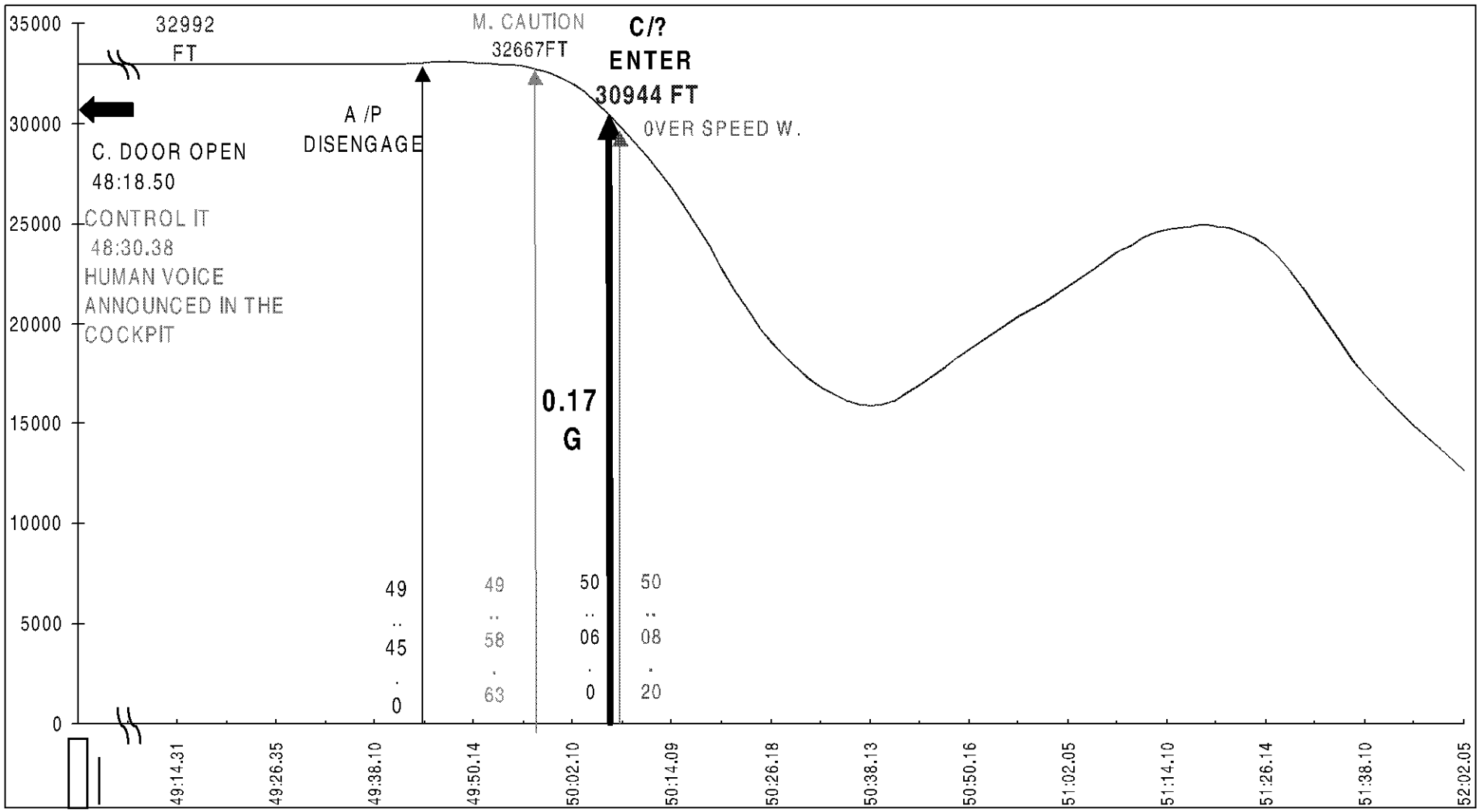
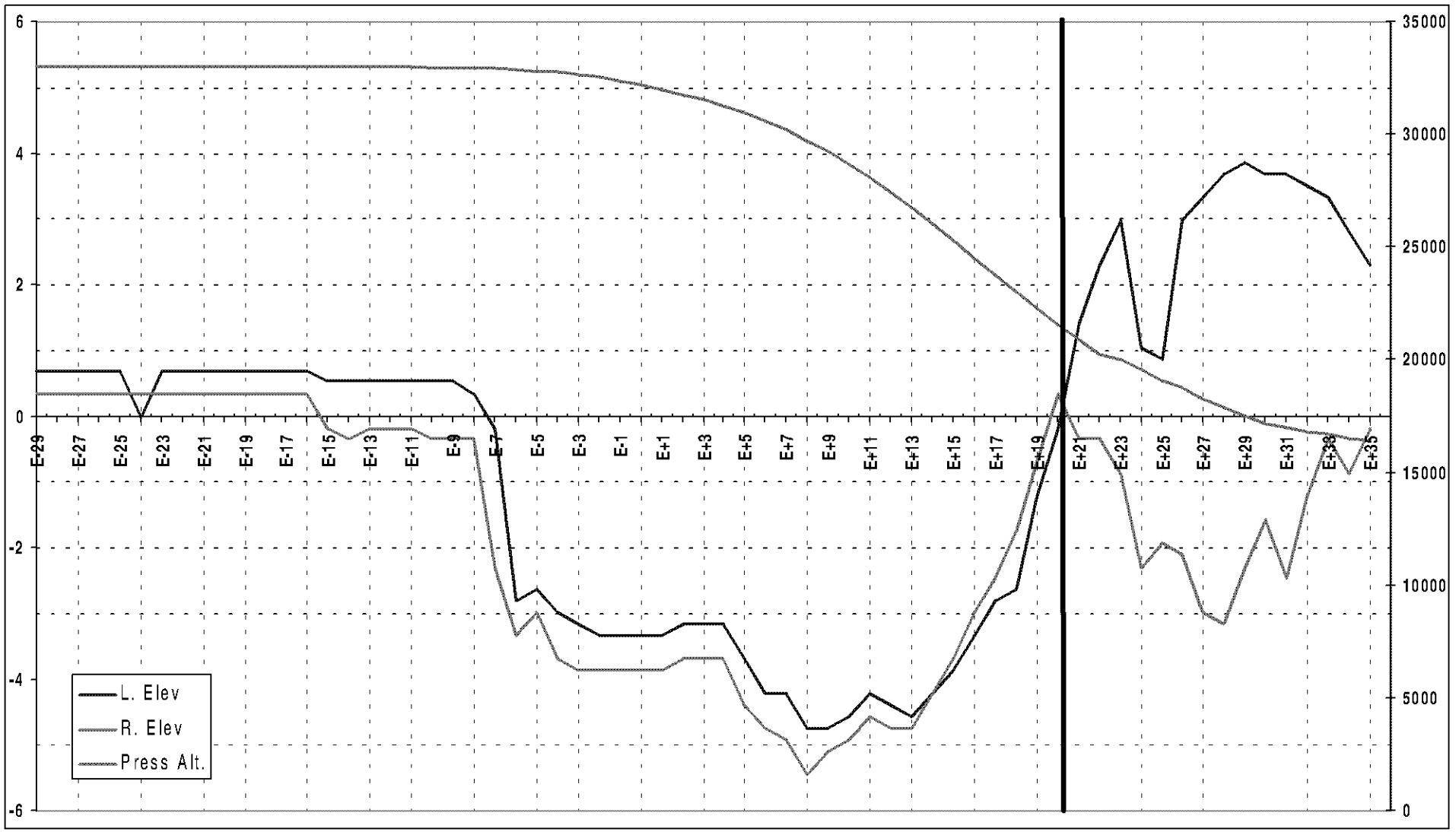
FDR

1-A Captain returned to cockpit very early in the event when the aircraft was about 31000 ft.



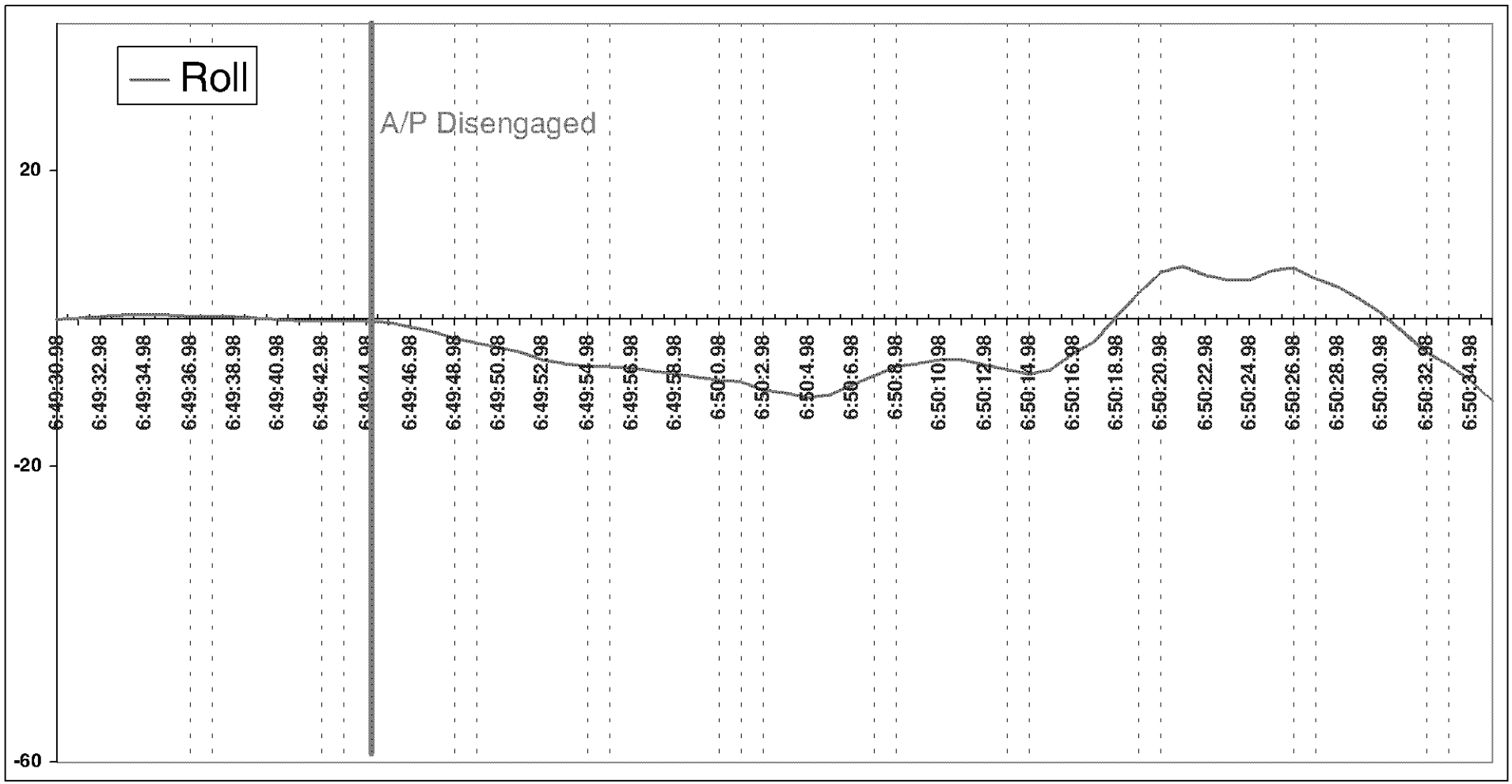
FDR

2-Both the elevators were moving simultaneously for the 1st 28 seconds of the dive



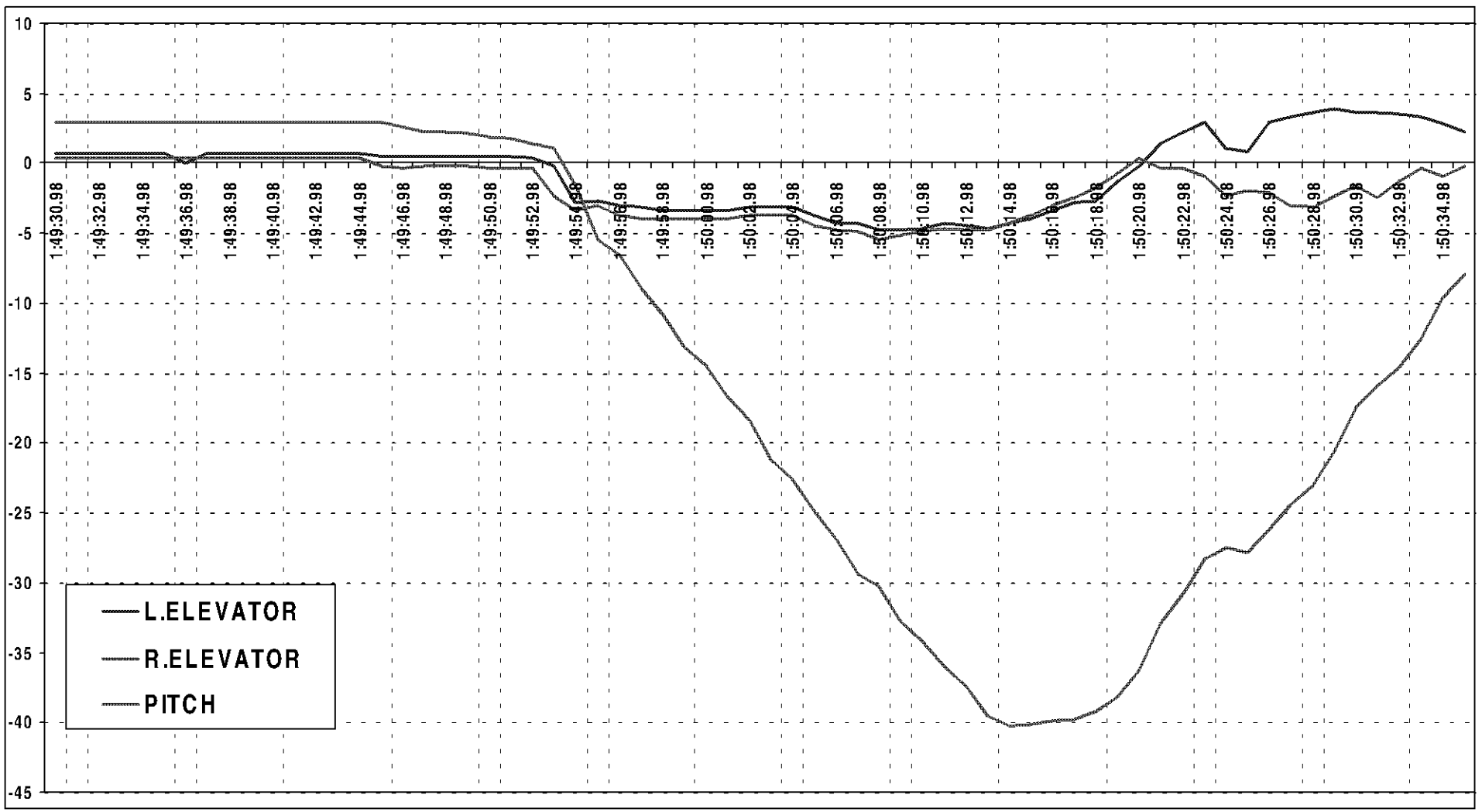
FDR

3-The bank angle was controlled throughout the dive



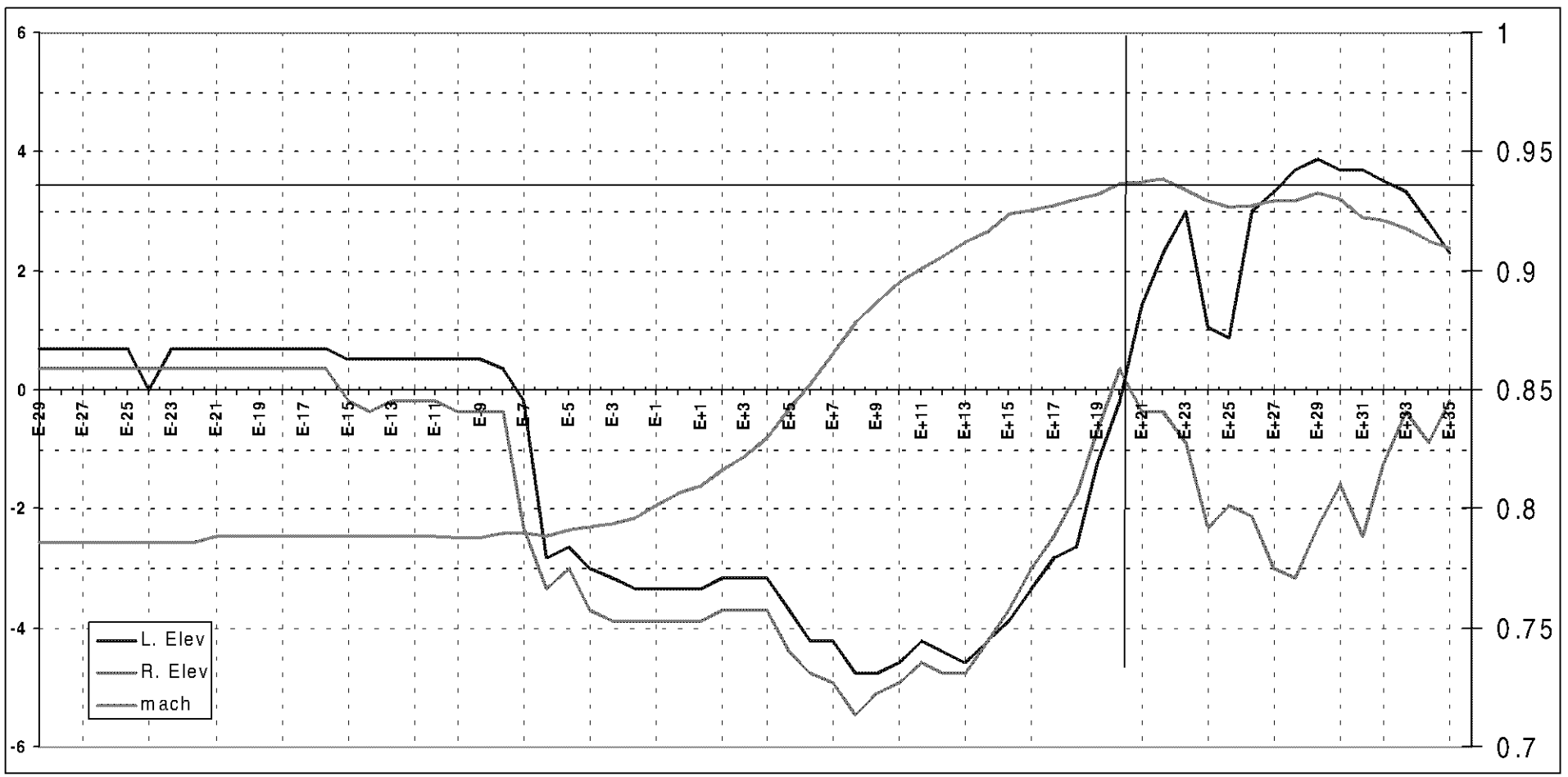
FDR

4-The elevators moved together as the nose came up, the dive was stopped, and aircraft control appeared to begin



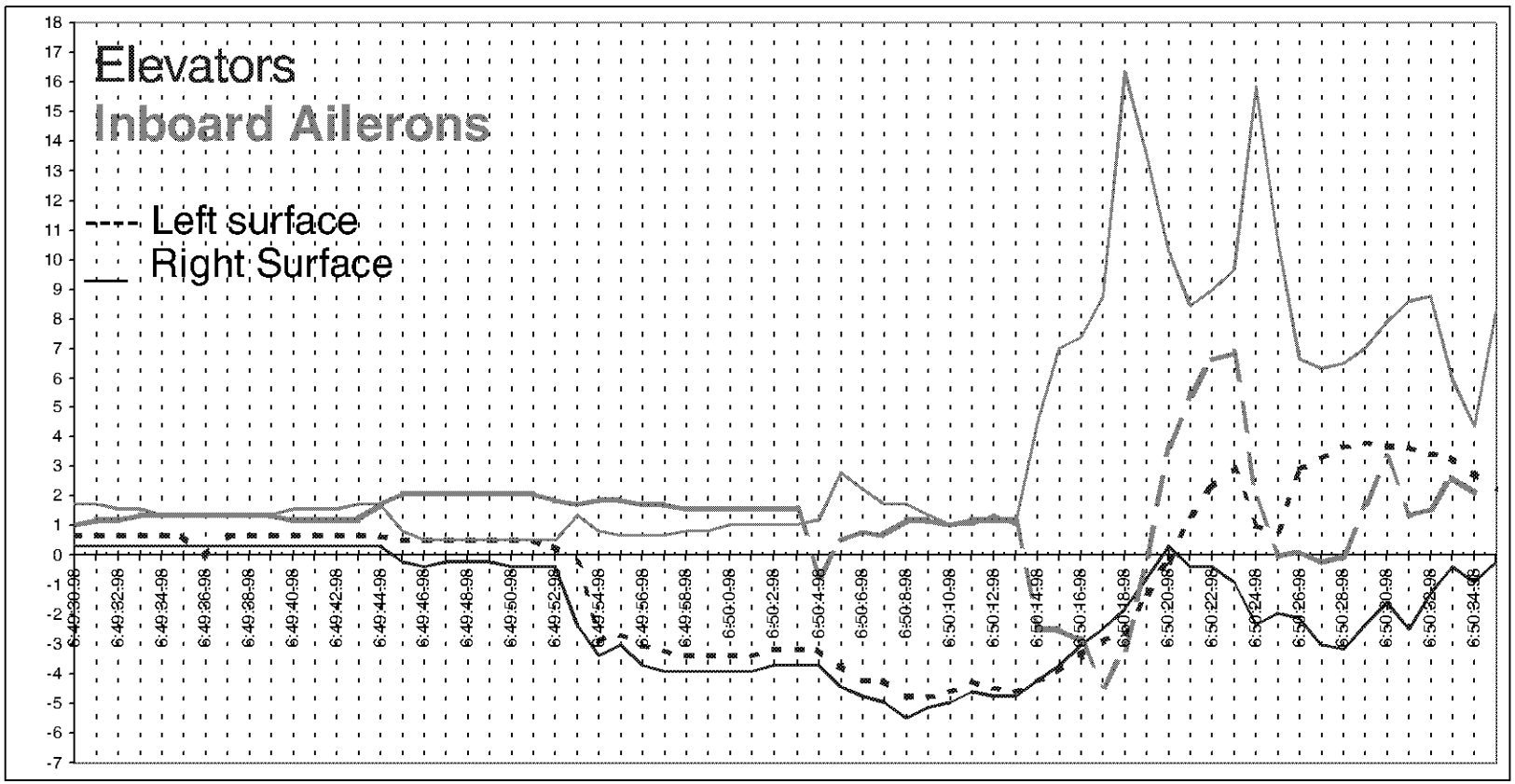
FDR

5-The elevator split does not appear until the last 15 seconds of the FDR data when the airplane was above 0.93 Mach. The airplane characteristics above Mach=0.91 is not available from manufacturer



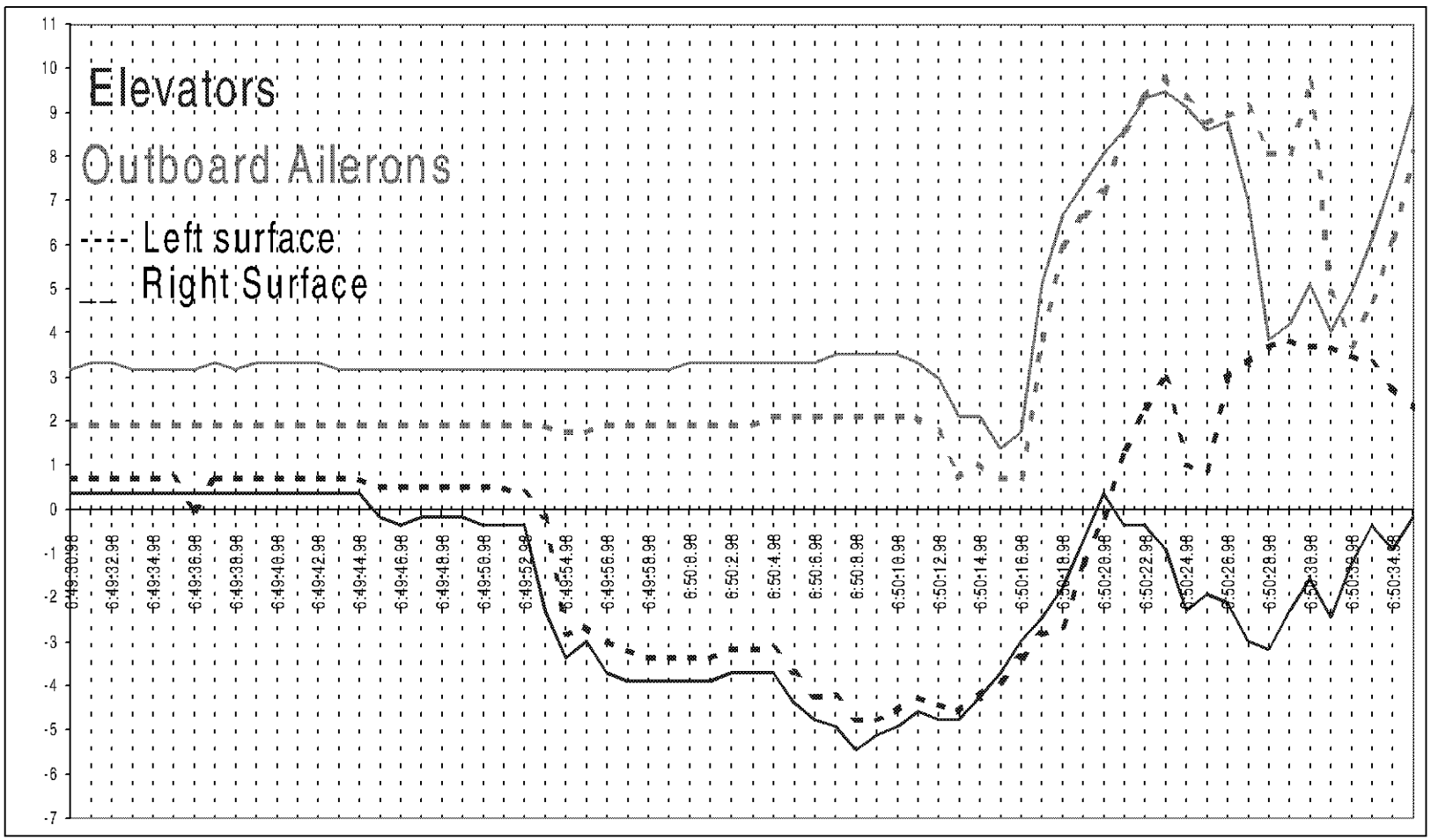
FDR

6-The elevator split at the end of the dive was incorrectly interpreted as a fight between the cockpit crew, at about the same time the elevators “split”, the aileron surfaces showed similar unexplained movement, again questioning the validity of the A/C performance in this Mach range



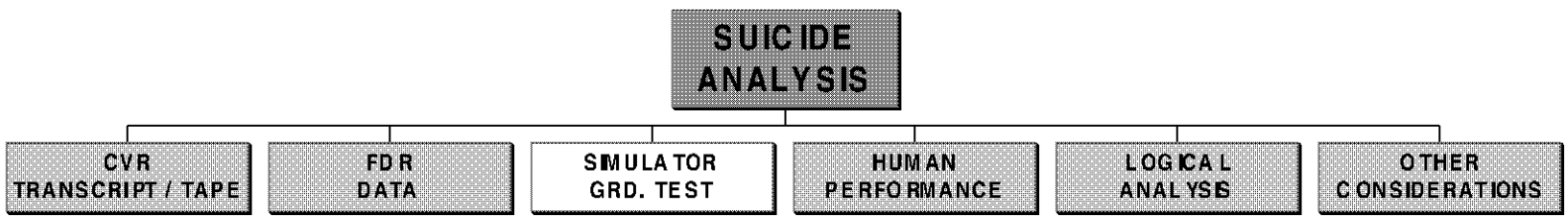
FDR

7-The elevator split at the end of the dive was incorrectly interpreted as a fight between the cockpit crew, at about the same time the elevators “split”, the aileron surfaces showed similar unexplained movement, again questioning the validity of the A/C performance in this Mach range



FDR Conclusion:

- The Captain was in the cockpit almost at the beginning of the dive
- The bank angle was controlled during the dive
- No indication of opposite control column input
- Elevators split occurred only at almost the highest Mach number value which is far above the normal design envelop of the airplane and could be attributed to other causes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Simulator , ground test preliminary results:

1-CVR/FDR Correlation:

the following has been noted:

In case there are only two pilots in the cockpit, all actions shown by the FDR can be done, except moving the speedbrake lever to the deployed position. This can be possible if there is a third pilot, in this case, pitch (as shown in the FDR) can be maintained

Simulator, ground test preliminary results:

2-Elevator failures:

the followings has been noted:

-In all cases of elevator failures and elevator split, the airplane was recoverable, either from the Captain or F/O side.Recovery was possible just after inserting the failure, 5 ,10 and 20 seconds after inserting the failure and at an altitude of 24000 ft.

Simulator, ground test preliminary results:

3-General findings

*With the right elevator surface maintained at 6 degrees (T.E. down) throughout the dive, the airplane was recoverable from the left column even when recovery started after -40 degree airplane pitch. (engines were shut down, speedbrakes deployed)

*Pulling force on either elevator column can not be maintained at the same level when moving the speedbrake levers or the engine controls, consequently the pitch can not be maintained

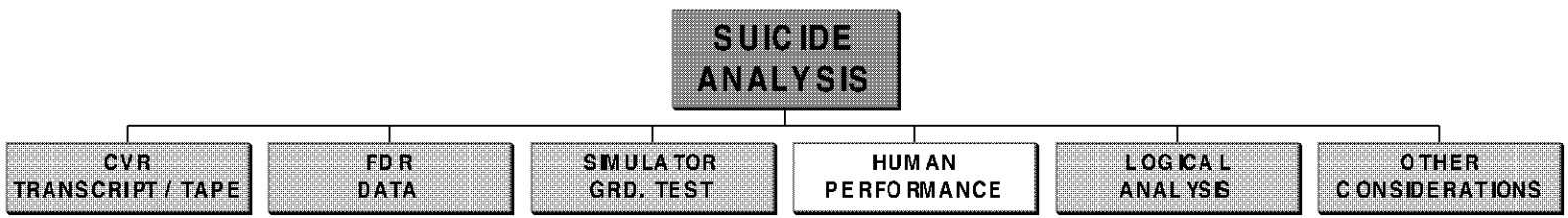
*It was possible to use stabilizer to assist in airplane trim, as long as the elevator column is used in the same direction with the stabilizer

*It is impossible to move the speedbrakes from the F/O side while pushing or pulling

*The forces needed to split the elevators were higher on the test airplane compared to the forces in the simulator

Simulator, Ground Test Conclusion:

- Actions made during the dive can only be made by more than two persons
- In all cases (elevator split, elevator failures), the A/C was recoverable from either elevator columns
- The A/C was recoverable even with the right elevator maintained at 6 degrees down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Human Performance

1-Reference to the F/O history, he had no mental or psychological problems

Psychiatric Report Re: Captain Gamil El Batoty
EgyptAir Accident Flight 990

There is no family history of mental illness and Capt. Battoty had no previous psychiatric treatment. He was making preparations for the marriage of his son in two months time.

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist

Human Performance

2-The F/O had no connections with any fanatic or terrorist groups

Human Performance

3-The F/O was social, popular, loved life and happy family man

I interviewed the family after the accident. Capt. Battoty was married and had 5 children and 3 grand children. His 3 sons are university students and two of them are about to graduate. One is already working. The family appears to be stable and greatly respecting the deceased father. Capt. Battoty was almost a father figure for many of his relatives and extended family.

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist

Human Performance

4- The F/O was in a good mood among his colleagues before and during the flight

I interviewed his friends in EgyptAir, especially his close friend Capt. Badrawy. There was a consensus of opinion that Battoty was always cheerful and that he loved life. He always accepted any pressures with satisfaction. He did not smoke or drink. While in New York on the day before the accident, Battoty gave Capt. Badrawy a few tablets of (Viagra). When Capt. Badrawy asked for more tablets, he refused and said "I keep the whole bottle for many friends in Cairo."

I reviewed the interview summaries done by the NTSB witness group, which was led by Bart Elias and others on 1 Nov 1999. According to the interview summaries, Capt. Battoty appeared to be friendly and helpful to others. Just before the accident there were no unusual events and everything appeared normal.

A period of discussion between the pilots -

The discussion was mainly about criticism of other pilots and policies inside the company. This went on for some time and Capt. Battoty participated in the conversation. However, he does not sound angry, rather he was calming and soothing to the others. He told Capt. Habashi not to worry, that everything will be alright."

Just before the accident -

It was evident that Capt. Battoty had just started eating and enjoying his dinner. The hostess asked him "Do you want any more food?" He replied using the Arabic expression "Keda foll awy" (No thank you, it is really really marvelous.)

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist

Human Performance

5-The F/O was planning for his future career after retirement

Capt. Battoty's son Karim told me on the telephone that Capt. Battoty was bringing home a few things for the family. Among them, two tires for their car in Cairo.

His wife Omayma told me that Battoty did not ask to leave the company, as he was already retiring in February. She said that he had many financial projects in his mind. He was due to take a good amount of money on his retirement from EgyptAir, almost 400,000 Egyptian pounds.

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist

Human Performance

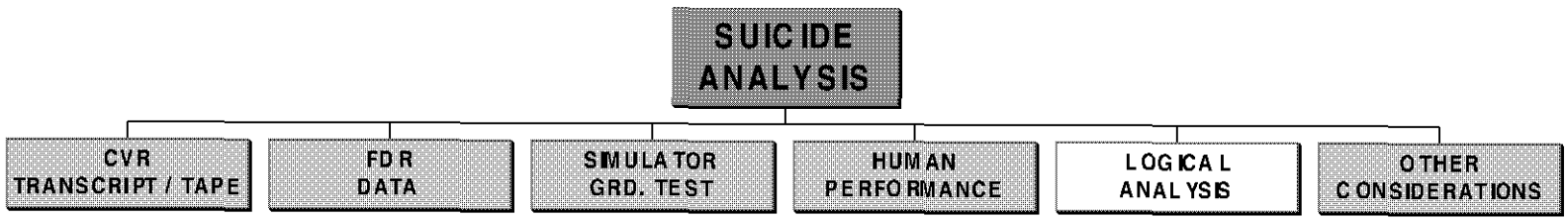
6- Studies do not identify any motive or reason to commit suicide or to murder 216 innocent persons

Human Performance Conclusion

- Religious man
- Loving family man
- Successful children
- No affiliation with religious or terrorist groups
- Financially secure
- Open successful social life
- Professional career with no indications of any problems
- Reported to be in good mood before the flight
- Respected by peers
- Normal career as flight instructor and first officer
- Investigations have found nothing incrimintive in his background
- **No motive at all to intentionally crash airplane**

- There is no evidence that Capt. Battoty was suffering from schizophrenia, alcohol intoxication, severe depression or any psychotic state.
- In any case of suspected suicide, the specialist of human behavior searches mainly for evidence of psychological depression. If he cannot find this evidence, the possibility of suicide is remote. But further to this, if he also finds evidence of enjoyment and good mood, the possibility of suicide becomes very remote and insignificant.

Dr. M. Adel Fouad, M.R.C. Psych. Lond Consultant Psychiatrist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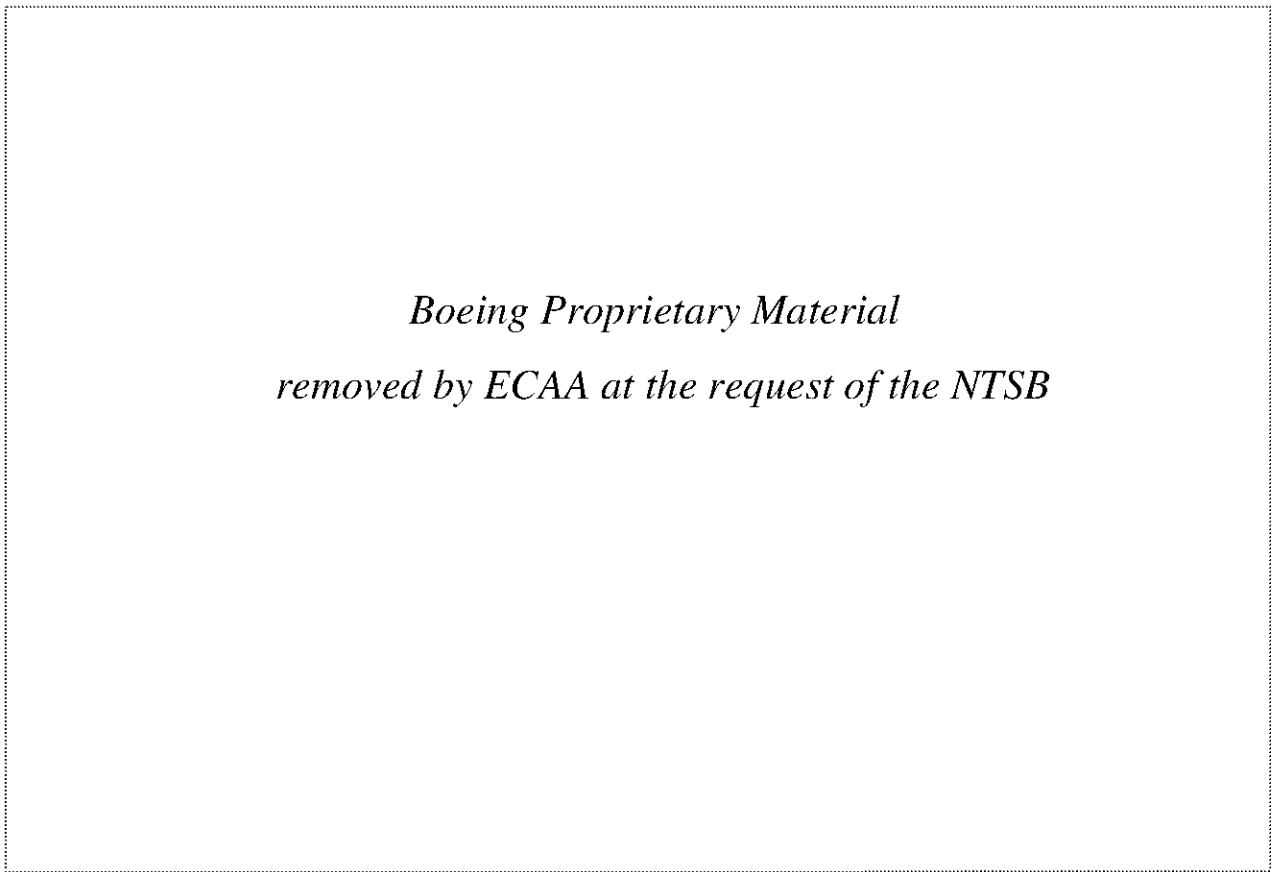
Logical Analysis

1- The FDR data showed that the aircraft entered a dive where the elevator deflection did not exceed 6 degrees. It is important to note that the maximum elevator deflection at that moment is 15 degrees down. A suicide attempt would have had the elevator deflection closer to the maximum deflection



Logical Analysis

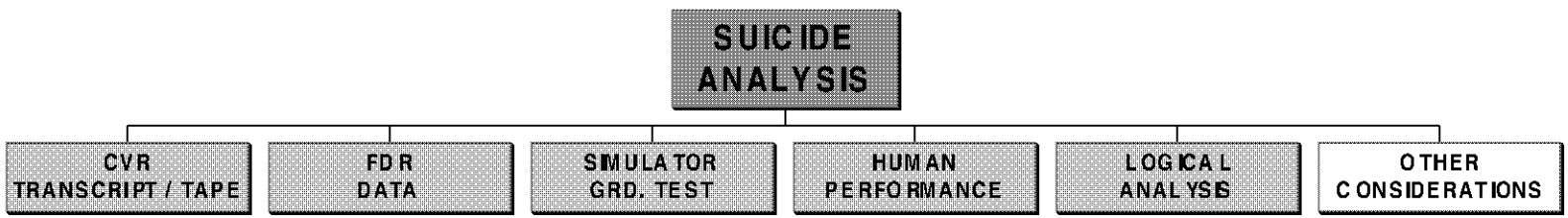
2-The engine thrust levers were retarded at the beginning of the dive. The 1st officer would push the levers forward if he intended a suicide attempt

Logical Analysis

3-There is no indication that the first officer was pushing the control column while the captain was pulling. The captain said "pull with me", not "don't push" once again, the conversation indicates that they are working together

Logical Analysis Conclusion:

- The pilot would have used max pitch, roll and thrust if suicide was intended.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Other Consideration

- The cockpit door was left open by the first officer

  A suicide plan would had dictated a closed locked door
- The first officer was eating his meal and commented on the quality of the meal - three minutes later he stopped and the dive started, this is inconsistent with a suicide plan, rather it indicates that something happened which caught his attention and caused him to stop his meal
- Illogical selection of location of the “suicide” … mid ocean or closer to the ground more logical to avoid detection.

Other Consideration Conclusion:

- Nothing in the F/O behavior indicates any intention of suicide

Suicide Evidence

- Prayer
- Alone in the cockpit
- Shut off the engine
- Split elevator
- Why seats changed
- Disengagement of Auto Pilot

Suicide Evidence

- Alone in the cockpit
- Shut off the engine
- Split elevator
- Why seats changed
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Suicide Evidence

- Shut off the engine
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Suicide Evidence

- Split elevator
- Why seats changed
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Suicide Evidence

- Why seats changed
- Disengagement of Auto Pilot

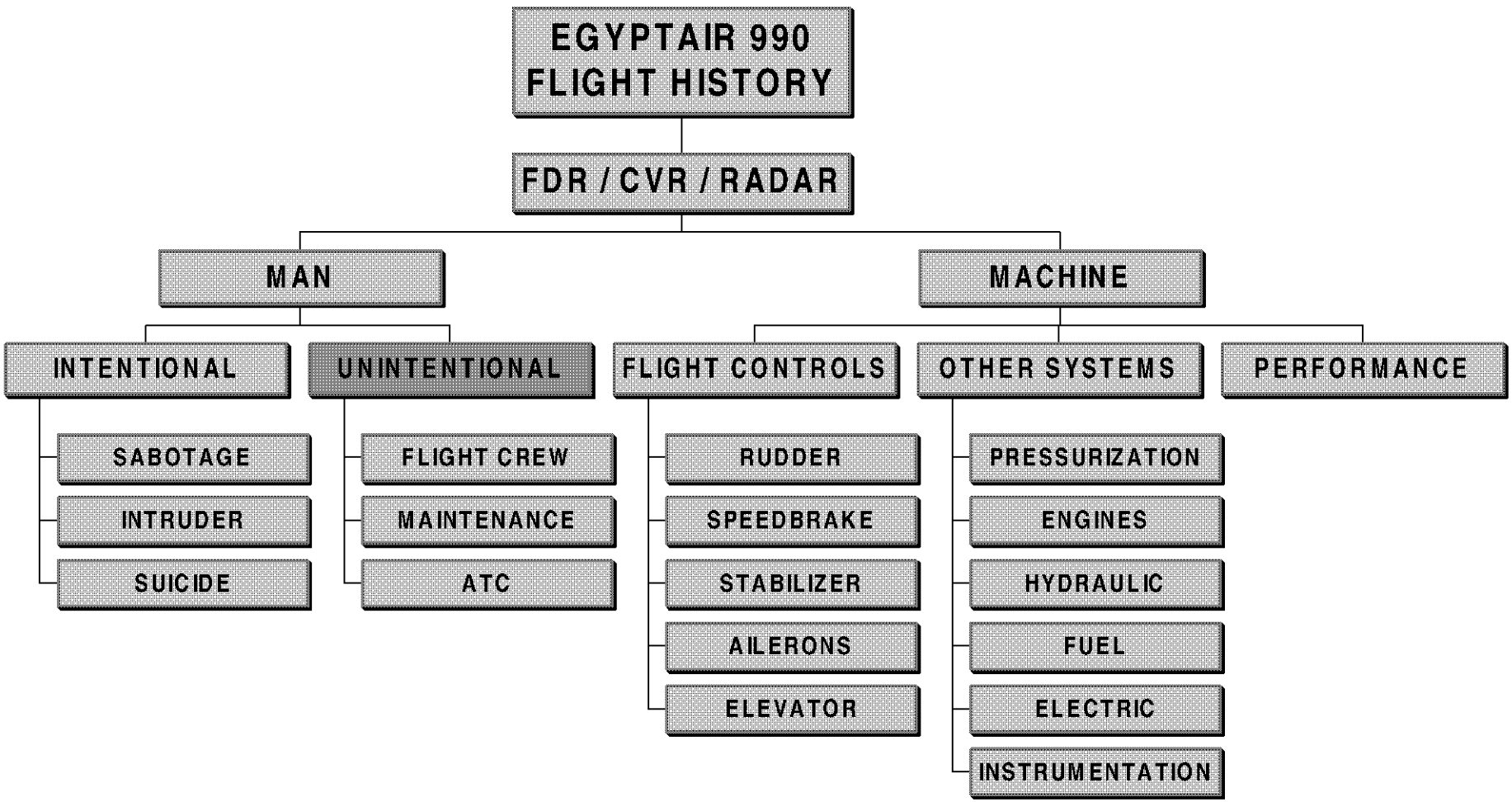
Suicide Evidence

- Disengagement of Auto Pilot

Suicide Evidence

Suicide final Conclusion:

We conclude that the suicide scenario is not consistent with data and facts of MS990 accident.


EGYPTAIR 990
FLIGHT HISTORY
FDR / CVR / RADAR
MAN
MACHINE
INTENTIONAL
UNINTENTIONAL
FLIGHT CONTROLS
OTHER SYSTEMS
PERFORMANCE
SABOTAGE
INTRUDER
SUICIDE
FLIGHT CREW
MAINTENANCE
ATC
RUDDER
SPEEDBRAKE
STABILIZER
AILERONS
ELEVATOR
PRESSURIZATION
ENGINES
HYDRAULIC
FUEL
ELECTRIC
INSTRUMENTATION

Unintentional Acts

Flight Crews:

- Study of the flight crew actions did not show any evidence of performance deficiency.

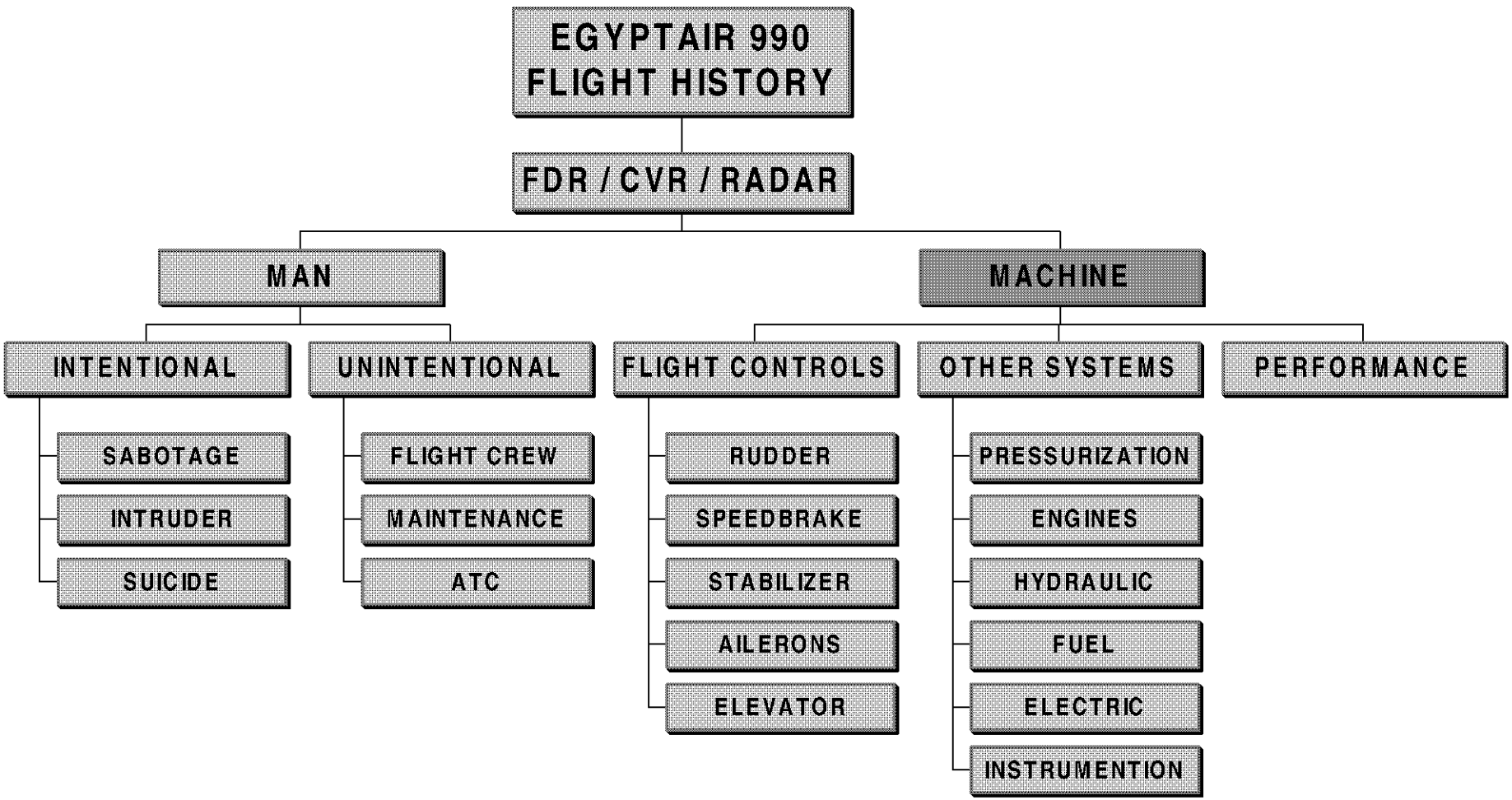
Unintentional Acts

Maintenance Crews:

- Study of the Maintenance crews actions did not show any evidence of maintenance deficiency.

Notes

- Examination of the Flying and Maintenance crews records and certifications showed conformity with relevant standards
- Examination of A/C logs and records showed full conformity with relevant standards


EGYPTAIR 990
FLIGHT HISTORY
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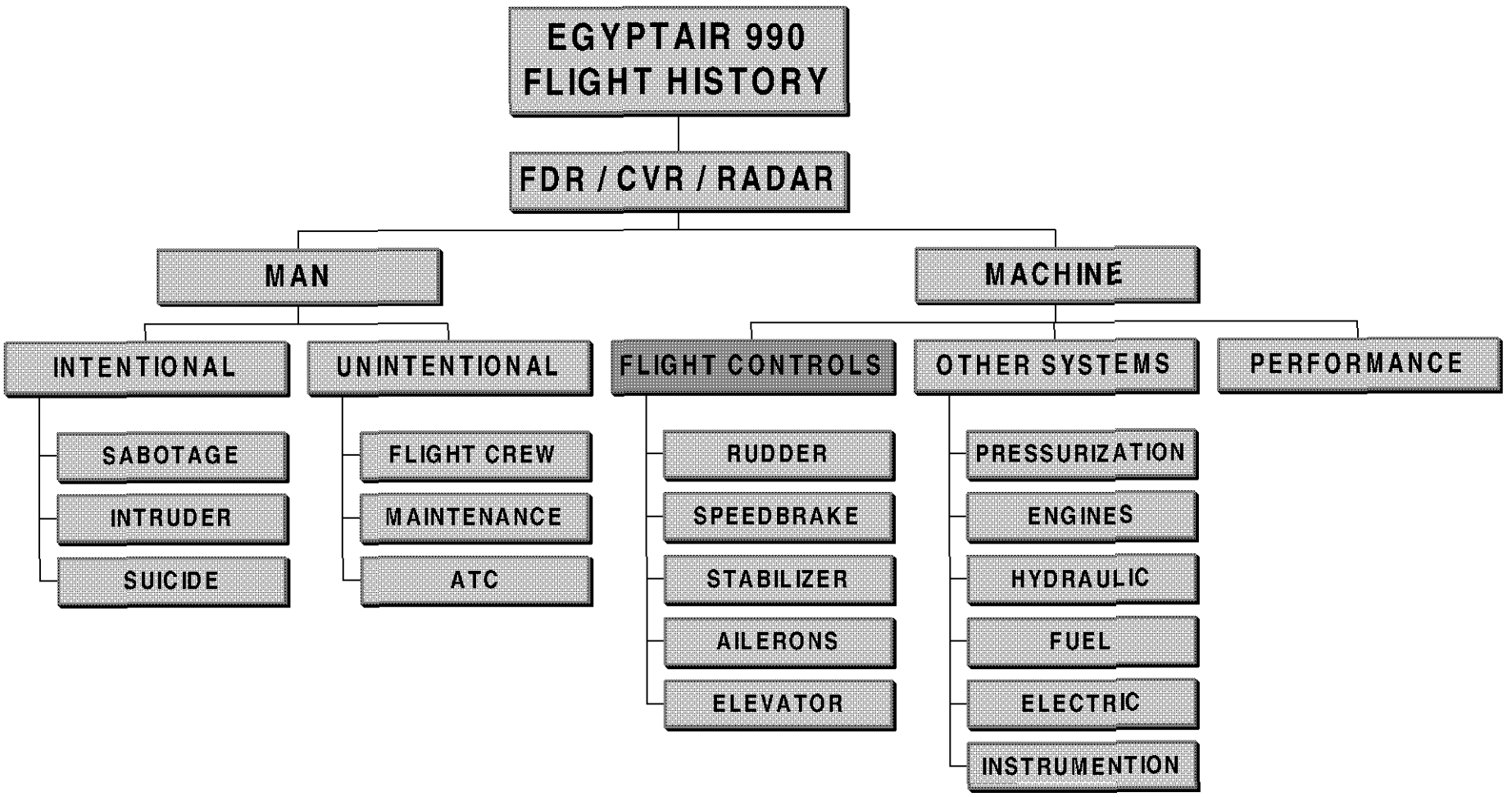
UNINTENTIONAL
FLIGHT CONTROLS
OTHER SYSTEMS
PERFORMANCE
SABOTAGE
INTRUDER
SUICIDE
FLIGHT CREW
MAINTENANCE
ATC
RUDDER
SPEEDBRAKE
STABILIZER
AILERONS
ELEVATOR
PRESSURIZATION
ENGINES
HYDRAULIC
FUEL
ELECTRIC
INSTRUMENTION


EGYPTAIR 990
FLIGHT HISTORY
FDR / CVR / RADAR
MAN
MACHINE
INTENTIONAL
UNINTENTIONAL
FLIGHT CONTROLS
OTHER SYSTEMS
PERFORMANCE
SABOTAGE
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Flight Controls Systems

Rudder

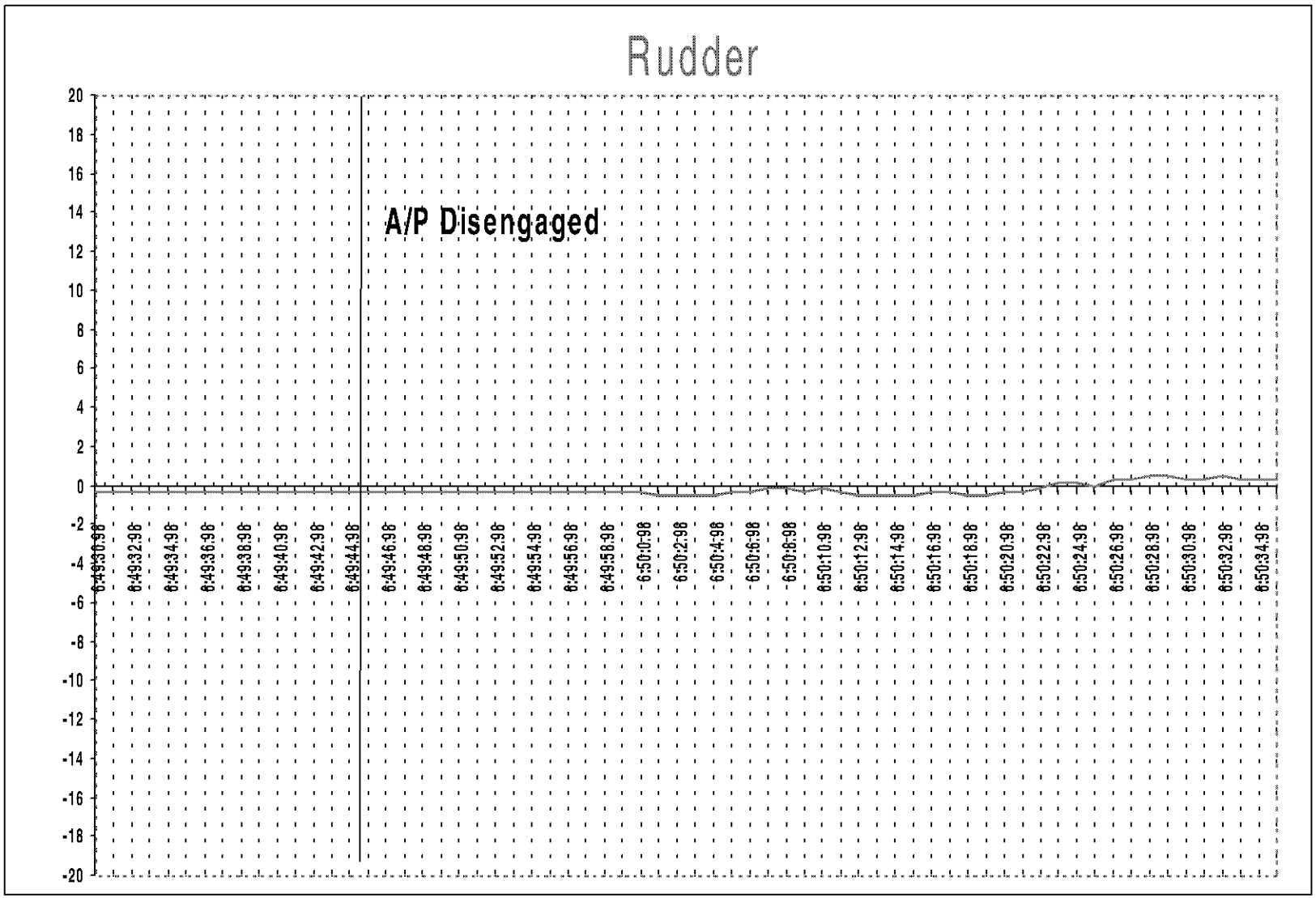
Speed Brakes

Stabilizer

Ailerons

Elevator

Rudder behavior before and during the dive:
The rudder did not show any significant abnormal behavior before and during the dive



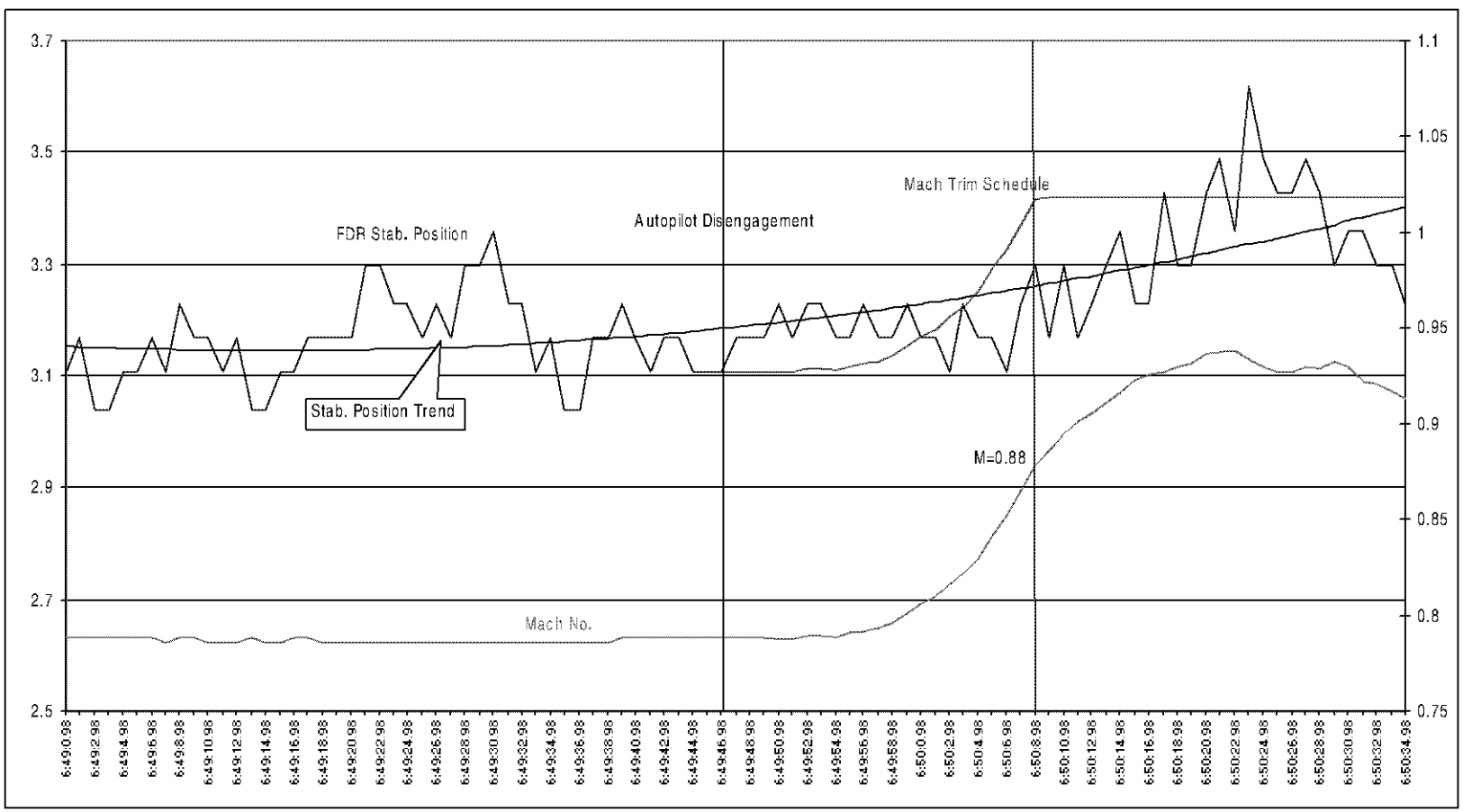
Speed brake behavior before/during the dive:

- The speedbrake surface positions are not recorded on FDR
- Speedbrake handle was deployed at the end of the dive (6:50:24.98 UTC).

Stabilizer behavior during the dive:

According to FDR data, stabilizer did not show significant movement to correct for the dive

Stabilizer should have moved under the command of the Mach trim to pitch up the A/C. FDR data did not show this movement.Mach trim operation analysis is ongoing

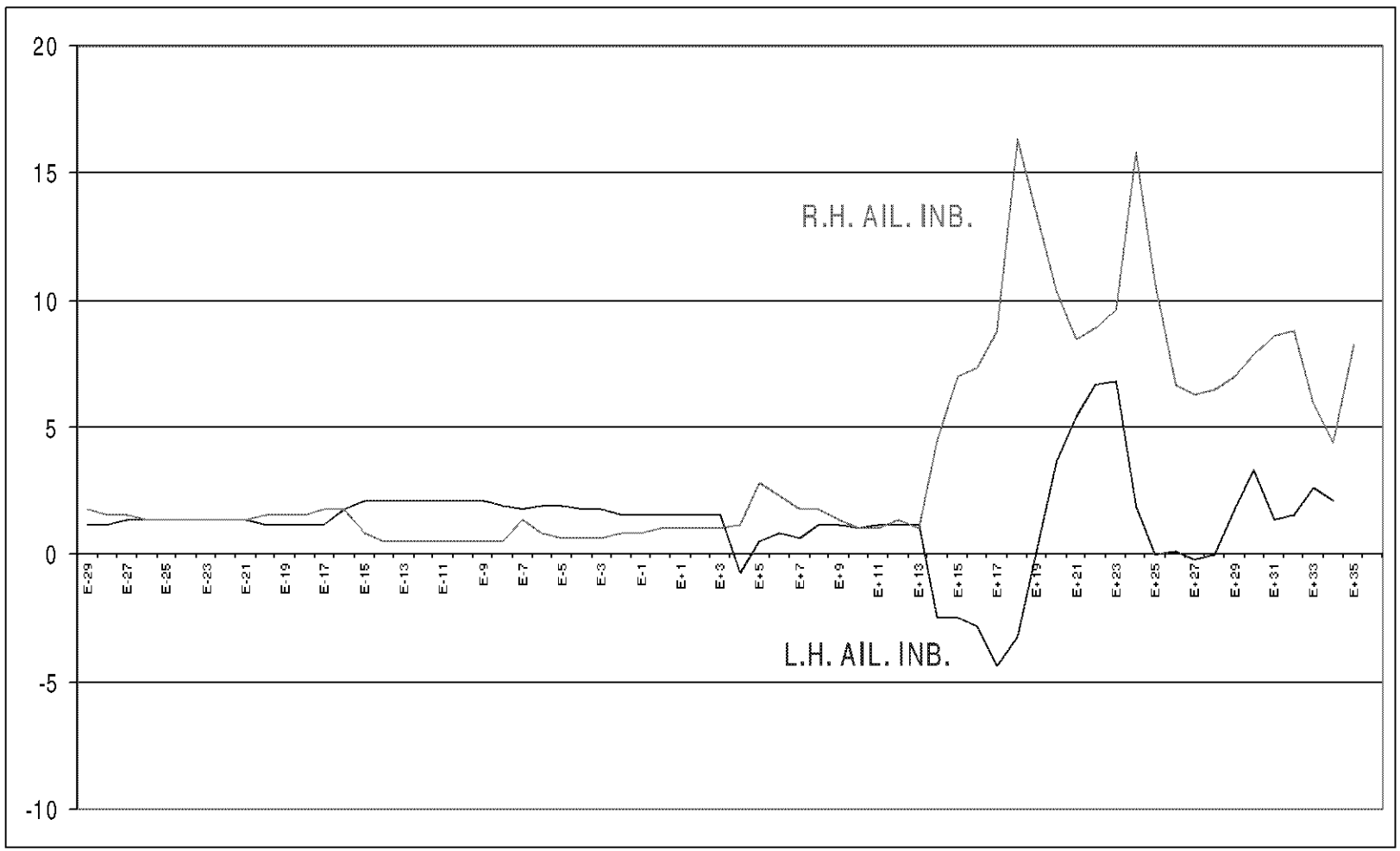


Aileron behavior before and during the dive:

Inboard Ailerons:

Both inboard ailerons moved significantly upward and then showed noticeable differential deflection (similar to what happened with the elevators).

Upward movement of the inboard ailerons would result in significant pitch down movement (acting as speed brakes)



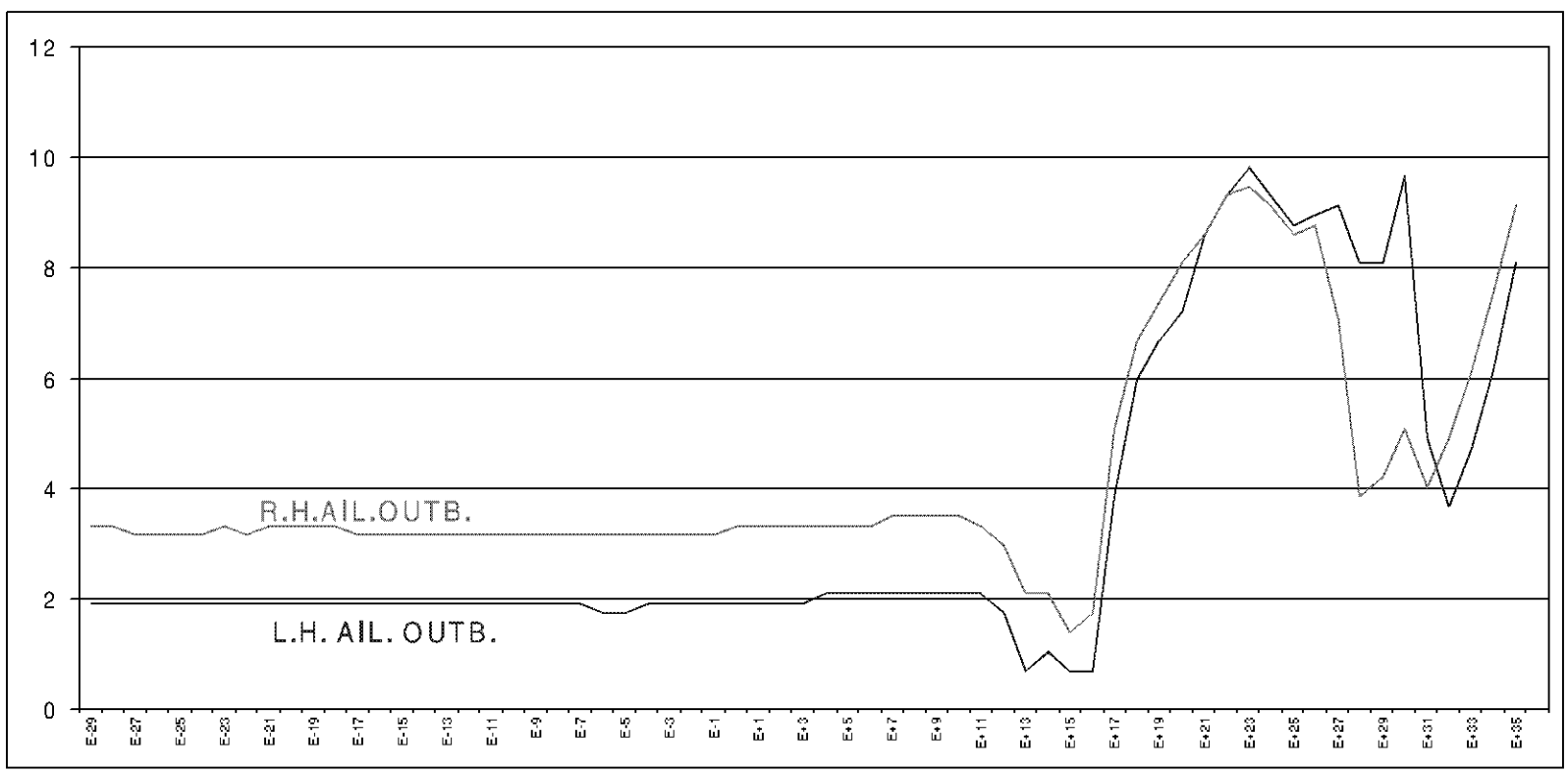
Aileron behavior before and during the dive:

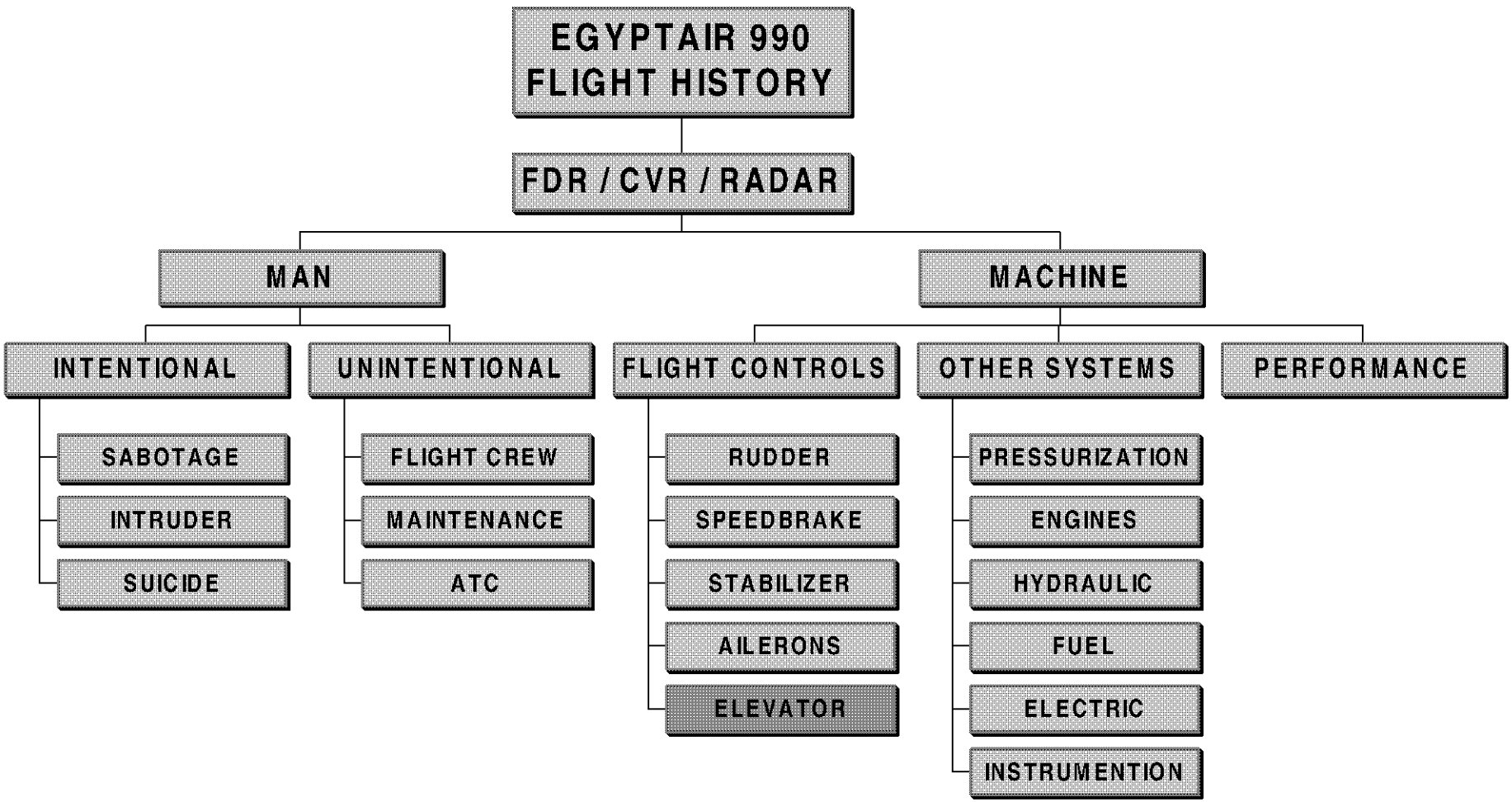
Outboard Ailerons:

Both ailerons showed slight movements before the dive

Both outboard ailerons(which are supposed to be locked during flight) moved significantly upward and then differentially(similar to what happened with the elevators).

Upward movement of the outboard ailerons would result in significant pitch down movement (acting as speed brakes)

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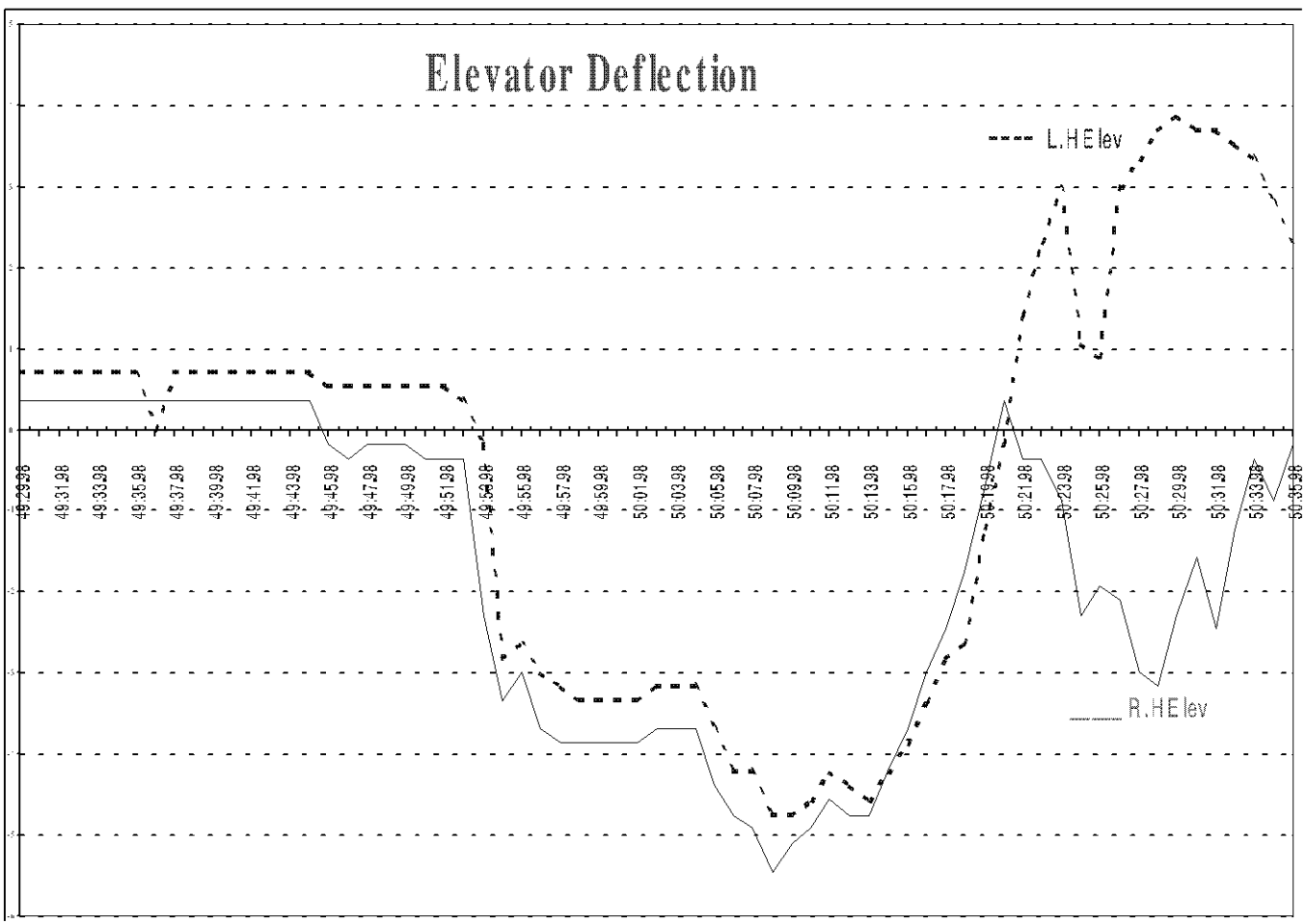
Elevator control

- The Objective of the presentation is to
  - Present evidence of possible elevator failure which is consistent with the accident data

Elevator behavior before and during the dive:
The right elevator showed a sudden movement of 0.5 degree down at 6:48:30 UTC for one second
The left elevator showed a sudden movement of 0.8 degree down at 6:49:37 UTC for one second
Elevator surfaces started down deflection at 6:49:53 UTC, causing A/C pitch down and dive.
Elevators started moving up towards neutral position to recover the A/C from the dive at 6:50:09 UTC
Elevators moved differentially(Elevators Split) at 6:50:21 UTC for about 3 seconds, then the left elevator started to follow the right elevator followed by another split for 3 seconds, then both elevators started to move towards the neutral position.



Failures resulting in initial elevators down movement:

Studies revealed that the failures which might lead to the events are:

- Dual PCA valve jam on one elevator
- Dual PCA valve disconnect on one elevator
- Combined PCA valve disconnect, valve jam on one elevator

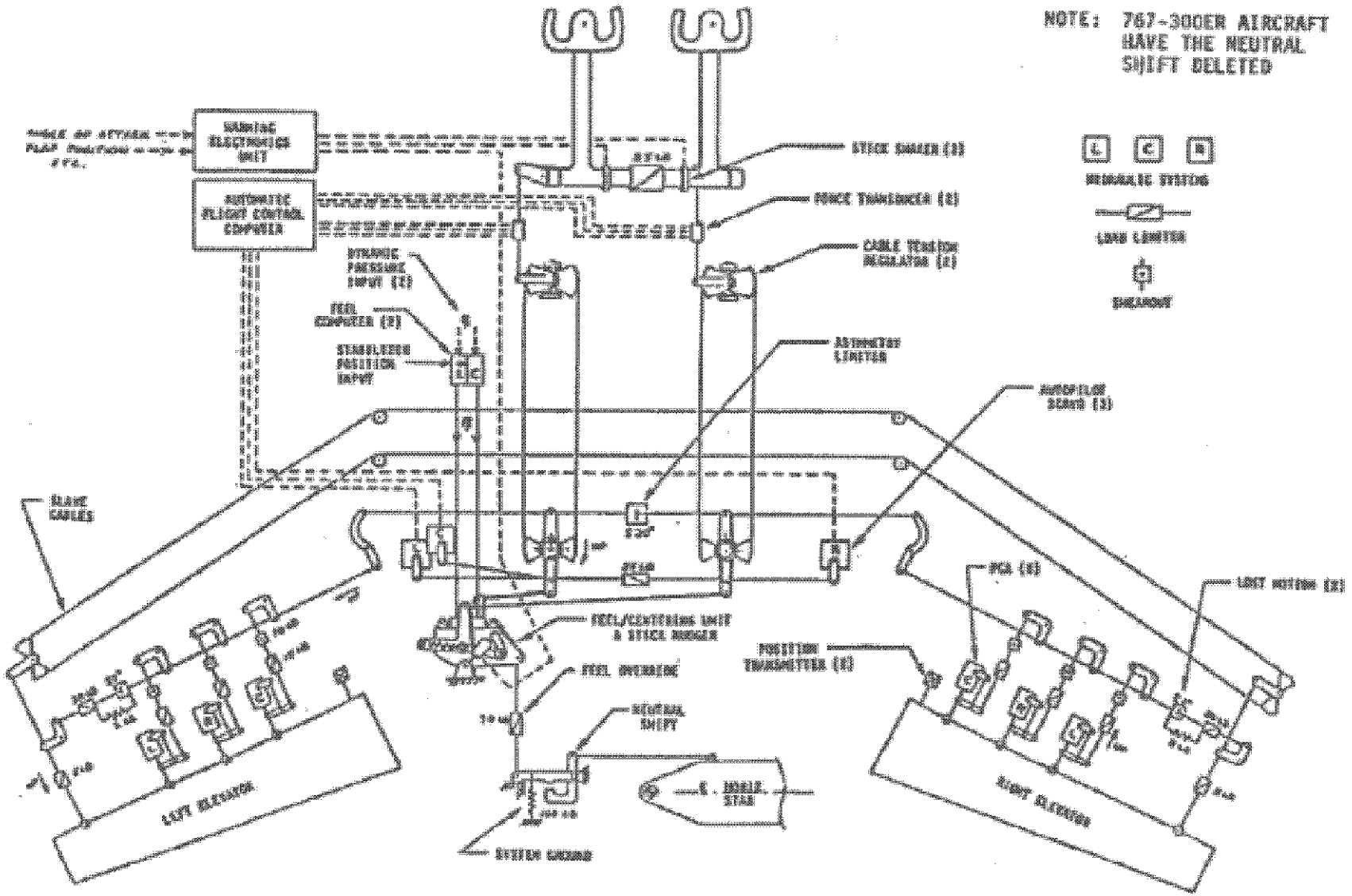


Figure 3.1-3. Elevator Control Schematic

Failures resulting in initial elevators down movement:

Thorough study of these failure scenario is being made, study is supported by the following:

*System/Analytical analysis

*Ground test on a Boeing 767-400 Aircraft

*Simulator demonstration

*Wreckage Examination, Analysis

Elevator dual failures was supported by Boeing letters references:

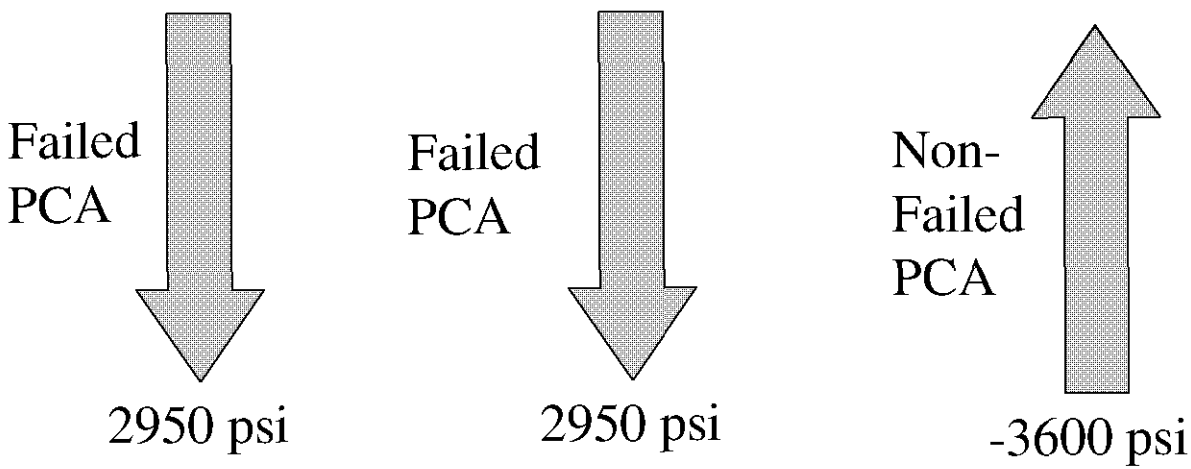
B-H200-16837-ASI-R1, 02 December 1999

B-H200-16854-ASI, 18 December 1999

B-H200-16882-ASI, 08 February 2000

Dual PCA Failure on one side
PCA operation on the failed side

In all cases of dual PCA failure on one side(either jamming, disconnect or combined jam and disconnect), the two failed PCA's will be fighting against the non failed PCA
Normal system press is 3000 psi, system return press 50 psi, non failed PCA relief press is 3600 psi



The effective force acting on the elevator is
(2950 psi + 2950 psi - 3600 psi) * PCA area
= 2300 psi * area = 0.77 PCA

Dual PCA failure;

I- Dual PCA valve linkage disconnect failure(right elevator):

L.H. Elevator does not show any movement

Force on the elevator column does not change

R.H. elevator moves to the full hard over down position

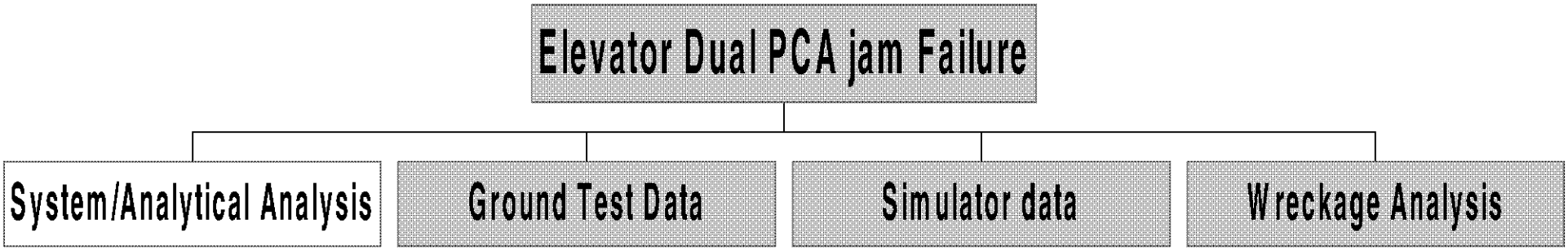
II- Combined PCA valve disconnect, PCA jammed(right elevator):

L.H. Elevator shows slight downward movement

Force on the elevator column is 15 lb higher than normal

R.H. elevator moves to the full hard over down position

III- Dual PCA valve jam failure(right elevator):



Results of dual PCA jam failure summary(right elevator)::

-R.H elevator moves hard over down without any control from either Captain or F/O column, deflection is dependent only on speed, deflection decreases with increasing Mach no.

-Control columns are pushed forward with 30 lb force, accordingly L.H. Elevator moves down

-L.H. elevator is controllable from the L.H. column at a force 30 lb higher than the normal force at this speed

-L.H. Elevator is controllable from the R.H. column at a force 30 lb higher than the normal force at this speed, until column force reaches 100 lb. At this point the two columns are disconnected, the F/O will have no control on the L.H. Elevator

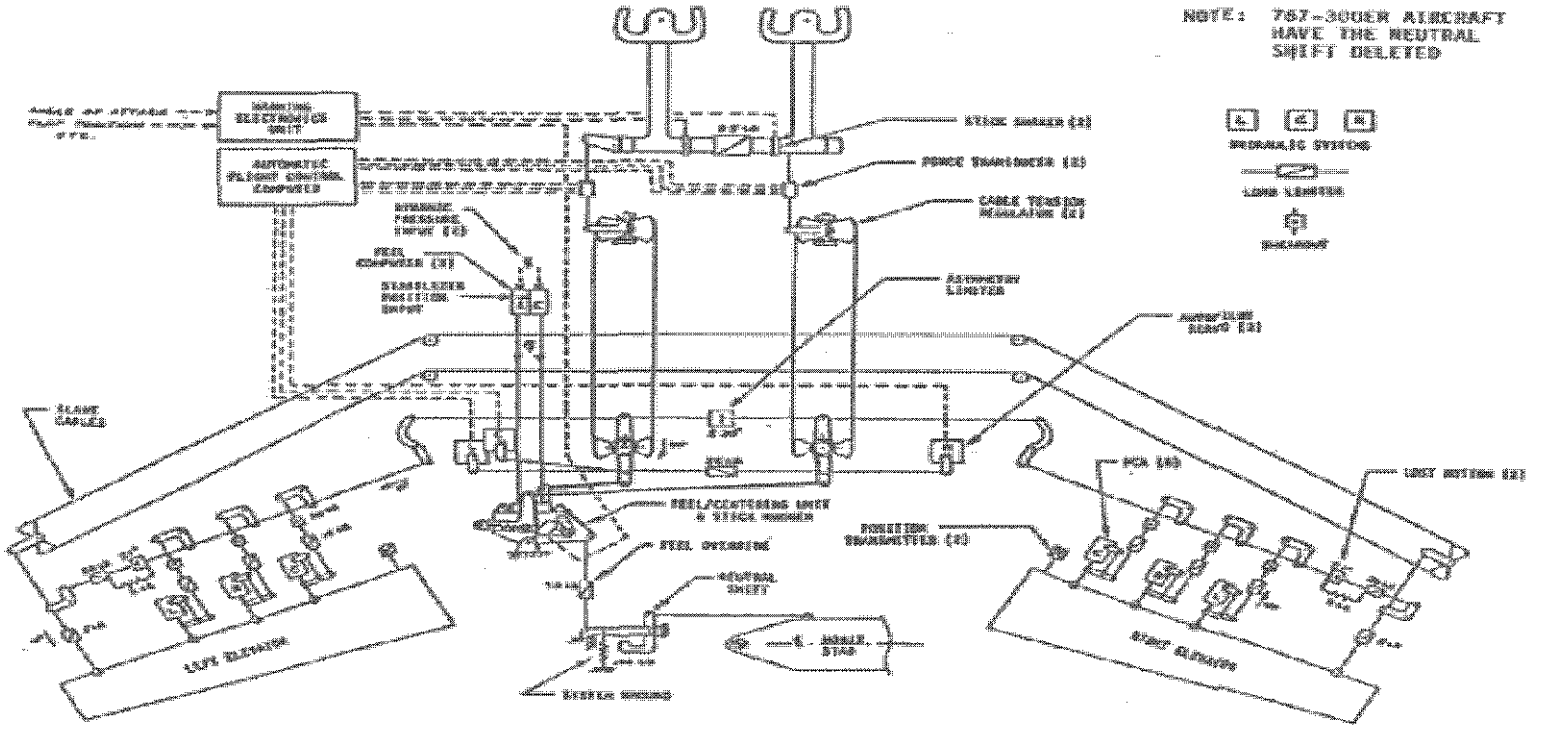
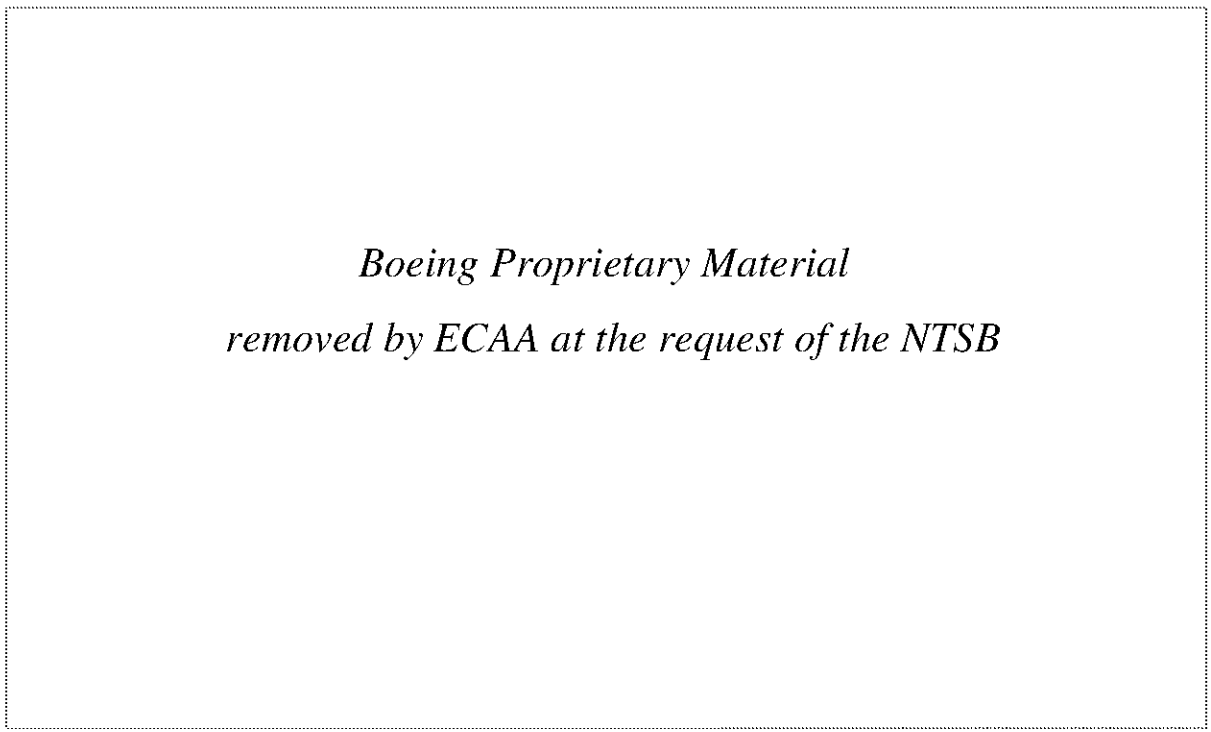


Figure 3.1-3. Elevator Control Schematic

Analysis to calculate the L.H and R.H elevator deflections as the result of dual PCA jam failure (right elevator) was done by three means:

1- Using Boeing charts for elevator blowdown against Mach, altitude and stabilizer position (system group)



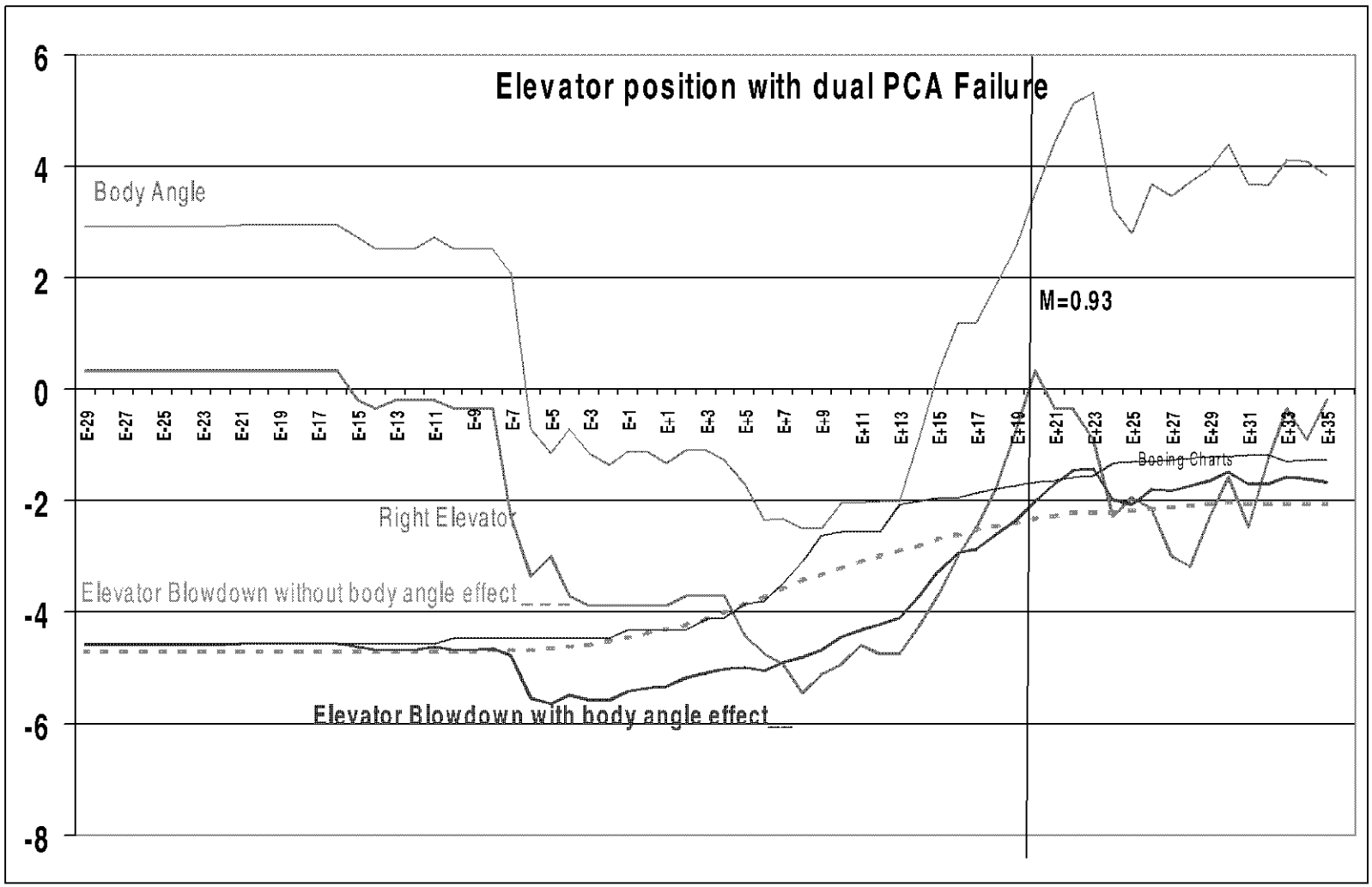
2- using Boeing analytical algorithm for elevator hinge moment(Performance group)

3- using Boeing analytical algorithm for elevator hinge moment considering the effect of the body angle variation (Performance group)

Right elevator

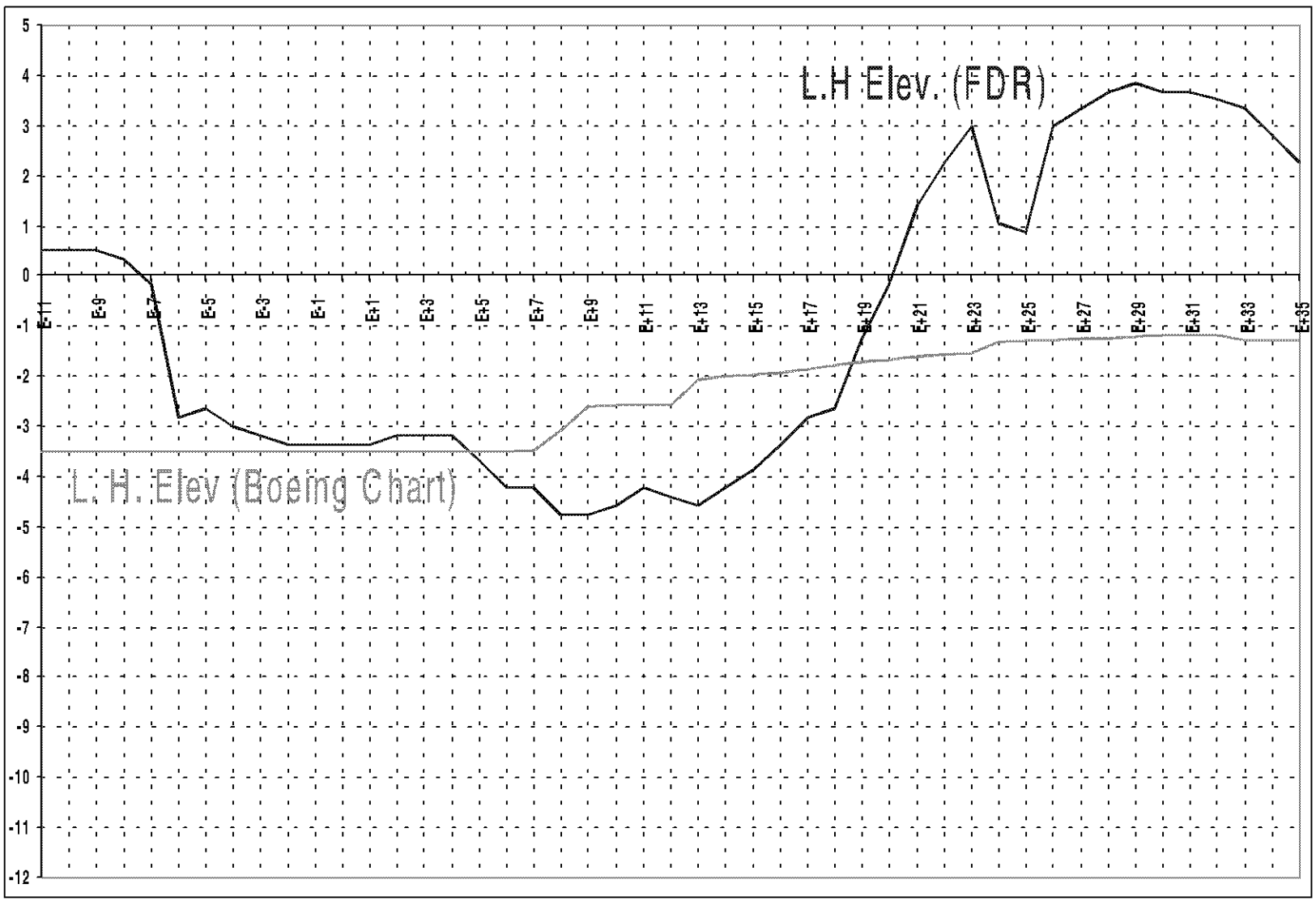
-The results obtained by the three means are not similar and lies within a band of a thickness reaching about 2 degrees

-This band is very close to R.H elevator deflection as shown by FDR data



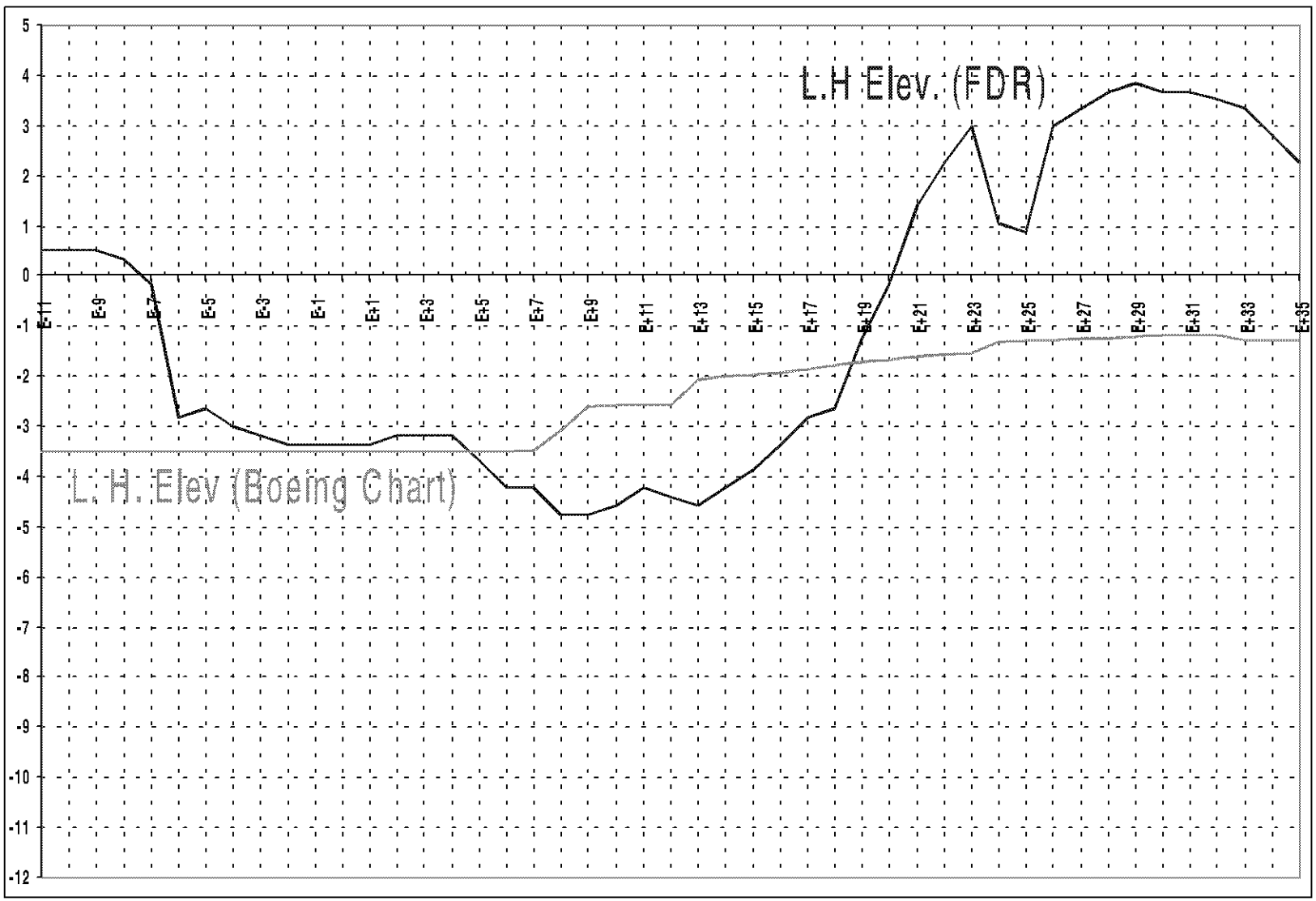
L. H. Elevator

Analysis results as obtained from Boeing Force vs deflection Chart, considering effect of Mach no increase



L. H. Elevator

Note: The left elevator is still under control, pulling the control column aft will result in elevator upward movement



Conditions during the dive:

- During the dive, the A/C exceeded the maximum A/C operating speed(0.86), and the critical Mach no.
- Mach No reached about 0.94 based on FDR speed data.
- Based on FDR acceleration data, the computed Mach No reached values above 0.98
- Characteristic data of the A/C above 0.91 is not available in any of the Boeing documents, all data above this Mach is extrapolated, and considered unreliable and uncertain.
- Ref. to B767 P.E.M. , the Airplane was severely suffering from buffeting, at the A/P Mach No and load factor
- At high Mach No, shock waves are expected to form at several locations, changing the airplane performance dramatically. Control surface capability will be much changed and reduced.

Conditions during the dive:(continued)

- At high Mach no's and high maneuver, the Airplane is subjected to very high loads which may cause structural disintegration
- During the dive, at almost the max Mach no, the elevators and ailerons surfaces showed split operation

taking into consideration that the A/C was flying :

- near sonic speed

- at high airplane body angles

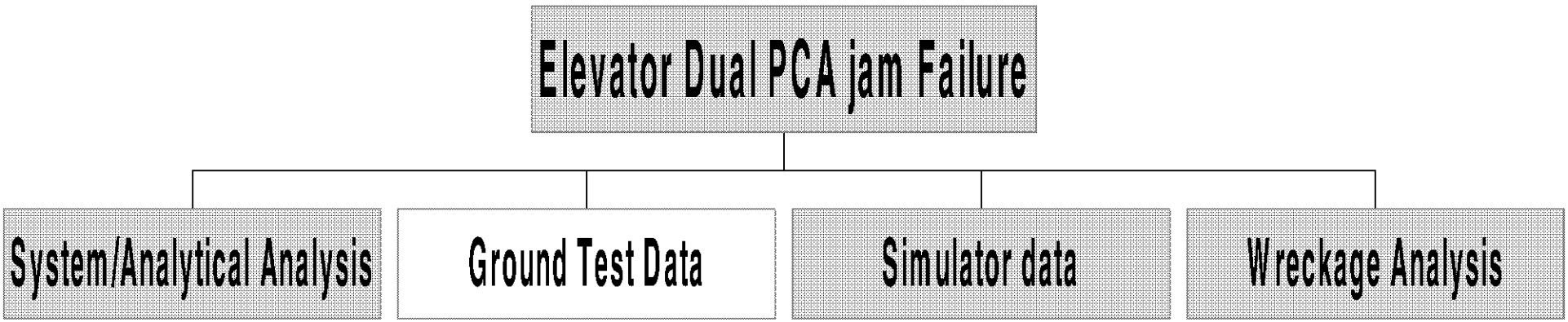
- at high acceleration and load factors

- at severe buffeting condition

under this circumstances flight control flutter would be expected

System/Analytical Analysis Conclusion:

- L.H, R.H. elevator deflection as the result of right elevator dual PCA jam failure is consistent with the FDR data where Boeing data is valid
- In the area beyond the normal airplane design envelop where the the data is not valid, all the flight control behavior is uncertain,control surfaces are subjected to flutter


Elevator Dual PCA jam Failure
System/Analytical Analysis
Ground Test Data
Simulator data
Wreckage Analysis

Overall Objectives:

- To validate the analytical predictions of the effects of elevator failures.
- To evaluate the acceptability of airplane control following the elevator failures

Preliminary results:

I.a- Single PCA jam failure(right elevator):

Upon introducing the jam failure, following has been noted:

-Left and right columns moved forward (as indicated by columns position indicators), movement was almost not visually noticeable

-Left elevator moved down

-Right elevator moved down.

-After overcoming pogo additional force and the elevator feel force, left Elevator was controllable from Captain column side. Force required was higher than normal.

- After overcoming pogo additional force and the elevator feel force, left Elevator was controllable from F/O column side. Force required was higher than normal.

- The columns were moved in both directions and released several times, each time, the L.H. elevator deflection indicator showed different elevator angles

- **With Auto Pilot engaged, neither the elevator columns nor the elevators surfaces have moved, i.e. this failure is latent with Auto Pilot engaged**

Preliminary results:(continued)

I.b- Dual PCA jam failure(right elevator):

Upon introducing the failure, following has been noted:

-Left and right columns moved forward (as indicated by columns position indicators), movement was almost not visually noticeable

-Left elevator moved down

-Right elevator moved hard over down.

-Right elevator stayed in the full down position without any possible control

-After overcoming pogos additional force and the elevator feel force, left Elevator was controllable from Captain column side. Force required was significantly higher than normal. At high force (about 100 lb) the two elevator columns were disconnected

• After overcoming pogo additional force and the elevator feel force, left Elevator was controllable from F/O column side. Force required was significantly higher than normal. At high force (about 100 lb) the two columns were disconnected, after that no further control was possible from the F/O side

- Columns disconnect was quite smooth and not noticeable

- Stabilizer electrical trim was not available after inserting the failure, control became available only when the columns were pulled sufficiently aft

- The columns were moved in both directions and released several times, each time, the L.H. elevator deflection indicator showed different elevator angles

Preliminary results:(continued)

II- Dual PCA valve linkage disconnect failure (right elevator):

L.H. Elevator did not show any movement

Forces in the elevator column did not significantly changed

R.H. elevator moved to the full hard over down position

III- Combined PCA valve disconnect, PCA jammed (right elevator):

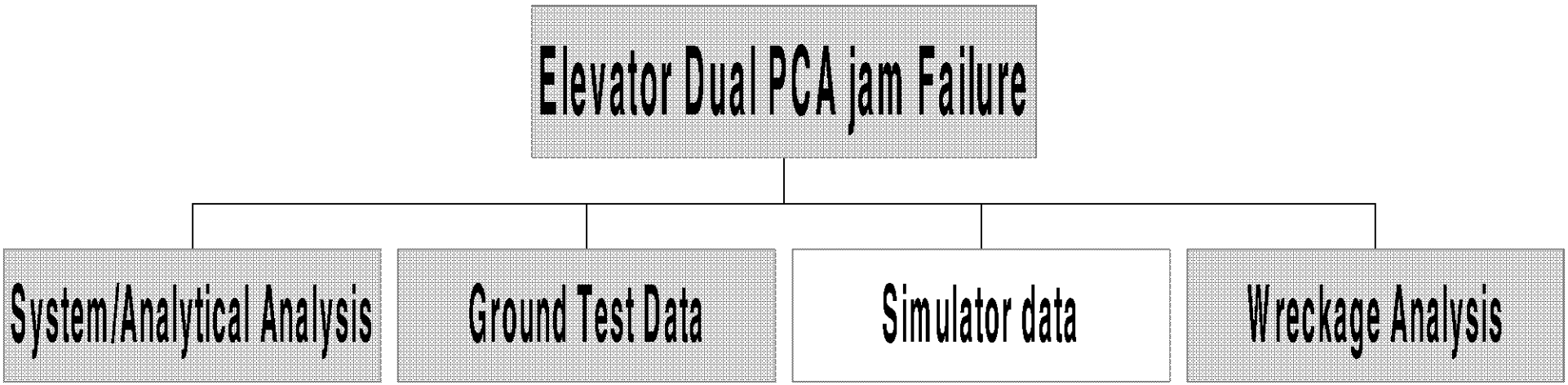
L.H. Elevator showed slight downward movement

Forces in the elevator column was higher than normal

R.H. elevator moved to the full hard over down position

Ground test preliminary Conclusion:

- Initial L.H., R.H. elevator movement as the result of the dual PCA jam failure validates the system analysis


Elevator Dual PCA jam Failure
System/Analytical Analysis
Ground Test Data
Simulator data
Wreckage Analysis

Simulator Cab demonstration

Overall Objectives:

1-Background Simulation(to determine the control inputs required to drive events)

2-Backdrive simulation with and without pilot interaction to evaluate human performance synchronized CVR/FDR

3-Backdrive "split Elevator" simulations to:

-Provide a replay of the flight deck instruments and controls with and without the CVR (No pilot intervention)

-Experience the timing of events, control force levels with split elevators, and sounds on the flight deck

-Allow the pilot to take control of the A/C during the elevator split and experience the workload and control forces required. The pilot is able to control the column, wheel and stabilizer.

4- Witness & Attempt to recover from Dual PCA Failures:

- Dual Control Valve Jam

- Dual Linkage Failure

- Combination of dual and disconnect PCA

(at different timings after insertion the failure)

Preliminary results:

Elevator failures:

-In all cases of elevator failures and elevator split, the airplane was recoverable, either from the Captain or F/O side. Recovery was possible just after inserting the failure; 5 , 10, 20 seconds after inserting the failure and at an altitude of 24000 ft.

Preliminary results:

Elevator failures:(continued)

With dual PCA jam failure, the resultant elevator surface deflections were consistent with the FDR data

Boeing Proprietary Material

removed by ECAA at the request of the NTSB

Preliminary results:

Elevator failures:(continued)

*With the right elevator surface maintained at 6 degree (T.E. down) throughout the dive, the airplane was recoverable from the left column even when recovery started after -40 degree airplane pitch. (engines were shut down, speedbrakes deployed)

*Pulling force at either sides of elevator columns can not be maintained at the same level when moving the speedbrake levers or the engines controls, consequently the pitch can not be maintained

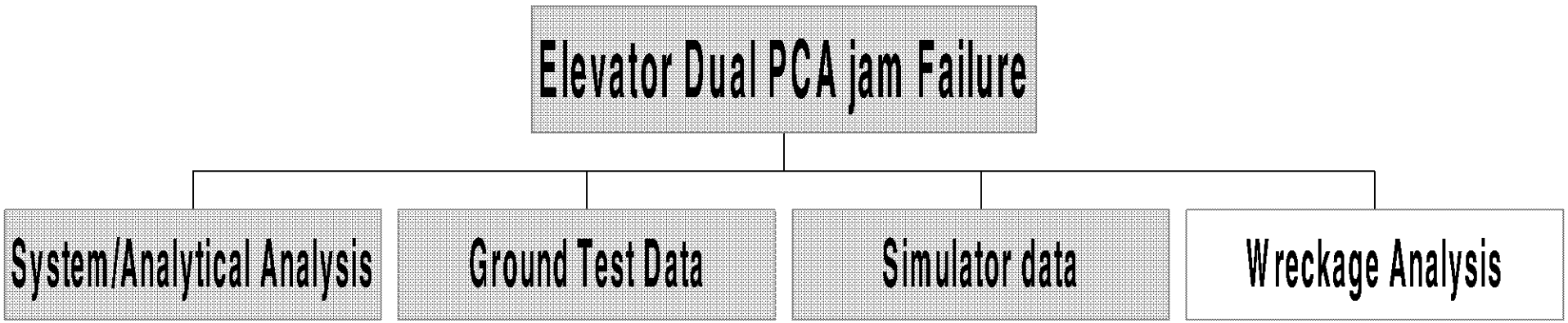
*It was possible to use stabilizer to assist in airplane trim, as long as the elevator column is used in the same direction with the stabilizer

*It is not possible for the F/O to deploy the speed brake while pushing or pulling

*The forces needed to split the elevators was higher on the test airplane compared to the forces at the simulator

Simulation demonstration conclusion:

- Preliminary results show that with elevator dual PCA jam failure, resulting elevator deflection is consistent with the FDR data
- The A/C was recoverable under all conditions


Elevator Dual PCA jam Failure
System/Analytical Analysis
Ground Test Data
Simulator data
Wreckage Analysis

Wreckage analysis:

Recovered elevator PCA's were examined at the Boeing facility, following is the preliminary findings:

- The internal slide spring cap was found separated from the slide in the servo valve for the right elevator outboard PCA through the rolled rivet. This was the only servo valve in which this cap was found separated.
- The right elevator outboard and center PCA bell crank linkage were sheared as if the bell crank arms were moving to a lower relative angle, while the other three bell cranks (the inboard of the right elevator and two of the left elevator) were sheared as if the bell crank arms were moving to a higher relative angle.

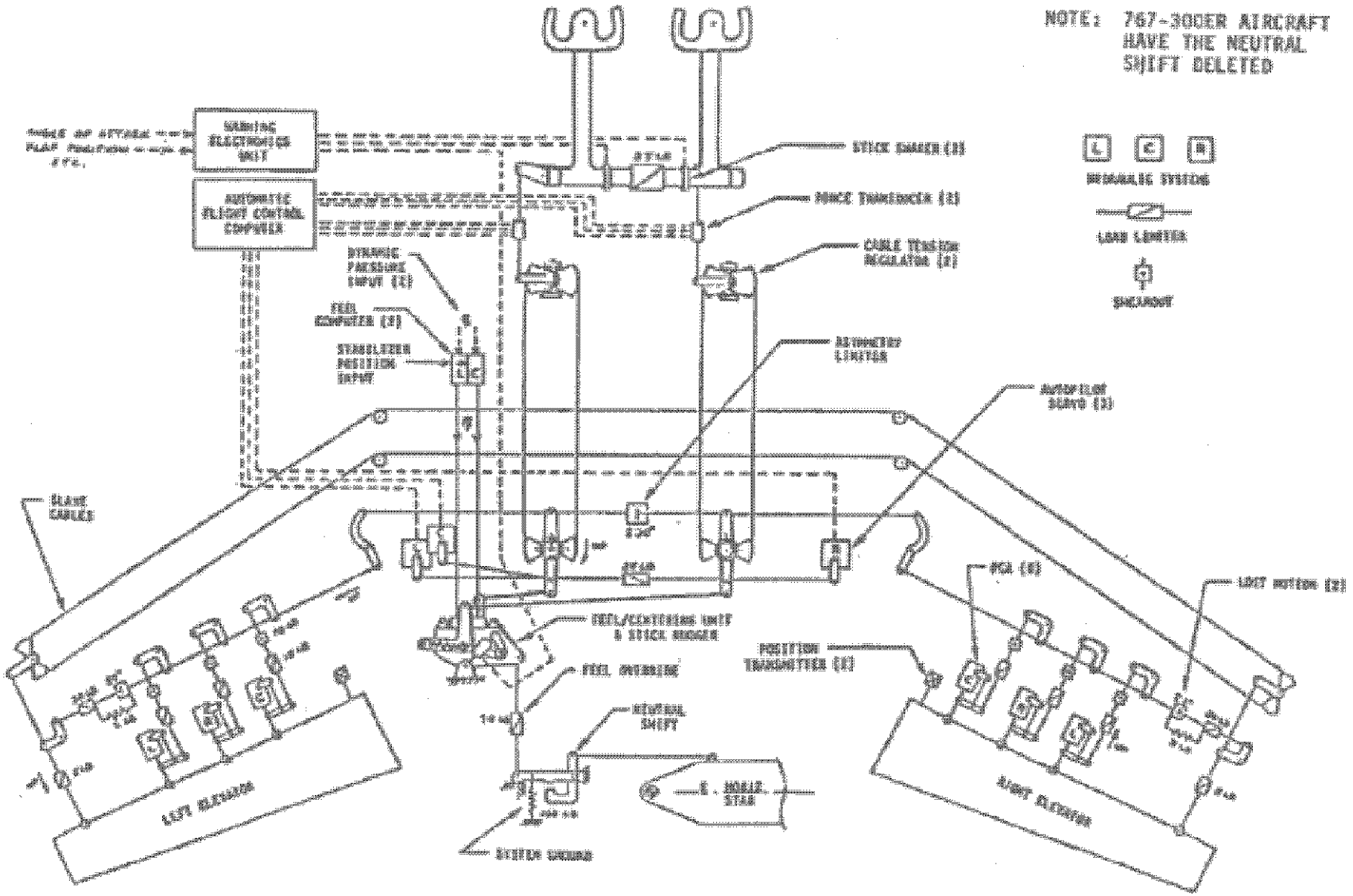


Figure 3.1-3. Elevator Control Schematic

Wreckage analysis conclusion

- The right elevator middle and outboard bell crank rivets shear direction is consistent with a jammed PCA reacting against pilot input to move the elevator up.
- At this time we are unsure of the meaning of the bell crank shears and may not be able to rule out that they were produced during the separation of the elevator components.

Elevator Analysis Conclusion

Elevator PCA dual failure is consistent with FDR data

Flight Safety Issue

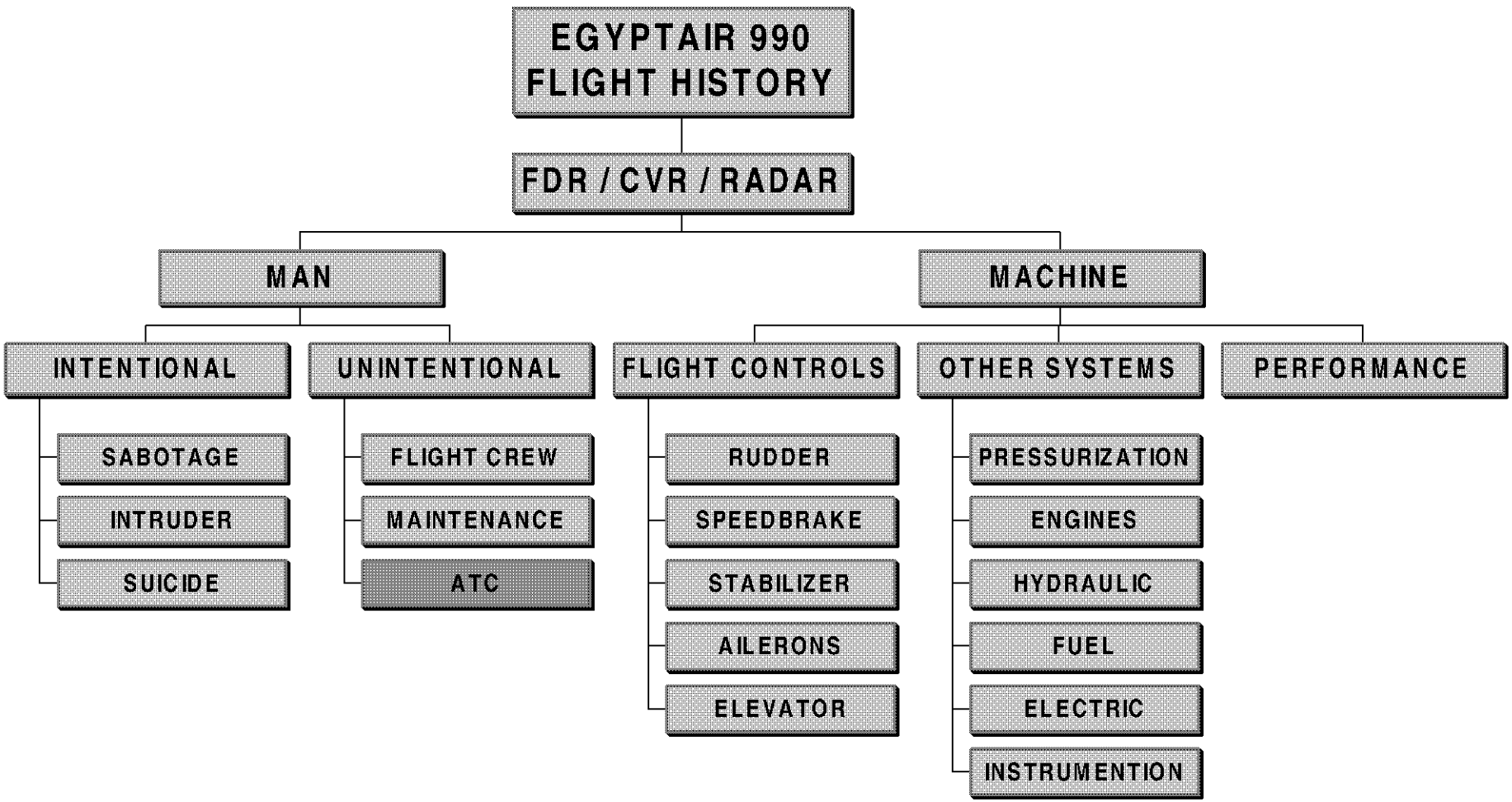
Flight safety issue:

As a result of what we have seen on the simulator and the safety concerns we have discussed, the Egyptian Civil Aviation Authority recommends the Federal Aviation Administration to take the following action:

- Require a cockpit indication in the Boeing 767 that will alert the flight crew to a condition of abnormal PCA operation where in a single fault in the elevator could result in uncommanded elevator movement. Until such a cockpit indication is installed require operators of B767 airplanes to perform daily check of the elevator system as now performed in the 400 hr inspection to isolate faults in the elevator system
- Review the B767 elevator control system design and conduct further examination of the causes of the reported discrepancies found in the elevator actuator bell crank, and
- In conjunction with the Boeing Company develops cockpit crew procedure that will aid the crew during flight in identifying, isolating and negating an uncommanded elevator hard over condition

Conclusion

Elevator control system PCA jam presents flight safety issue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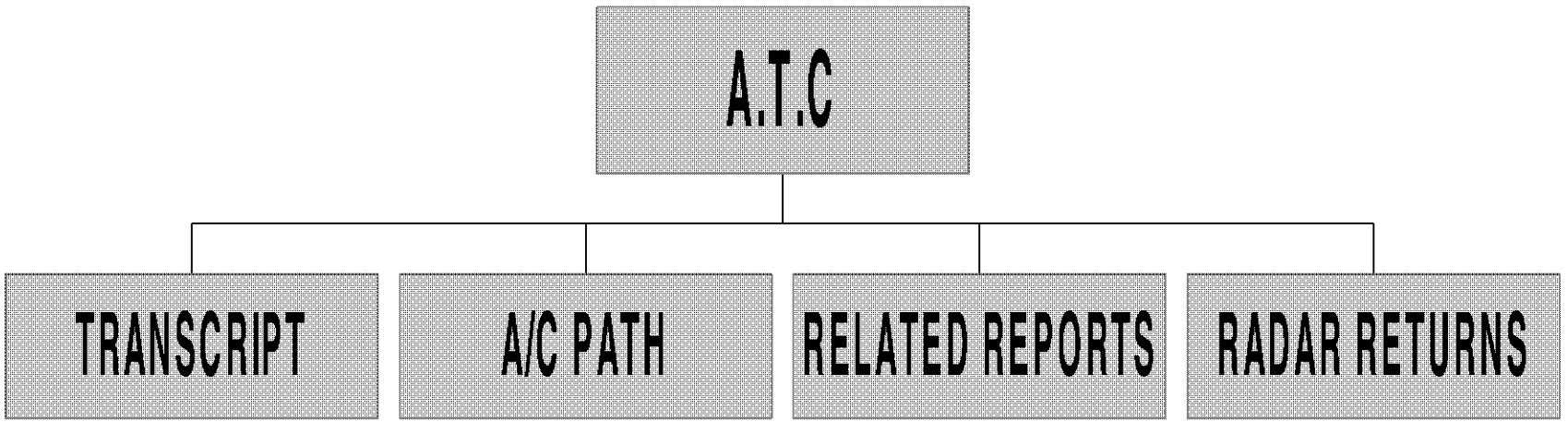

A.T.C
TRANSCRIPT
A/C PATH
RELATED REPORTS
RADAR RETURNS

ATC Analysis

- The following presentation is intended to present ATC information which may lead to a

  deliberate act by one of the pilots

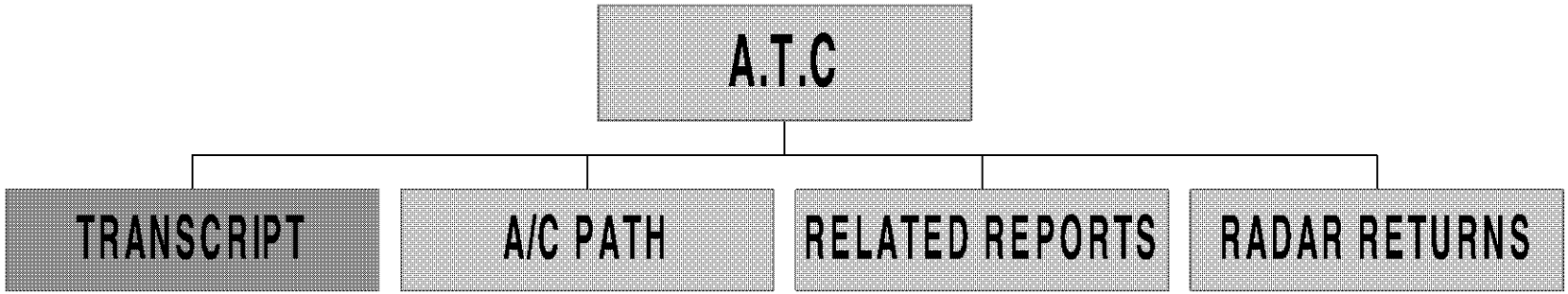
- The analysis is supported by:

  Transcript

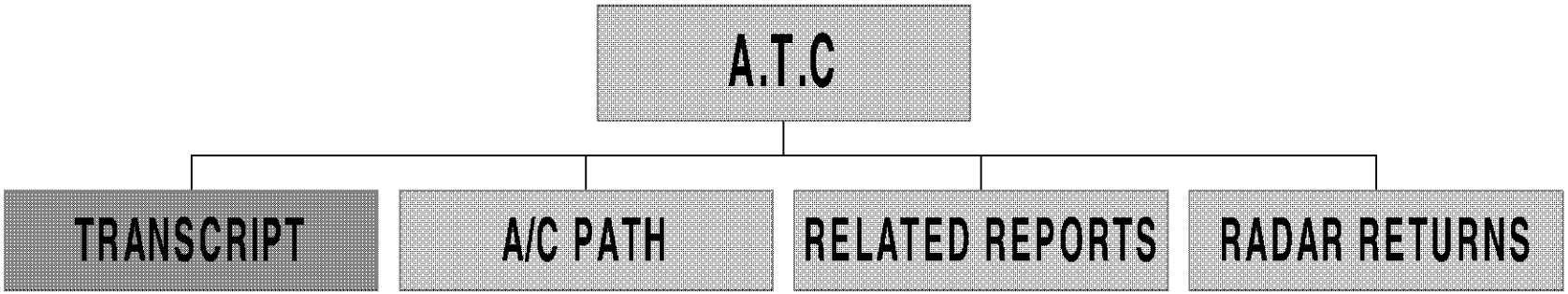
  A/C path

  Related reports

  Radar returns



The following information will show that the controllers responsible for the 990 flight did not have the aircraft's flight plan and suggests that the military also did not know the intended flight plan even so, flight plan 990 was proceding through a military zone.



ATC transcript:

ATC transcript showed that the MS990 was not properly tracked during the critical flight phase 06:47:33 UTC (last communication) until 06:54:00 UTC (disappearance from radar screen)

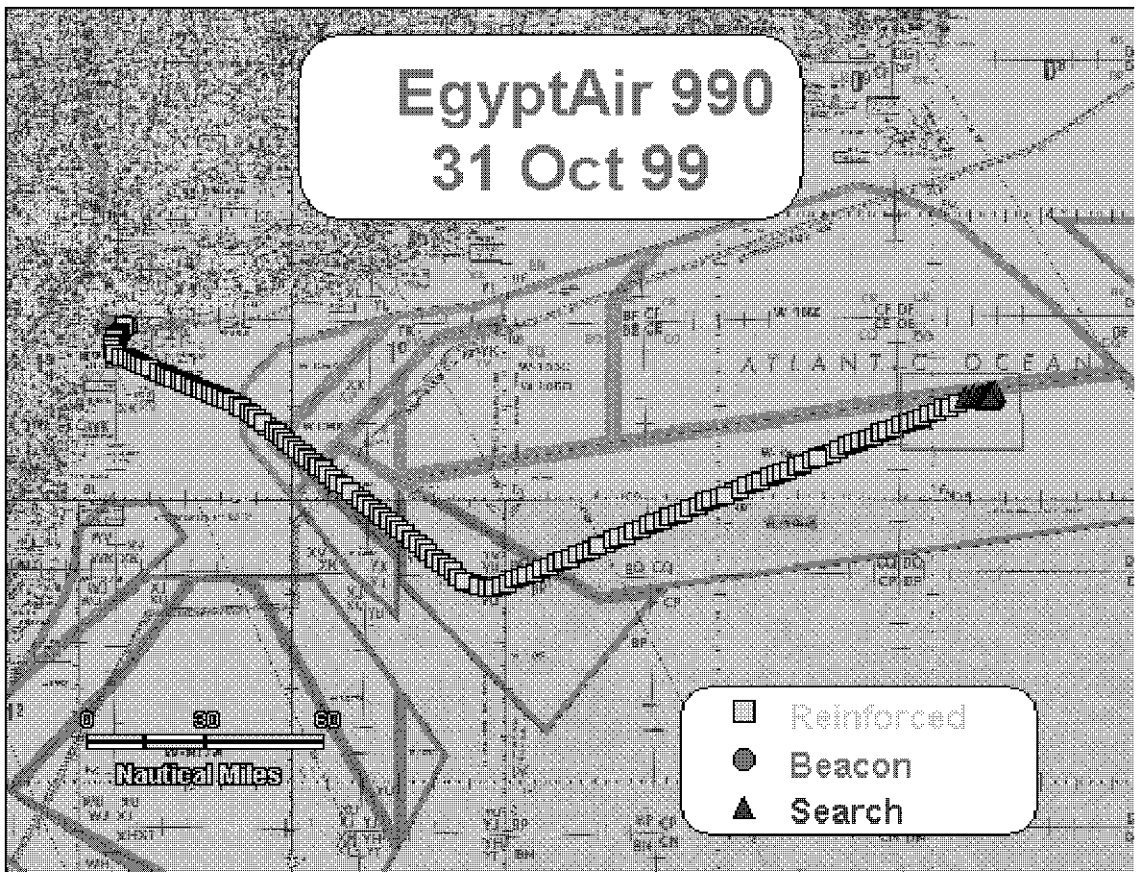
(Following is a sample from ATC transcript)

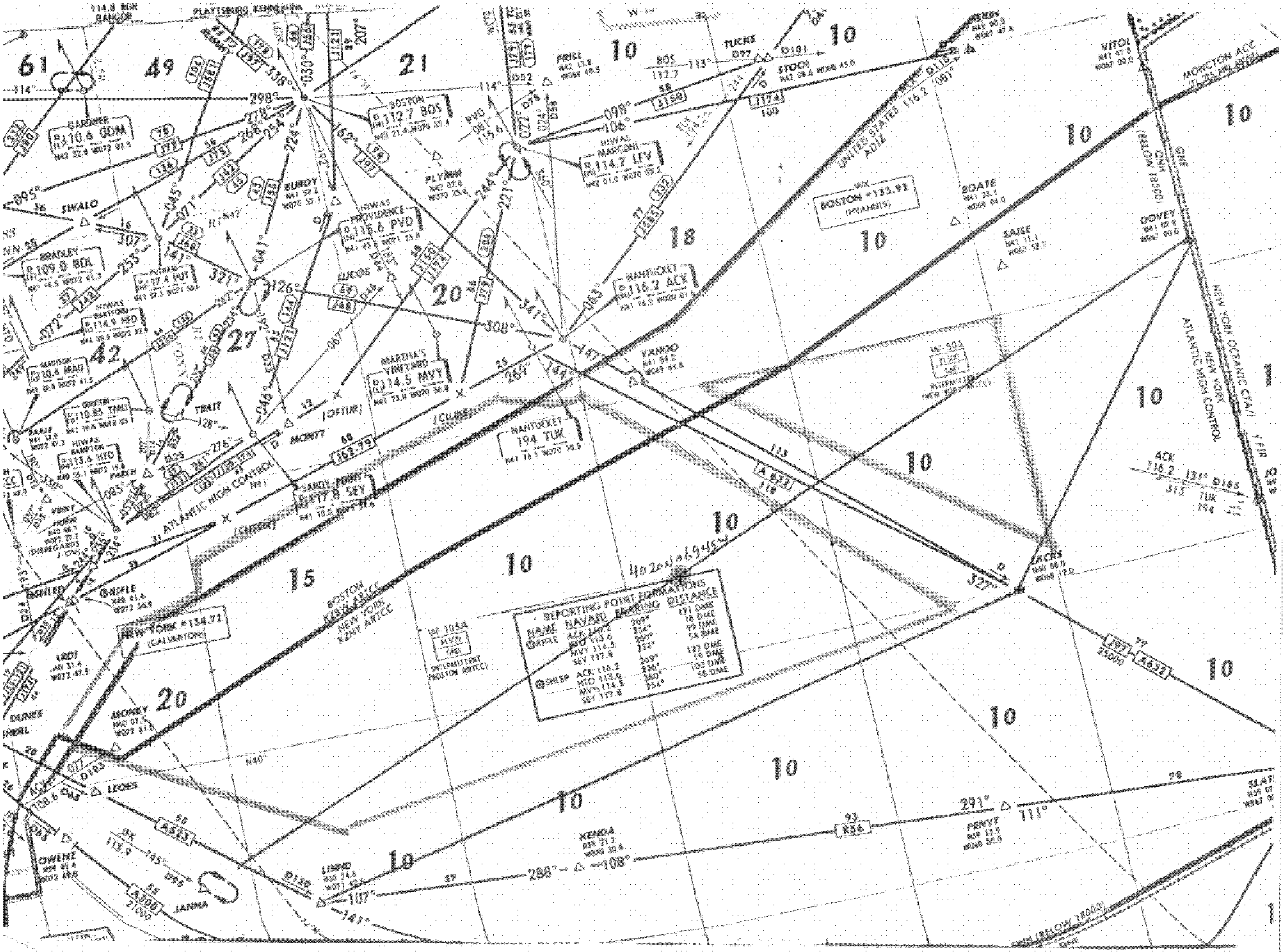
ATC transcript

0624:46	N90	(unintelligible) kennedy manual handoff egypt air nine ninety
0624:58	ZNY	doesnt anybody know over at the tower that they gotta put these flight plans back in
0625		
0625:01	N90	its just disgusting
0625:03	ZNY	uh let me see if they put anything in i maybe just didnt get the paper hang on I see him coming keep him coming
0625:10	N90	wilco
0625:11	ZNY	lets see you can go to twenty three with him too
0625:13	N90	twenty three
0625:14	ZNY	yeah uh and let me see if there is anything in here of course not uh i don't have all of his routing either oh thats wonderful
0625:23	N90	shipp linnd lacks dovey natz santiago s t g and hes going to cairo h e c a
0625:33	ZNY	o k cairo and what code do you have him on
0625:36	N90	seventeen twelve
0625:38	ZNY	o k let me start a track track pick this new equipment i dont even know how to do this stuff enter there he is o k interim two three oh do you know what he wants for a final
0625:50	N90	i got thirty three thousand
0625:52	ZNY	o k uh hes radar contact and uh yeah just go to twenty three
0626:00	N90	o k wilco
0626:01	ZNY	all right thanks

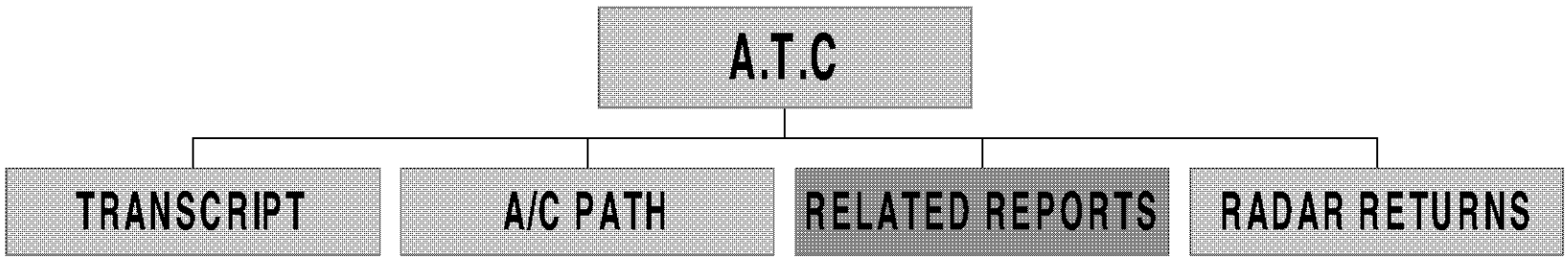
A.T.C

TRANSCRIPT | A/C PATH | RELATED REPORTS | RADAR RETURNS





BOSTON 112.7 BOS
PROVIDENCE 115.6 PVD
BRADLEY 109.0 BDL
GARDNER 110.6 GDM
MARTHA'S VINEYARD 114.5 MVY
NANTUCKET 116.2 ACK
NANTUCKET 194 TUK
SANDY POINT 117.8 SEY
MARCONI 114.7 LFV
NEW YORK 134.72 (CALVERTON)
BOSTON 133.92
ATLANTIC HIGH CONTROL
BOSTON ARTCC
NEW YORK ARTCC
UNITED STATES ADIZ
NEW YORK OCEANIC CTA/FIR
NEW YORK ATLANTIC HIGH CONTROL
MONCTON ACC
REPORTING POINT FORMATIONS
NAME NAVAID BEARING DISTANCE
RIFLE
SHLEP


A.T.C
TRANSCRIPT
A/C PATH
RELATED REPORTS
RADAR RETURNS

Related Reports

RJ 151126 15 JAN 00

SUB: Pilot report

ATT: Mr. Ismail Dyaa

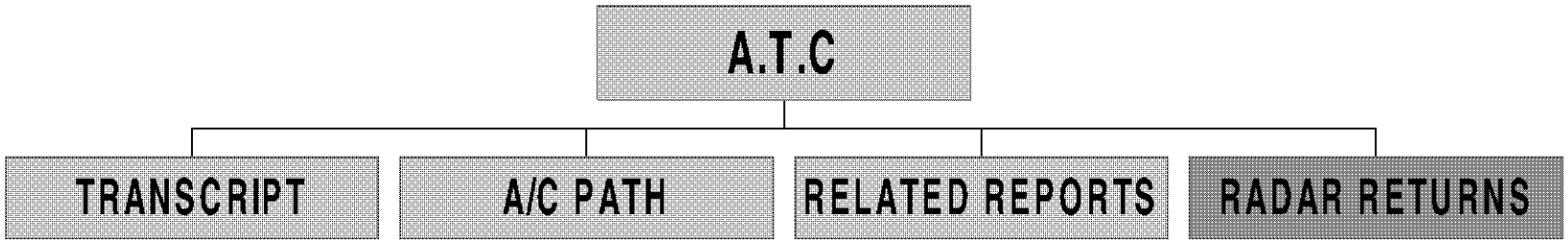
Copy:Pres / CEO

From:Exec. assist Pres. Corp. Safety

Dear Sir, Further to you enquiry, hereunder are the details we have on file regarding the pilot report in question; The Captain of flight RJ262 NYC /AMS on 31st Oct. 1999 telephoned the Corporate Safety Department some two weeks after the flight to report a sighting. He had not reported it to ATC at the time of occurrence as is required and he was asked to file a written report. This he did a week later i.e. 3 weeks after the incident and with not enough detail. He was asked more than once to pass by the Corporate Safety Department with his F/O to pinpoint his exact position at the time of the incident by reference to navigation charts and the flight log he was using, and other details to make his report credible and comprehensive. To date he has not done so. The ASR that was filed with little detail had the following text word by word:

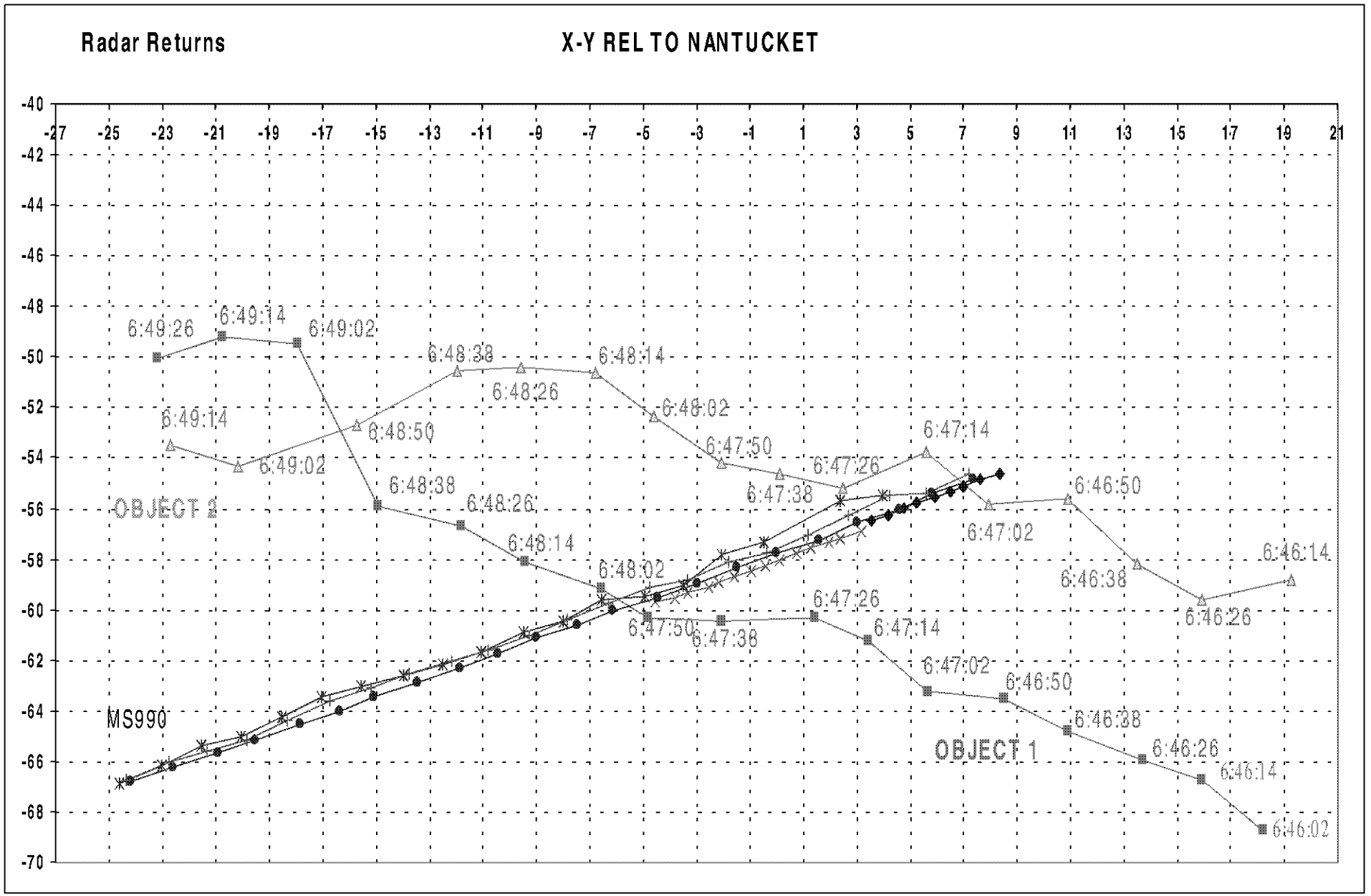
Related Reports (continue)

" Take off from JFK, SID was Happie 2-Yahoo Trans.Whale, Eanancs. After cruising at FL330 with Boston ATC, I was looking head down to the left on NAV.Chart 3,4 Canada to pick some en route airports, suddenly the F/O Shouted "Allah Akbar, Allah Akber, la Ilaha Ella Allah" repeatedly, so I looked at him and asked him (Awad) what happened… he said "Captain I saw a Fire ball like a shooting star passing ahead at us very close from right to left going down…. I said "how far do you think it was passing ahead of us?"… He said "Captain I could say around less than 50 M."…I noticed from the way he was talking and from his look that it was serious, so I said to him "(Awad) do not worry, we have so many good Airports en-route anything happens God's will we will manage". I really do not know what hold me not to report that to ATC, but after Egyptair flight 990 accident in that area which had the SID clearance as we had, I found myself obliged to submit this report to you as it is never too late in improving aviation safety."



- Returns data have been obtained from four radar's stations:
  - ARSR-4 AT Riverhead, NY (RIV)
  - ARSR-4 at Gigsboro, NJ (GIB)
  - ARSR-4 AT North Truro,MA (NOR)
  - ASR9 at Nantucket, MA (ACK)
- Radar data provides two types of returns:
  - Beacon (supported by airplane transponder)
  - Primary (not supported by airplane transponder)

  (Data is classified as reinforced data when both beacon and primary returns data coincide for the same target)


Radar Returns
X-Y REL TO NANTUCKET
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-44
-46
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6:48:38
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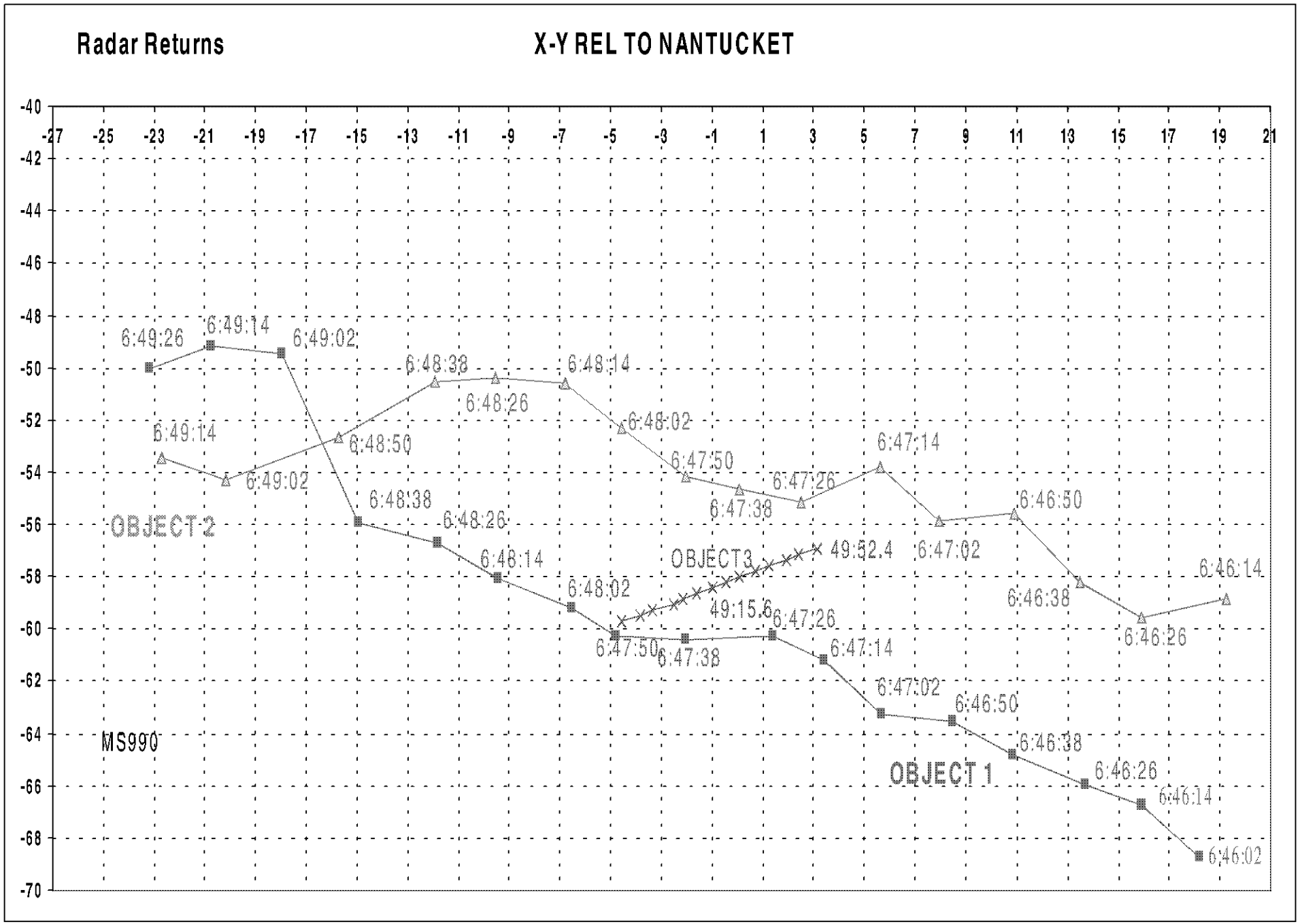
OBJECT 2
OBJECT 1
MS990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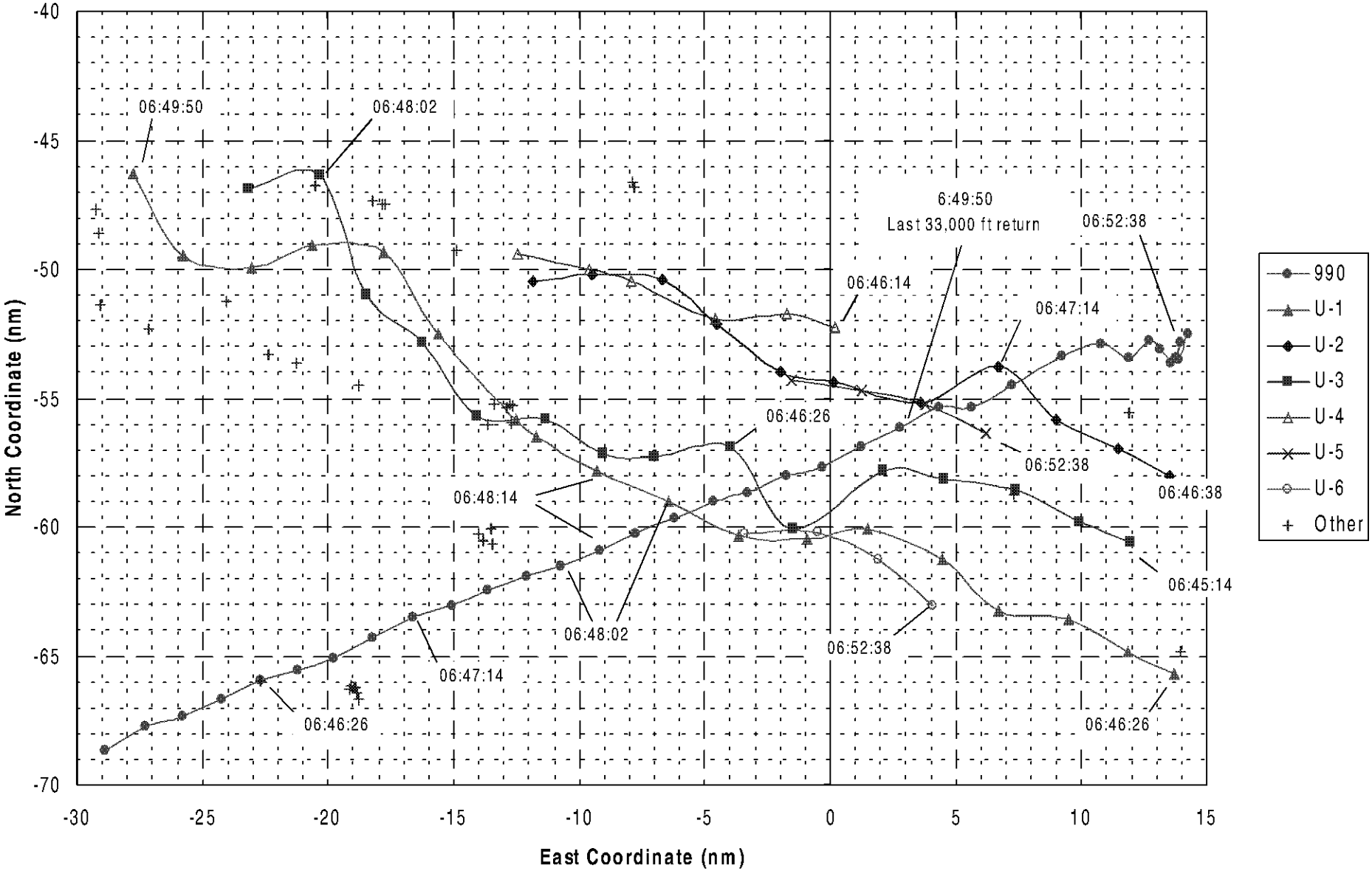
6:47:38
6:47:26
6:47:14
6:47:02
6:46:50
6:46:38
6:46:26
6:46:14
OBJECT 2
OBJECT3
49:52.4
49:15.6
OBJECT 1
MS990

Egypt Air 990
Track Plots



Summary:

- Many of the unidentified returns formed continuous flight paths. These targets were travelling generally from East to West at a high ground speed.
- The altitude of the targets is not identified
- The continuous flight paths of the unidentified returns crossed the path of MS990 several times
- At this time, the only explanation for these returns are :

  1- They are caused by an unknown phenomenon that is unique to that location over the ocean

  Or

  2- They were caused by real airborne objects
- Further information is requested from NTSB to continue the analysis.

ATC Analysis conclusion

- Analysis revealed that there are a lot of returns forming continuous paths crossing the flight path of MS990, which may reflect deliberate evasive action by one of the pilots

Requests not fulfilled yet :

1.Aileron documents (hinge moment of inboard and outboard. ailerons with body angle).

2.Air data computer performance over 412 knots (under study).

3.Performance factual report does not include the aileron study.

4.Simulator/Ground test data received are not in processed form.

5.Post-recovery wreckage inspection factual report of the second recovery process.

6.Elevator components tear down/inspection at Boeing facilities factual report.

7.FDR final factual report.

8.Second Master Caution (under study).

9.An expert to cooperate in the CVR tape study.

10.Sound spectrum group meeting is required to discuss the remarks on the factual report draft.

11.Human performance final study report.

12.Request from P&W the mathematical formula or charts for engine performance at EPR less than 1.00

13.Mathematical formula of the charts to calculate mass of air through engine core.

Requests not fulfilled yet :(Continued)

14.ATC/RADAR task requirements:

a)Letter of agreement between FAA and Military concerning special use of warning areas W 102,W105 and W506(valid for the accident time).

b)The list of the activated warning areas during October, 1999

(Conditions, period of releasing back to FAA).

c)A description of the responsibilities of R 86 A

e)Multi radar coverage charts for New York and Boston centers at FL 50,100,200&300 feet.

d)Multi radar tracking mosaic and clutter and interference study for radar sites.

e)The configuration of the ZNY ATC system, including radar and flight data processors, radar and voice data recorder voice communication switching system and the relevant radar sites.

f)The last flight check reports for the relevant radar sites.

g)Antenna radiation pattern for ASR 9 and ARSR's

h)Sufficient technical data to make analysis for the interference

affecting RIV radar.

Conclusion:

- The investigation to date confirms that the First Officer did not commit suicide and murder
- Elevator control system failure scenario shows consistency with FDR data.
- Elevator control system (PCA jam) presents a “Flight Safety Issue”.
- Remaining deliberate act may be attributed to an evasive action. More radar data needed to verify this scenario.