Du Pont G-II N204C Crash

Roger K. Parsons

Seagull Publishing
303 Briarpark Drive
Houston, Texas 77042

ISNB 0-000-000000-0

ABCDEFGHIJ-DO-93

Table of Contents

CHAPTER 1

Ground Track

The following analysis is based on the cockpit voice recorder (CVR) recording from the aircraft and the transcript of ATC recording. The aircraft heading at first impact was determined in the survey of tree-cut geometry at the location of first impact. Ground elevation along the aircraft ground track was determined using the 1:250,000 Joint Operations Chart (Series 1501, Sheet NB 50 - 10, Edition 2-GSGS). Magnetic variation for the region in 1991, per the Tactical Pilotage Chart (Series TPC, Sheet L-11B, Edition 4-GSGS, Scale 1:500,000), was less than 1' W; therefore, within the precision of the VOR and the magnetic compass instrumentation on the aircraft, magnetic north and true north are equivalent.

Events (e.g. "Event132") referenced in this chapter are cataloged in **Table1** and are referred to by the name assigned in that table.

Assumptions

On the Tactical Pilotage Chart the first impact point is on a 4000 f elevation contour at 30.9 nmi south and 2.9 nmi west of the VJN VOR/DME. The first impact point determined by the calculations presented in this chapter is 31.3 nmi south and 2.9 nmi west of the VJN VOR/DME. The 0.4 nmi error here is within the precision of the DME instrumentation used on the aircraft. The correctness of the assumptions made in the analysis is confirmed by the accuracy of this prediction of the first impact point.

Assumption 1.1
The pilots maintained a course 205^{o} after passing the VOR. At the time of Event132 the pilots established a heading 180^{o}.

Assumption 1.2
The pilots established a constant rate turn to the right at Event189. The turn rate is calculated assuming an aircraft heading 180^{o} before the turn was initiated and a heading 210^{o} on first impact.

Assumption 1.3
The pilots established a constant rate climb at Event190 just prior to first impact. The average climb rate between Event189 and Event192 is calculated using the aircraft altitude at Event189, just before the climb is initiated; the aircraft altitude at first impact, determined in the survey of the crash site; and the lapsed time of the climb phase between Event189 and Event192. The average rate of climb during the climb phase is approximately 28 f/s and is consistent with the tree cut geometry at the first impact location.

Results

Table 1: *Flight Parameters and Communications.*
Table of the calculated aircraft flight parameters correlated to events on the CVR and the ATC recordings. The spreadsheet formulas used to calculate **Table 1** immediately follow the table.

Figure 1: *Aircraft Ground Track*
This figure shows the aircraft ground position during the phase of flight the position can be determined using the information recorded by the CVR. North is at the top of the figure. The VJN VOR/DME is located at the point (0.0 nmi, 0.0 nmi).

Figure 2: *Aircraft Ground Track After Passing the VJN VOR/DME.*
This figure shows the aircraft ground position after the aircraft flew over the VJN VOR/DME. North is at the top of the figure. The VJN VOR/DME is located at the point (0.0 nmi, 0.0 nmi).

Figure 3: *Aircraft Altitude Versus Time Before Impact.*
This figure shows the aircraft altitude during the last 25 minutes of flight. The axis scaled in seconds (s) is time before impact (TBI).

Figure 4: *Aircraft Altitude and Ground Elevation Below the Aircraft Versus Time Before Impact After Turning To Heading 180^{o}.*
This figure shows the aircraft altitude and the ground elevation below the aircraft during the last 6 minutes of flight. The axis scaled in seconds (s) is time before impact (TBI). The earliest time represented (the largest TBI) is the time the pilots established the heading 180^{o}.

FIGURE 1 *Aircraft Ground Track*

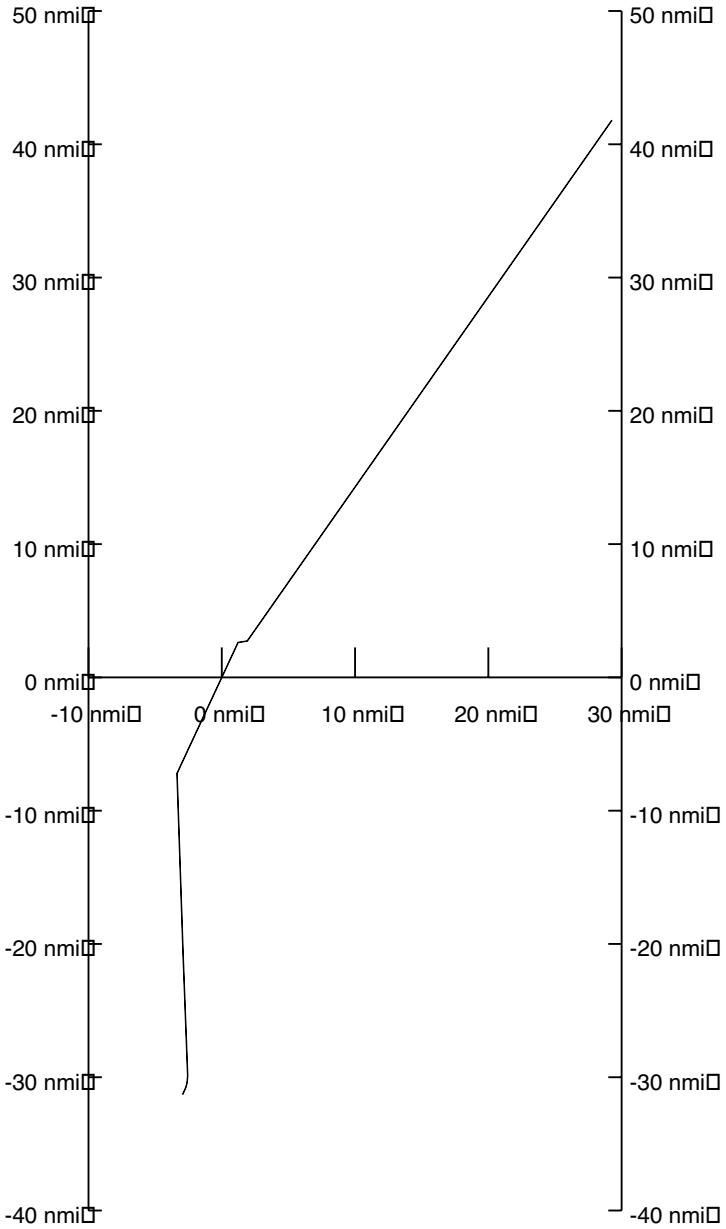


FIGURE 2 *Aircraft Ground Track After Passing the VJN VOR/DME*

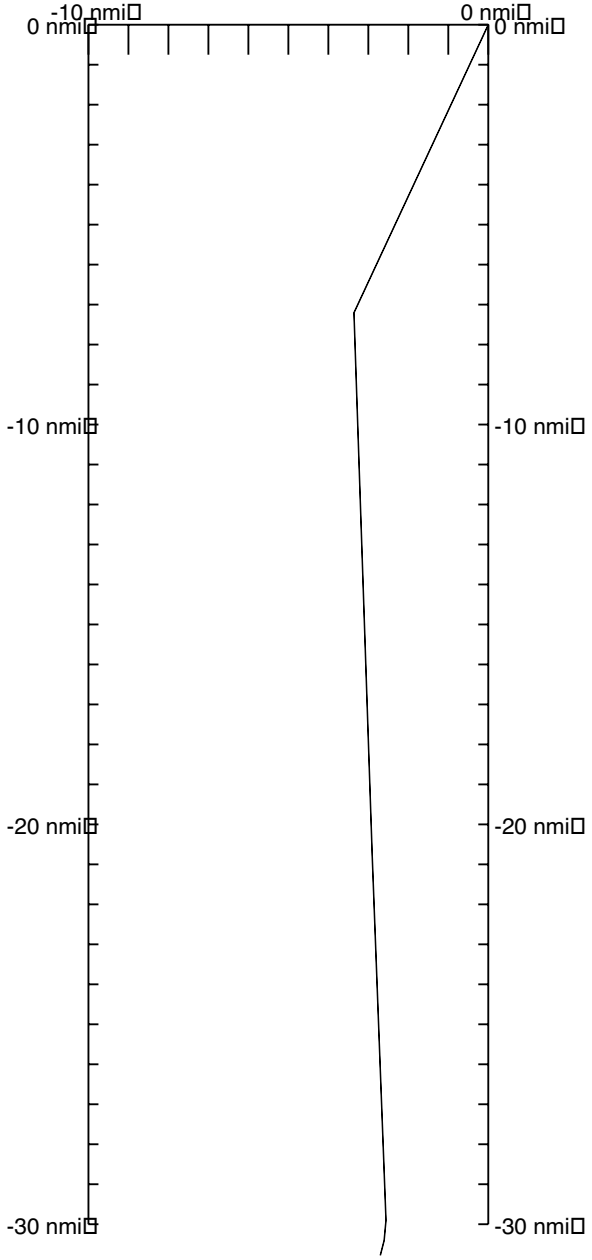


FIGURE 3 *Aircraft Altitude Versus Time Before Impact*

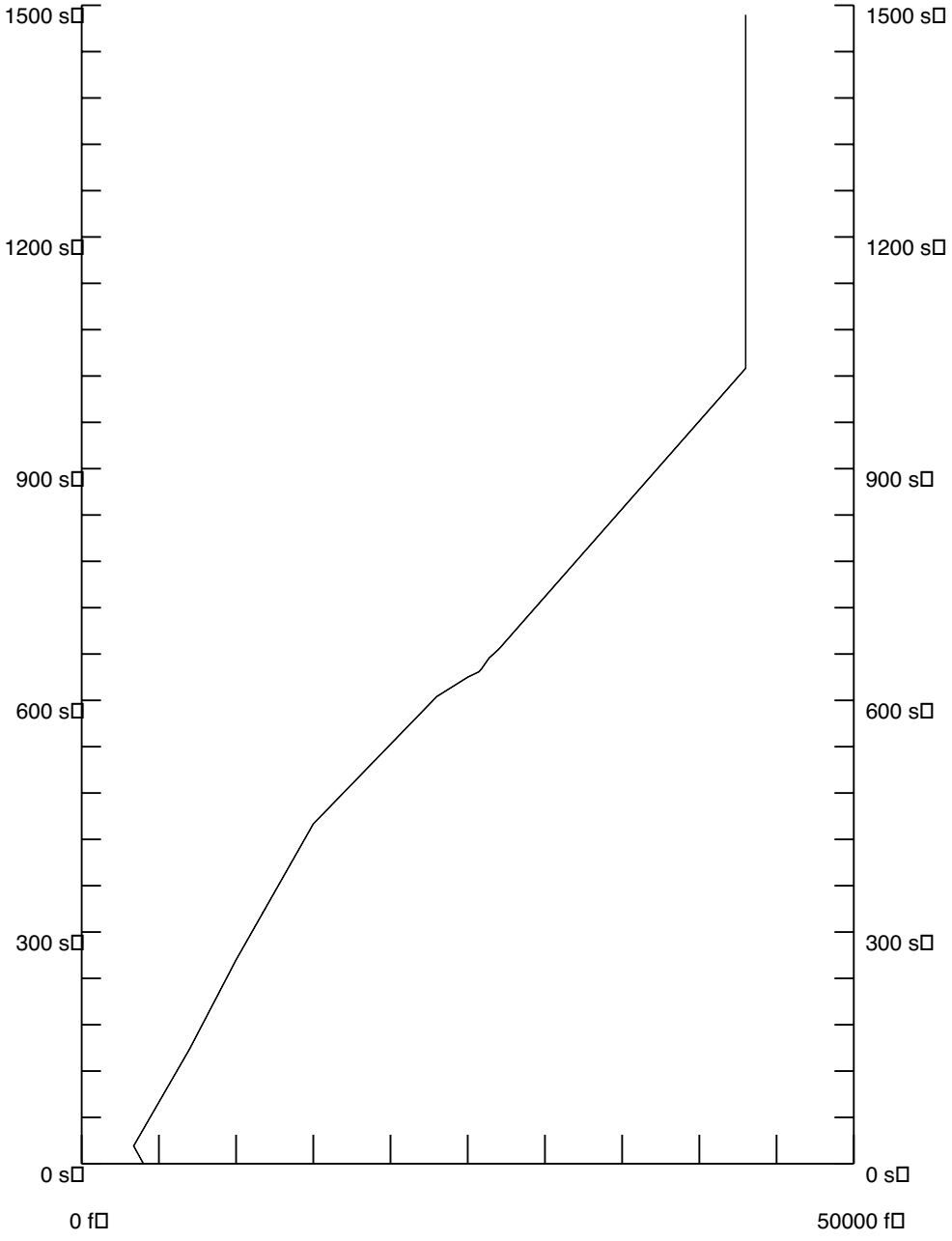
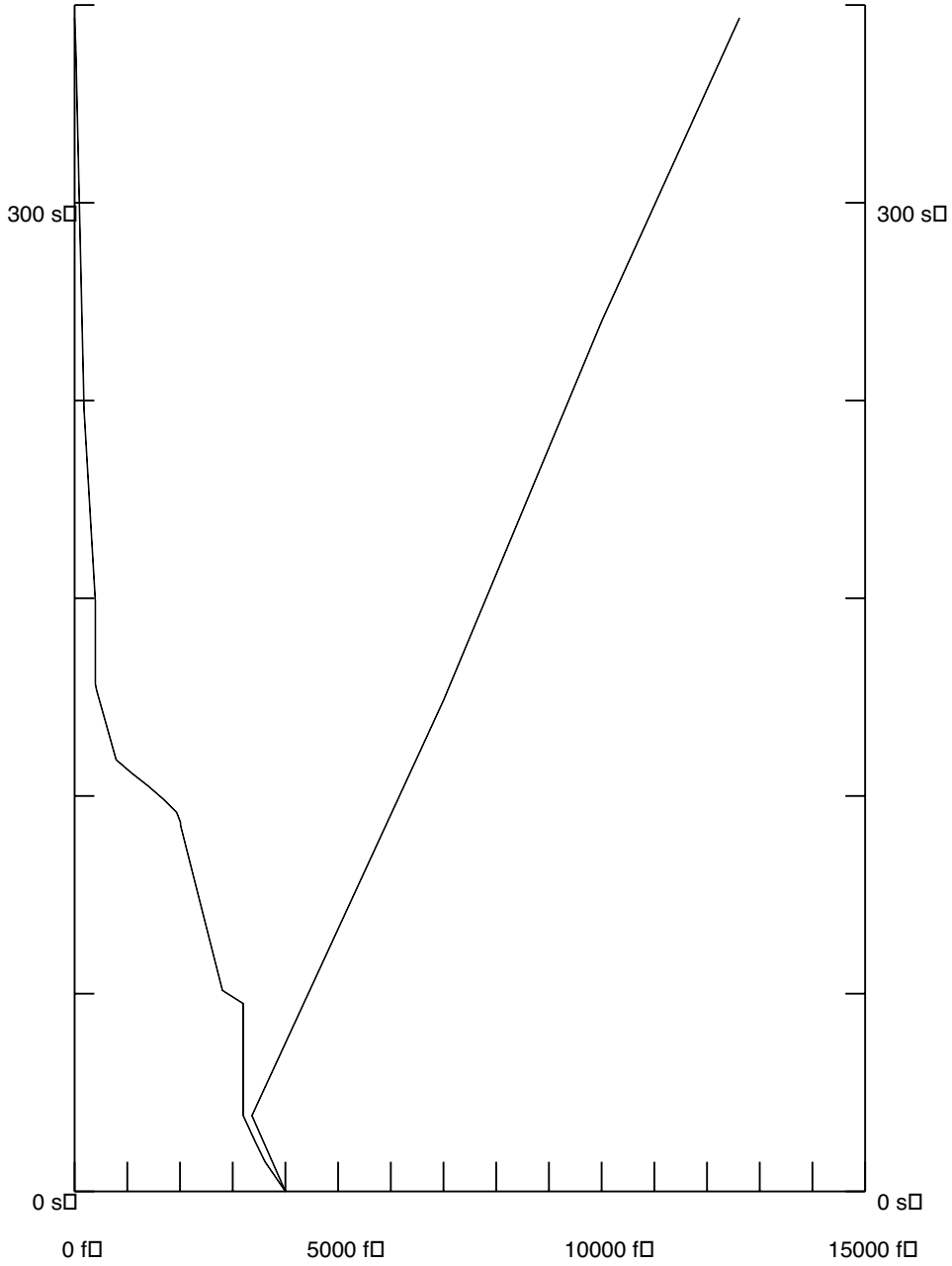


FIGURE 4 *Aircraft Altitude and Ground Elevation Below Aircraft Versus Time Before Impact After Turning To Heading 180°.*



Pilot Errors

Error 1
The pilots did not slow the aircraft to approach speed when directed by ATC (Event69). This error put the aircraft over VJN VOR/DME approximately 15 minutes earlier than ATC expected. The average ground speed inbound to the VOR/DME, between Event65 (DME 37 nmi) and Event104 (DME 0.0 nmi), was 400 knots.

Error 2
The pilots did not descend according to the published descent profile for their arrival sector. If the pilots had done this the aircraft would have been at 4000 f altitude over the VJN VOR/DME and in position for the initial approach segment for a VOR/DME approach procedure.

Error 3
The CVR recording indicates the pilots did not consider any published approach other than the ILS approach. Nevertheless, the pilots did not specifically request the ILS approach.

Error 4
The radiotelephone communication methods used by copilot Johnston were sloppy and not compliant with ICAO standards. Specifically, Johnston indicated to ATC he understood and would comply with the ATC directive to descend over the VJN VOR/DME to 9,500 feet. He did this by repeating (part of) the directive at Event118 suggesting to ATC he understood the directive and would comply.

Error 5
The pilots did not ask for clarification on the ATC directive to “descend south of the airfield” and put the aircraft on a heading 180^{o}. The aircraft ground track suggested by Frank Petersen in his deposition and in his report titled “REPORT OF INVESTIGATION INTO THE ACCIDENT INVOLVING N204C” (April 24, 1992) has the aircraft flying outbound from the VJN VOR/DME on the 180^{o} radial. This ground track can not be correct since it would put the aircraft 3 nmi east of the crash site at the time the pilots initiated the right turn. The 3 nmi distance could not have been covered in the 25 s between initiating the right turn and the impact. (At 230 knots it would take over 46 s to cover this distance.) Furthermore, the aircraft would have crashed before it did into the mountains along the 180^{o} radial from the VJN VOR/DME.

Error 6
The cockpit conversation at Event179 indicates both pilots saw high terrain 52 s before impact. At this time the aircraft was less than 1 nmi from eye-level hills at 4000 f and less than 1.7 nmi from a peak at 4875 f. The pilots should have realized they were violating IFR approach procedures. (At this time of day the cloud cover near these hills would have been broken with cloud bases above 4,000 f.) The pilots made no comment to ATC about the terrain or the cloud conditions.

Recommendations

Recommendation 1.1
Obtain an early generation copy of the CVR recording and carry out an accurate timing of events. Digital audio tape (DAT) would be best.

Recommendation 1.2
Obtain an early generation copy of the ATC recording and carry out accurate timing of events. Digital audio tape (DAT) would be best.

Recommendation 1.3
Obtain the topographical maps along the flight path from the Sabah Department of Geographical Mapping. This may require a government release since maps at this scale are released only to citizens of Malaysia.

Recommendation 1.4
Obtain the aerial (stereographic?) photographs taken by the Malaysia Department of Civil Aviation (DCA) in their crash investigation.

Recommendation 1.5
Obtain the radar data from the facility in Brunei that reportedly had hits on the aircraft.

Definitions

Event
Utterances or sounds identified on the aircraft CVR recording or on the transcript of the ATC recording.

GMT
Greenwich Mean Time for the event. GMT for all events was calculated by measuring the lapsed time on the CVR recording between the events and Event13. The lapsed time was then added to the GMT time specified on the ATC recording transcript for Event13 (05:46:06 GMT).

Note: After using Event13 to standardize the time on CVR recording, the time on CVR recording transcript provided by Du Pont and the time on the ATC recording transcript provided by Du Pont, timings still differ by almost one minute for some events. Early generation copies of the CVR and ATC recordings should be obtained to do the timings in a consistent manner.

TBI
Time before the first impact.

Navigation
The parameters under this title are flight parameters discussed in radio communications to ATC. All parameters are relative to VJN VOR/DME.

VOR
VOR radial in degrees reported by the pilots to ATC.

DME
DME distance in nautical miles (nmi) reported to ATC by the pilots.

Note: DME distance is “slant range” distance (straight-line distance) between the aircraft and the DME ground station. The DME distance is a good approximation of the horizontal distance since for the altitudes DME distances are reported (37 DME inbound and 21 DME outbound) the difference between DME and horizontal distance is small (0.4 nmi and 0.03 nmi respectively).

FL
Flight Level in hundreds of feet (f) reported to ATC by the pilots.

heading
Aircraft heading in degrees.

Note: Wind drift is accounted for only after the aircraft passed the VJN VOR/DME.

Note: Magnetic variation over the region for 1991 was approximately 1’W (per the Tactical Pilotage Chart L-11B). This is insignificant and is neglected in the calculations.

Coordinates
The parameters under this title are flight parameters interpolated and extrapolated from the Navigation parameters. All parameters are relative to the VJN VOR/DME.

e
Aircraft distance in nautical miles (nmi) east of the VJN VOR/DME. Negative numbers are distances west of VJN VOR/DME.

n
Aircraft distance in nautical miles (nmi) north of the VJN VOR/DME. Negative numbers are distances south of the VJN VOR/DME.

z
Aircraft altitude in feet (f) above mean sea level.

bearing
Aircraft bearing in degrees from the VJN VOR/DME.

range
Aircraft horizontal distance in nautical miles (nmi) from the VJN VOR/DME.

GL
Ground level in feet (f) above mean sea level.

AGL
Aircraft altitude above ground level in feet (f).

Speed
The parameters under this title are calculated aircraft average speeds.

GS
Aircraft average ground speed in knots.

AS
Aircraft average air speed in knots.

DR
Aircraft average descent rate in feet per second (f/s).

RTF Communications
Items under this title regard the radiotelephone communications identified on the transcript of the CVR and ATC recordings.

From
Sender of the radio transmission.

To
Intended receiver of the radio transmission.

Text
Text of the radio transmission.

Flight Deck Conversations and Sounds
Items under this title regard statements and sounds identified on the aircraft CVR recording excluding radiotelephone communications.

Origin
Source of the statement or sound.

Text
Text of the statement or sound.

Calculations

Navigation parameters VOR, DME and FL are found in the RFT Communications. Navigation parameter “heading” is assumed to be 180^{o} after Event131 when the pilots apparently interpreted an ATC instruction “descend south of the airfield” to mean “descend, on a heading 180^{o}”.

Coordinate parameters e, n, z, bearing and range, and Speed parameters GS, AS and DR is calculated by interpolating and extrapolating the Navigation parameters. The ground level parameter GL is taken from the 1:250,000 Joint

Operations Chart. AGL is the aircraft altitude (z) and ground level (GL) difference.

The aircraft air velocity and the wind drift effect after passing the VJN VOR/DME are calculated as follows.

Let e0 = 0.0 nmi and n0 = 0.0 nmi be the easting and northing for the aircraft over the VJN VOR/DME (Event104) and t0 the time the aircraft is at Event104 and location (0.0 nmi, 0.0 nmi).

Let e1 and n1 be the easting and northing for the aircraft when the pilots turned from an aircraft course 205^o to an aircraft heading 180^o (Event131) and t1 (06:05:35 GMT1) the time the aircraft is at location (e1, n1).

Let e2 and n2 be the easting and northing for the aircraft when the pilots reported the aircraft at DME 21 nmi (Event161) and t2 (06:08:45 GMT1) the time the aircraft is at location (e2, n2).

Let e3 and n3 are the easting and northing for the aircraft when the pilots reported the aircraft at DME 29 nmi (Event185) and t3 (06:10:52 GMT1) the time the aircraft is at location (e3, n3).

Let v_e be the east-component and v_n be the north-component of the aircraft air velocity.

Let w_e be the east-component and w_n be the north-component of the wind velocity.

Then, the equations for e1 and n1 are:

$$e1 = (v1_e + w_e)*(t1 - t0) \quad \textbf{(EQ 1)}$$

$$n1 = (v1_n + w_n)*(t1 - t0). \quad \textbf{(EQ 2)}$$

Between the point (e0, n0) and the point (e1, n1) the aircraft tracked on the 205^o radial from the VJN VOR/DME. (Assuming the aircraft maintained the heading it had immediately before passing over the VJN VOR/DME.) Therefore

$$e1/n1 = \tan(205^o) \text{ or} \quad \textbf{(EQ 3)}$$

$$e1 = n1 * \tan(205^o). \quad \textbf{(EQ 4)}$$

Substituting **(EQ 1)** and **(EQ 2)** into equation **(EQ 3)** and solving for $v1_e$ yields:

$$v1_e = (v1_n + w_n) * \tan(25^o) - w_e. \quad \textbf{(EQ 5)}$$

The equations for e2 and n2 are:

$$e2 = e1 + w_e * (t2 - t1) \quad \textbf{(EQ 6)}$$

$$n2 = n1 + (-s1 + w_n) * (t2 - t1), \quad \textbf{(EQ 7)}$$

where s1 is the air speed on the leg between the points (e0, n0) and (e1, n1) and between the points (e1, n1) and (e2, n2). The air speed is related to the components of air velocity on the flight leg between the points (e0, n0) and (e1, n1) by

$$s1 = (v1_e^2 + v1_n^2)^{1/2}. \quad \textbf{(EQ 8)}$$

Now at Event161 the aircraft is at the point (e2, n2) and 21 nmi from the VJN VOR/DME; therefore,

$$n2^2 + e2^2 = (21 \text{ nmi})^2. \quad \textbf{(EQ 9)}$$

Using the wind speed and direction provided by ATC at Event127 we have:

$$w_e = 10 \text{ knots} * \sin(110^o) \quad \textbf{(EQ 10)}$$

$$w_n = 10 \text{ knots} * \cos(110^o). \quad \textbf{(EQ 11)}$$

(This assumes wind speed and direction are constant up to 15,000 f.)

Substitution into equation **(EQ 9)** yields a nonlinear equation with one independent variable, $v1_n$. The equation is solved using the Newton's Method algorithm "Root" on an HP48SX calculator. The approximate solution is:

$$v1_n = -226.065384615 \text{ knots}. \quad \textbf{(EQ 12)}$$

This result is used in the spreadsheet calculations of the aircraft position for events between (e0, n0) and (e2, n2).

The equations for e3 and n3 are:

$$e3 = e2 + w_e * (t3 - t2) \quad \textbf{(EQ 13)}$$

$$n3 = n2 + (v3_n + w_n) * (t3 - t2) \quad \textbf{(EQ 14)}$$

At Event185 the aircraft is at the point (e3, n3) and 29 nmi from the VJN VOR/DME; therefore,

$$e3^2 + n3^2 = (29 \text{ nmi})^2 \quad \textbf{(EQ 15)}$$

and

$$n3 = -[(29 \text{ nmi})^2 - e3^2]^{1/2}. \quad \textbf{(EQ 16)}$$

Substituting equation **(EQ 16)** into equation **(EQ 14)** yields

$$v3_n = -\{[(29 \text{ nmi})^2 - e3^2]^{1/2} + n2\}/(t3 - t2) - w_n. \quad \textbf{(EQ 17)}$$

This result is used in the spreadsheet calculations of the aircraft position for events between (e2, n2) and (e3, n3). The aircraft location after passing the point (e3, n3) are determined by extrapolation. It is assumed the pilots did not change air velocity until the right turn was initiated at Event189.

CHAPTER 2

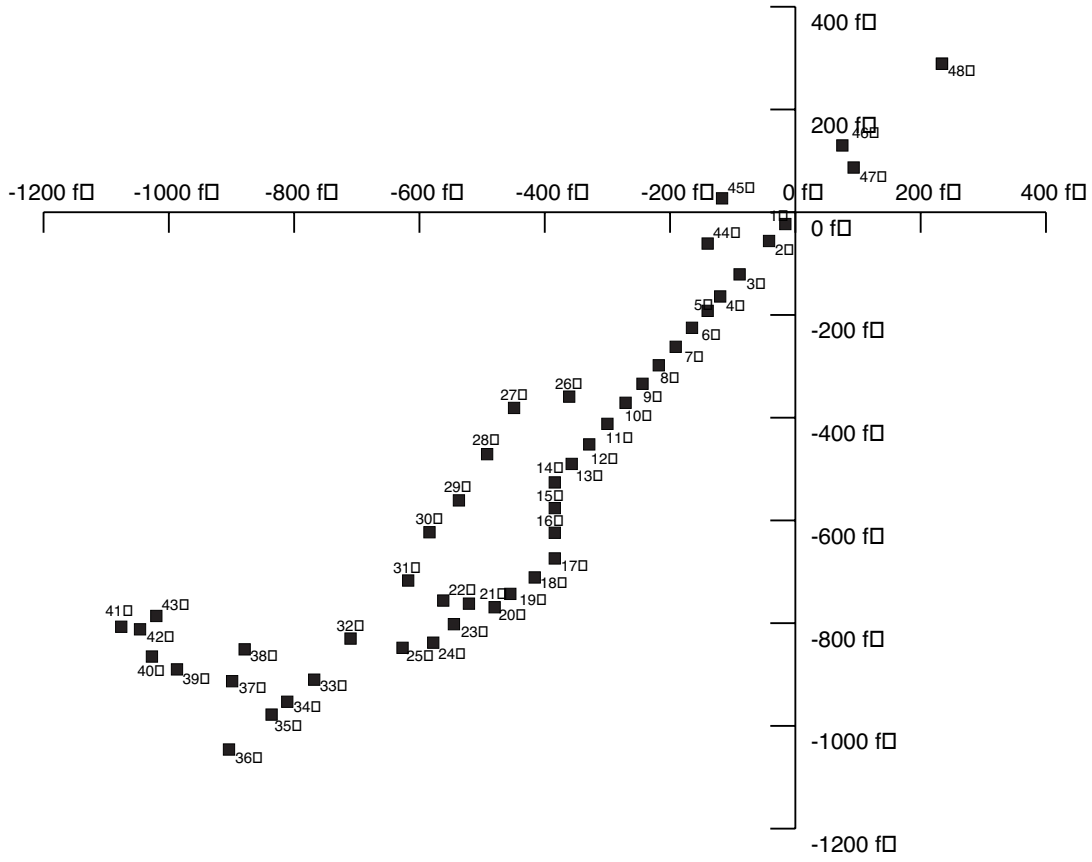
Crash Site Survey

Results

Table 2: *Crash Site Survey*
This table contains the measurements made in the field and the calculated survey station locations relative to Station0 at the helicopter landing zone LZ1 near the first impact point. The spreadsheet formulas used to calculate **Table 2** immediately follow the table.

Figure 5: *Survey Station Ground Positions*
This figure shows the ground position of the survey stations used in the crash site survey. The origin, (0.0 f, 0.0 f), is the location of survey station Station0 at the helicopter landing zone LZ1 near the first impact point. North is at the top of the figure.

FIGURE 5 *Survey Station Ground Positions*



Recommendations

Recommendation 2.1
Obtain the aerial photographs of the crash site taken by the Malaysia Department of Civil Aviation (DCA). If the photographs are stereographic then tree top elevations can be determined.

Recommendation 2.2
A physical model of the crash site has been made using the survey data and video and still photography. The physical model should be digitized.

Definitions

Survey Data
The parameters length, azimuth and elevation under this title are the components of the survey segment vector for the current survey station relative to the spherical coordinates of previous survey station. These are the parameters that were measured in the field.

length
Straight-line distance in feet (f) from the previous survey station to the current survey station.

azimuth
Magnetic bearing in degrees from the previous survey station to the current survey station.

elevation
Angle in degrees above (+) or below (-) the horizontal plane from the previous survey station to the current survey station.

Coordinate Differentials
The parameters dn, de and dz under this title are the rectilinear coordinates of the survey segment vector from the previous survey station to the current survey station. The parameter dr under this title is the horizontal projection of the survey segment vector from the previous survey station to the current survey station.

dr
Horizontal distance in feet (f) from the previous survey station to the current survey station.

de
Easting distance in feet (f) from the previous survey station to the current survey station.

dn
Northing distance in feet (f) from the previous survey station to the current survey station.

dz
Altitude change in feet (f) from the previous survey station to the current survey station.

Coordinates
The parameters n and e under this title are the northing and easting in feet from survey station Station0 to the current survey station. The parameter z is the altitude above mean sea level of the current survey station.

e
Easting distance in feet (f) from Station0 to the current survey station.

n
Northing distance in feet (f) from Station0 to the current survey station.

z
Altitude in feet (f) of the current survey station relative to mean sea level.

(The MSL altitude of Station0 was established by altimeter on the Sabah Air helicopter, a hand held altimeter and a Magellan 1000 GPS unit.)

range
Horizontal distance in feet (f) from Station0 to the current survey station.

bearing
Magnetic bearing in degrees from Station0 to the current survey station.

CHAPTER 3

Fuselage Trajectory

Results

Table 3: *Fuselage Trajectory Calculations*
This table contains the parameters needed to calculate the fuselage trajectory. The spreadsheet formulas used in calculating **Table3** immediately follow the table.

Table 4: *Fuselage Trajectory*
This table contains the fuselage location every 0.1 s after first impact. The spreadsheet formulas used in calculating **Table4** immediately follow the table.

Figure 6: *Fuselage Trajectory Ground Track*
This figure shows the fuselage ground position after first impact. North is at the top of the figure. Survey station Station0 is located at the point (0.0 f, 0.0 f).

Figure 7: *Fuselage Trajectory Cross Section*
This figure shows the fuselage altitude, ground elevation and (estimated) tree top elevation versus position along the free-fall ground track. Survey station Station0 is located at the point (0.0 f, 4000 f).

FIGURE 6 *Fuselage Trajectory Ground Track*

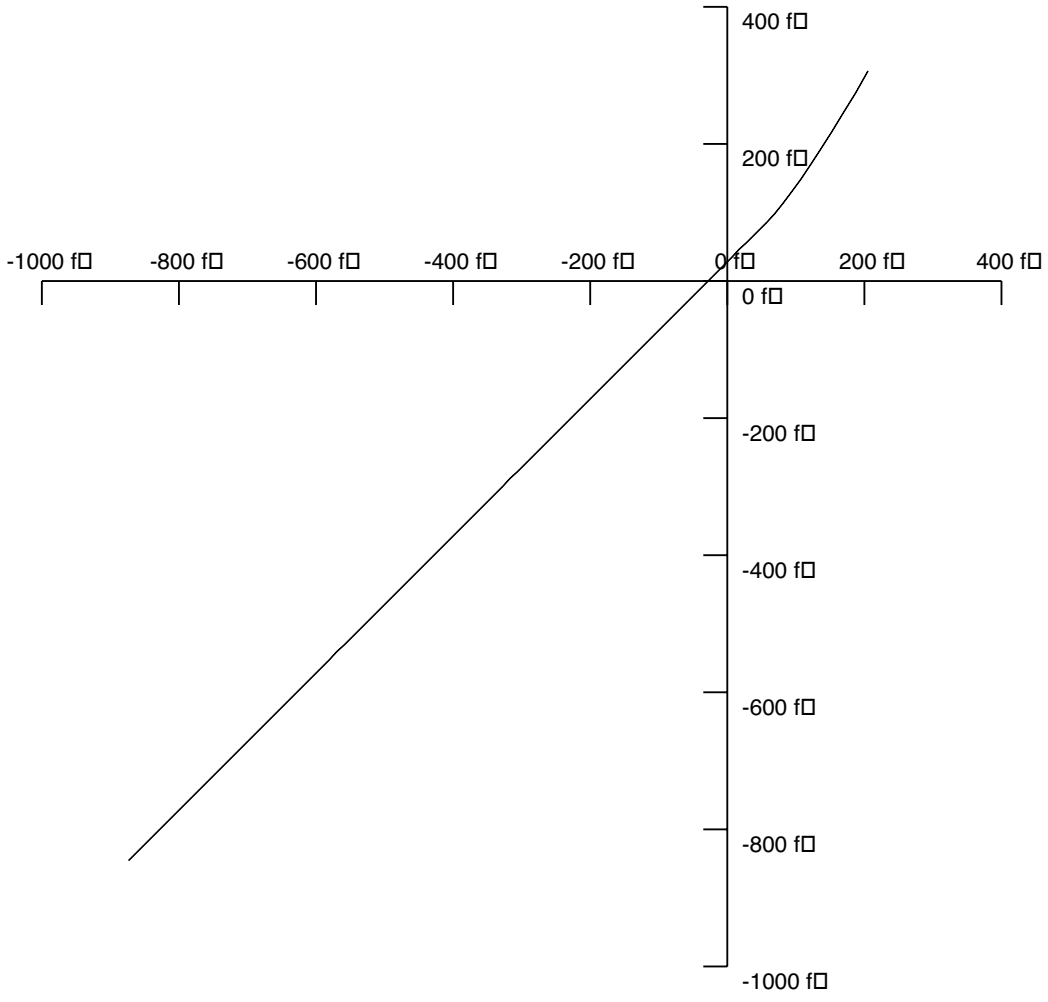
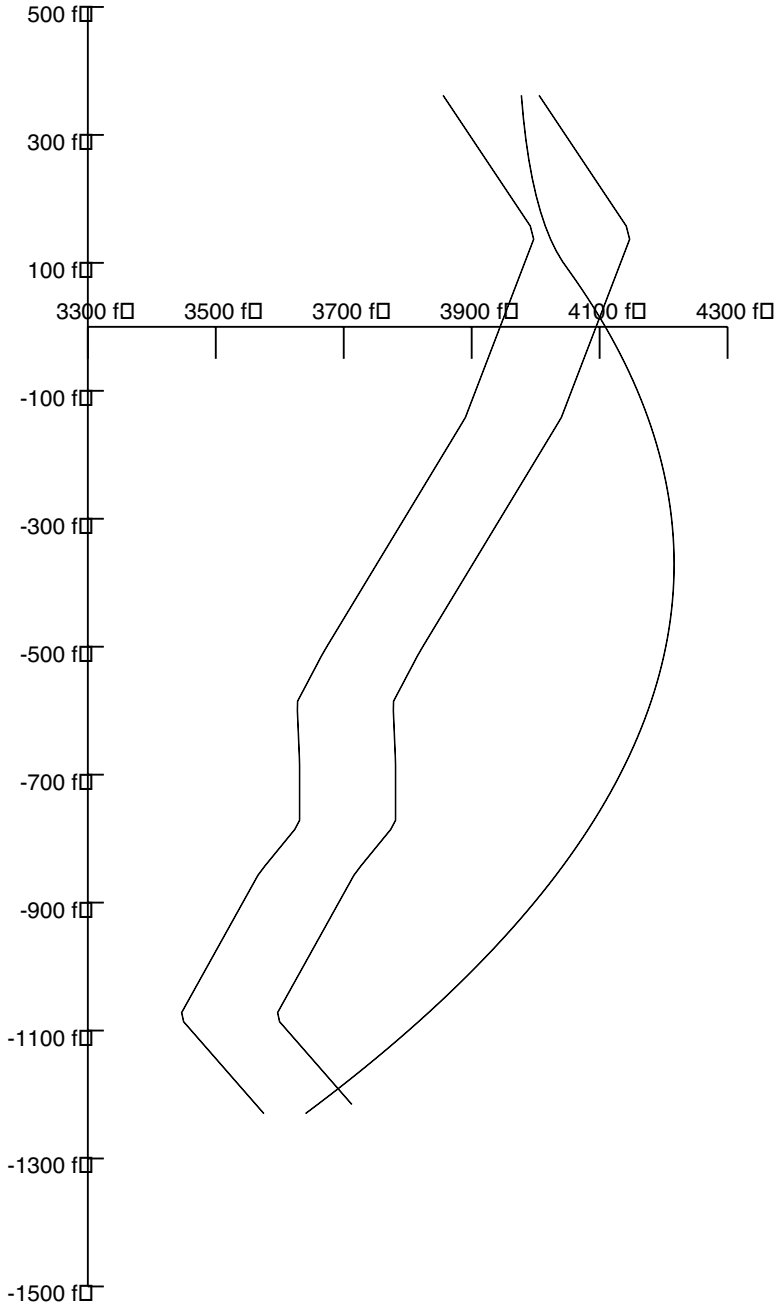


FIGURE 7 *Fuselage Trajectory Cross Section*



Definitions

t
Time in seconds (s) from first impact.

e
Fuselage distance in feet (f) east of Station0. Negative numbers are distances west of Station0.

n
Fuselage distance in feet (f) north of Station0. Negative numbers are distances south of Station0.

z
Fuselage altitude in feet (f) above mean sea level.

p
Horizontal distance in feet (f) along the free-fall ground track. The following conventions are used here: the point on the free-fall ground track closest to Station0 has p = 0.0 f, points along the free-fall ground track towards the initial impact point are positive and points along the free-fall ground track away from the initial impact point are negative.

GL
Ground level in feet above mean sea level.

TL
Tree top level in feet above mean sea level. (Ground level plus 150 f.)

r1
The p-value in feet for the highest tree cleared by the fuselage just after the free-fall phase began.

h1
Altitude in feet (f) above mean sea level for the highest tree cleared by the fuselage just after the free-fall phase began.

r-Error
A measure of the error in feet (f) for satisfying the dynamical constraints imposed by an assumption of constant acceleration during the initial impact phase.

(e0, n0, z0)
Fuselage position vector in feet (f) at the beginning of the initial impact phase.

v0
Magnitude of the fuselage velocity in feet per second (f/s) at the beginning of the initial impact phase.

($v0_e$, $v0_n$, $v0_z$)
Fuselage velocity vector in feet per second (f/s) at the beginning of the initial impact phase.

i0
Fuselage climb angle in degrees at the beginning of the initial impact phase.

(e1, n1, z1)
Fuselage position vector in feet (f) at the end of the initial impact phase.

v1
Magnitude of the fuselage velocity in feet per second (f/s) at the end of the initial impact phase.

($v1_e$, $v1_n$, $v1_z$)
Fuselage velocity vector in feet per second (f/s) at the end of the initial impact phase.

i1
Fuselage climb angle in degrees at the end of the initial impact phase.

v2
Magnitude of the fuselage velocity in feet per second (f/s) at the end of the free-fall phase.

($v2_e$, $v2_n$, $v2_z$)
Fuselage velocity vector in feet per second (f/s) at the end of the free-fall phase.

i2
Fuselage climb angle in degrees at the end of the free-fall phase.

d2
Horizontal distance in feet (f) traveled by the fuselage during the free-fall phase.

t1
Lapsed time in seconds (s) during the initial impact phase.

t2
Lapsed time in seconds (s) during the free-fall phase.

a
Magnitude of fuselage acceleration in feet per second squared (f/s^2) during the initial impact phase.

(a_e, a_n, a_z)
Fuselage average acceleration vector in feet per second squared (f/s^2) during the initial impact phase.

G
Magnitude of fuselage acceleration in G-force equivalents during the initial impact phase.

(G_e, G_n, G_z)
Fuselage acceleration vector in G-force equivalents during the initial impact phase.

Calculations

Let (e, n, z) be the fuselage location, t the lapsed time from the beginning of the initial impact phase, (e0, n0, z0) the fuselage location at the beginning of the initial impact phase, ($v0_e$, $v0_n$, $v0_z$) the fuselage velocity at the beginning of the initial impact phase and (a_e, a_n, a_z) the average acceleration experienced by the fuselage during the initial impact phase. Then, during the initial impact phase:

$$e = a_e * t^2/2 + v0_e * t + e0 \quad \textbf{(EQ 18)}$$

$$n = a_n * t^2/2 + v0_n * t + n0 \quad \textbf{(EQ 19)}$$

$$z = a_z * t^2/2 + v0_z * t + z0. \quad \textbf{(EQ 20)}$$

Let ($v1_e$, $v1_n$, $v1_z$) be the fuselage velocity at the end of the initial impact phase, then:

$$v1_e = a_e * t + v0_e \quad \textbf{(EQ 21)}$$

$$v1_n = a_n * t + v0_n \quad \textbf{(EQ 22)}$$

$$v1_z = a_z * t + v0_z \quad \textbf{(EQ 23)}$$

Let (e1, n1, z1) be the fuselage location at the end of the initial impact phase and t1 the lapsed time during the initial impact phase. Then, using equations **(EQ 18)**, **(EQ 19)** and **(EQ 20)** and equations **(EQ 21)**, **(EQ 22)** and **(EQ 23)**:

$$e1 - e0 = (v1_e + v0_e) * t1/2 \quad \textbf{(EQ 24)}$$

$$n1 - n0 = (v1_n + v0_n) * t1/2 \quad \textbf{(EQ 25)}$$

$$z1 - z0 = (v1_z + v0_z) * t1/2. \quad \textbf{(EQ 26)}$$

Solving for the lapsed time during the initial impact phase:

$$t1 = (e1 - e0)*2/(v1_e + v0_e) \quad \textbf{(EQ 27)}$$

$$t1 = (n1 - n0)*2/(v1_n + v0_n) \quad \textbf{(EQ 28)}$$

$$t1 = (z1 - z0)*2/(v1_z + v0_z). \quad \textbf{(EQ 29)}$$

For an arbitrary point (e1, n1, z1) equations **(EQ 27)**, **(EQ 28)** and **(EQ 29)** do not give the same lapsed time t1 for the initial impact phase. To satisfy the assumption the acceleration is constant during the initial impact phase, the point (e1,

n1, z1) must be constrained so that equations **(EQ 27)**, **(EQ 28)** and **(EQ 29)** give the same t1.

The climb rate at first impact, $v0_z$, is not known very accurately so z1 is not constrained. The direction of travel after the initial impact phase is known and the location at the end of the free-fall phase is known; therefore the velocity ($v1_e$, $v1_n$, $v1_z$) at the end of the initial impact phase is known. (This is done in the development of equations **(EQ 30)** - **(EQ 42)**.)

Equations **(EQ 27)** and **(EQ 28)** are used to determine the point (e,1 n1) along the free-fall trajectory at which the t1 given by these two equation are nearly equal. This is the point at which the constant acceleration stopped, the initial impact phase ended and the free-fall phase began. In practice (e1, n1) is found iteratively by moving the location e1 and n1 along the free-fall trajectory until equations **(EQ.27)** and **(EQ 28)** give the same value for t1. The spreadsheet is designed to calculate an error parameter r-Error that is a distance in feet e1 and n1 should be displaced along the free-fall trajectory in order to make equations **(EQ 27)** and **(EQ 28)** give closer values for t1.

Solving equations **(EQ 21)**, **(EQ 22)** and **(EQ 23)** for the components of the acceleration during the initial impact phase:

$$a_e = (v1_e - v0_e)/t1 \qquad \textbf{(EQ 30)}$$

$$a_n = (v1_n - v0_n)/t1 \qquad \textbf{(EQ 31)}$$

$$a_z = (v1_z - v0_z)/t1. \qquad \textbf{(EQ 32)}$$

During the free-fall phase after the initial impact phase, let r be the horizontal distance traveled in time (t - t1). Then r is given by:

$$r = v1 * \cos(i1) * (t - t1). \qquad \textbf{(EQ 33)}$$

During the free-fall phase z obeys the equation:

$$z = -g * (t - t1)^2/2 + v1* \sin(i1) * (t - t1) + z1. \qquad \textbf{(EQ 34)}$$

If d2 is the horizontal distance traveled during the free-fall phase, z2 is the altitude at the end of the free-fall phase and t2 is the lapsed time of the free-fall phase, then from equation **(EQ 33)**:

$$v1 * t2 = d2/\cos(i1). \qquad \textbf{(EQ 35)}$$

Evaluating equation (EQ 34) at t = t2 + t1 and using equation **(EQ 35)** to replace v1* t2 with d2/cos(i1) in the second term on the right hand side of equation **(EQ 34)** yields:

$$z2 - z1 = -g * t2^2/2 + d2 * \tan(i1). \qquad \textbf{(EQ 36)}$$

Solving equation **(EQ 36)** for t2:

$$t2 = \{2*[d2 * \tan(i1) + z1 - z2]/g\}^{1/2} \qquad \textbf{(EQ 37)}$$

This result can be used with equation **(EQ 35)** to determine the magnitude of velocity v1 at the end of the initial impact phase.

$$v1 = d2/[t2 * \cos(i1)] \quad \textbf{(EQ 38)}$$

The angle i1 is determined as follows. We know the fuselage was at altitude 4025 f as it passed over Station46 of the site survey. We know the fuselage cleared a tree top with an altitude h1 = 4140 f located along the free-fall trajectory at p = r1 = -33. The climb angle after the initial impact phase is:

$$i1 = \text{atan}[(4140 - 4025)/(125 + 33)] = 36^{o}. \quad \textbf{(EQ 39)}$$

The horizontal distance traveled in free-fall is:

$$d2 = 1318 \text{ f} \quad \textbf{(EQ 40)}$$

The vertical distance traveled in free-fall is:

$$z1 - z2 = 4047 \text{ f} - 3649 \text{ f} = 398 \text{ f} \quad \textbf{(EQ 41)}$$

The magnitude of the fuselage velocity at the end of the initial impact phase is:

$$v1 = 177 \text{ f/s} \quad \textbf{(EQ 42)}$$

The magnitude of the fuselage horizontal velocity at the beginning of the initial impact phase is:

$$v0 = 224 \text{ knots} = 378 \text{ f/s} \quad \textbf{(EQ 43)}$$

The lapsed time in the initial impact phase is found to be:

$$t1 = 1.0 \text{ s} \quad \textbf{(EQ 44)}$$

The lapsed time in the free-fall phase is found to be:

$$t2 = 9.2 \text{ s} \quad \textbf{(EQ 45)}$$

Therefore total lapsed time from the beginning of the initial impact phase to the end of the free-fall phase is:

$$t1 + t2 = 10.2 \text{ s} \quad \textbf{(EQ 46)}$$

The magnitude of the average acceleration during the initial impact phase is:

$$a = 243 \text{ f/s}^2 = 7.6 \text{ G} \quad \textbf{(EQ 47)}$$

At the end of the free-fall phase the impact angle from the horizontal plane is:

$$i2 = 53^{o}. \quad \textbf{(EQ 48)}$$

The magnitude of the fuselage velocity at the end of the free-fall phase is:

$$v2 = 238 \text{ f/s (141 knots)}. \quad \textbf{(EQ 49)}$$

Table 1: Flight Parameters and Communications

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event001	5:34:50	0:36:41														
Event002	5:34:56	0:36:35														
Event003	5:35:04	0:36:27			430				43000							0
Event004	5:35:19	0:36:12							43000							0
Event005	5:35:24	0:36:07							43000							0
Event006	5:35:44	0:35:47							43000							0
Event007	5:35:52	0:35:39							43000							0
Event008	5:36:03	0:35:28							43000							0
Event009	5:36:06	0:35:25							43000							0
Event010	5:36:10	0:35:21							43000							0
Event011	5:36:10	0:35:21							43000							0
Event012	5:36:10	0:35:21							43000							0
Event013	5:40:15	0:31:16							43000							0
Event014	5:40:18	0:31:13							43000							0
Event015	5:40:20	0:31:11							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event016	5:40:23	0:31:08							43000							0
Event017	5:40:46	0:30:45							43000							0
Event018	5:40:49	0:30:42							43000							0
Event019	5:41:15	0:30:16							43000							0
Event020	5:41:19	0:30:12							43000							0
Event021	5:41:22	0:30:09							43000							0
Event022	5:41:24	0:30:07							43000							0
Event023	5:42:31	0:29:00							43000							0
Event024	5:42:37	0:28:54							43000							0
Event025	5:42:42	0:28:49							43000							0
Event026	5:42:52	0:28:39							43000							0
Event027	5:45:14	0:26:17							43000							0
Event028	5:45:17	0:26:14							43000							0
Event029	5:45:19	0:26:12							43000							0
Event030	5:45:20	0:26:11							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event031	5:45:22	0:26:09							43000							0
Event032	5:45:26	0:26:05							43000							0
Event033	5:45:30	0:26:01							43000							0
Event034	5:45:32	0:25:59							43000							0
Event035	5:45:36	0:25:55							43000							0
Event036	5:45:40	0:25:51							43000							0
Event037	5:45:48	0:25:43							43000							0
Event038	5:45:53	0:25:38							43000							0
Event039	5:45:55	0:25:36							43000							0
Event040	5:46:01	0:25:30							43000							0
Event041	5:46:06	0:25:25			430				43000							0
Event042	5:46:15	0:25:16							43000							0
Event043	5:46:20	0:25:11							43000							0
Event044	5:46:27	0:25:04							43000							0
Event045	5:46:29	0:25:02							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event046	5:46:31	0:25:00							43000							0
Event047	5:46:39	0:24:52							43000							0
Event048	5:46:44	0:24:47							43000							0
Event049	5:46:53	0:24:38							43000							0
Event050	5:46:57	0:24:34							43000							0
Event051	5:47:03	0:24:28							43000							0
Event052	5:47:25	0:24:06							43000							0
Event053	5:47:28	0:24:03							43000							0
Event054	5:47:33	0:23:58							43000							0
Event055	5:47:37	0:23:54							43000							0
Event056	5:47:41	0:23:50							43000							0
Event057	5:47:56	0:23:35							43000							0
Event058	5:47:57	0:23:34							43000							0
Event059	5:47:58	0:23:33							43000							0
Event060	5:48:01	0:23:30							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event061	5:48:02	0:23:29							43000							0
Event062	5:48:05	0:23:26							43000							0
Event063	5:48:17	0:23:14							43000							0
Event064	5:48:25	0:23:06							43000							0
Event065	5:48:36	0:22:55							43000							0
Event066	5:48:40	0:22:51							43000							0
Event067	5:48:44	0:22:47							43000							0
Event068	5:48:54	0:22:37							43000							0
Event069	5:49:00	0:22:31							43000							0
Event070	5:49:03	0:22:28							43000							0
Event071	5:49:03	0:22:28							43000							0
Event072	5:49:14	0:22:17							43000							0
Event073	5:49:51	0:21:40							43000							0
Event074	5:49:57	0:21:34							43000							0
Event075	5:49:59	0:21:32							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event076	5:50:03	0:21:28							43000							0
Event077	5:50:08	0:21:23							43000							0
Event078	5:50:14	0:21:17							43000							0
Event079	5:50:17	0:21:14							43000							0
Event080	5:50:23	0:21:08							43000							0
Event081	5:50:23	0:21:08							43000							0
Event082	5:50:23	0:21:08							43000							0
Event083	5:50:23	0:21:08							43000							0
Event084	5:51:09	0:20:22							43000							0
Event085	5:51:09	0:20:22							43000							0
Event086	5:51:13	0:20:18							43000							0
Event087	5:51:18	0:20:13							43000							0
Event088	5:51:28	0:20:03							43000							0
Event089	5:51:32	0:19:59							43000							0
Event090	5:51:38	0:19:53							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event091	5:52:13	0:19:18							43000							0
Event092	5:52:24	0:19:07							43000							0
Event093	5:52:29	0:19:02							43000							0
Event094	5:52:35	0:18:56							43000							0
Event095	5:52:39	0:18:52							43000							0
Event096	5:52:45	0:18:46							43000							0
Event097	5:52:49	0:18:42							43000							0
Event098	5:52:51	0:18:40							43000							0
Event099	5:52:57	0:18:34							43000							0
Event100	5:53:40	0:17:51							43000							0
Event101	5:53:46	0:17:45							43000							0
Event102	5:53:47	0:17:44							43000							0
Event103	5:53:48	0:17:43							43000							0
Event104	5:54:08	0:17:23							43000							0
Event105	5:54:15	0:17:16							43000							0

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event106	5:54:21	0:17:10							43000							44
Event107	5:54:25	0:17:06							42824							44
Event108	5:54:30	0:17:01							42604							44
Event109	5:54:36	0:16:55							42341							44
Event110	5:54:39	0:16:52	35			215			42209	35						44
Event111	5:54:45	0:16:46				215			41945	35						44
Event112	5:54:50	0:16:41				215			41725	35						44
Event113	5:54:55	0:16:36				215			41505	35						44
Event114	5:55:11	0:16:20				215			40802	35						44
Event115	5:55:17	0:16:14				215			40538	35						44
Event116	5:55:42	0:15:49				215			39440	35						44
Event117	5:55:42	0:15:49				215			39440	35						44
Event118	5:55:43	0:15:48				215			39396	35						44
Event119	5:55:44	0:15:47				215			39352	35						44
Event120	5:56:01	0:15:30				215			38604	35						44

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event121	5:56:04	0:15:27				215			38473	35						44
Event122	5:56:06	0:15:25				215			38385	35						44
Event123	5:56:17	0:15:14				215			37901	35						44
Event124	5:56:22	0:15:09		51		215	29.3	41.8	37681	35	51.0			471		44
Event125	5:56:29	0:15:02				215	28.7	41.0	37374	35	50.1			471		44
Event126	5:56:32	0:14:59				215	28.5	40.7	37242	35	49.7			471		44
Event127	5:56:48	0:14:43				215	27.3	39.0	36538	35	47.6			471		44
Event128	5:56:54	0:14:37				215	26.9	38.3	36275	35	46.8			471		44
Event129	5:57:01	0:14:30				215	26.3	37.6	35967	35	45.9			471		44
Event130	5:57:09	0:14:22				215	25.7	36.7	35615	35	44.9			471		44
Event131	5:57:38	0:13:53				215	23.5	33.6	34341	35	41.1			471		44
Event132	5:57:43	0:13:48				215	23.2	33.1	34121	35	40.4			471		44
Event133	5:57:51	0:13:40				215	22.6	32.2	33769	35	39.4			471		44
Event134	5:57:56	0:13:35				215	22.2	31.7	33549	35	38.7			471		44
Event135	5:58:02	0:13:29				215	21.7	31.1	33286	35	37.9			471		44

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event136	5:58:09	0:13:22		37		215	21.2	30.3	32978	35	37.0			400		44
Event137	5:58:16	0:13:15				215	20.8	29.7	32670	35	36.2			400		44
Event138	5:58:24	0:13:07				215	20.3	28.9	32319	35	35.3			400		44
Event139	5:58:26	0:13:05				215	20.1	28.8	32231	35	35.1			400		44
Event140	5:58:32	0:12:59				215	19.8	28.2	31967	35	34.4			400		44
Event141	5:58:41	0:12:50				215	19.2	27.4	31571	35	33.4			400		44
Event142	5:58:47	0:12:44				215	18.8	26.8	31308	35	32.8			400		44
Event143	5:58:51	0:12:40				215	18.5	26.5	31132	35	32.3			400		44
Event144	5:58:55	0:12:36				215	18.3	26.1	30956	35	31.9			400		44
Event145	5:59:09	0:12:22				215	17.4	24.8	30341	35	30.3			400		44
Event146	5:59:24	0:12:07				215	16.4	23.5	29681	35	28.7			400		44
Event147	5:59:32	0:11:59				215	15.9	22.8	29330	35	27.8			400		44
Event148	5:59:40	0:11:51				215	15.4	22.0	28978	35	26.9			400		44
Event149	5:59:55	0:11:36				215	14.5	20.7	28319	35	25.2			400		44
Event150	5:59:57	0:11:34				215	14.3	20.5	28231	35	25.0			400		44

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event151	6:00:02	0:11:29				215	14.0	20.0	28011	35	24.4			400		44
Event152	6:00:05	0:11:26				215	13.8	19.8	27879	35	24.1			400		44
Event153	6:00:12	0:11:19				215	13.4	19.1	27571	35	23.3			400		44
Event154	6:00:15	0:11:16				215	13.2	18.8	27440	35	23.0			400		44
Event155	6:00:20	0:11:11				215	12.9	18.4	27220	35	22.4			400		44
Event156	6:00:25	0:11:06			270	215	12.6	17.9	27000	35	21.9			400		56
Event157	6:00:31	0:11:00				215	12.2	17.4	26667	35	21.2			400		56
Event158	6:00:36	0:10:55				215	11.9	16.9	26389	35	20.7			400		56
Event159	6:00:36	0:10:55				215	11.9	16.9	26389	35	20.7			400		56
Event160	6:00:36	0:10:55				215	11.9	16.9	26389	35	20.7			400		56
Event161	6:00:36	0:10:55				215	11.9	16.9	26389	35	20.7			400		56
Event162	6:00:47	0:10:44				215	11.2	15.9	25778	35	19.4			400		56
Event163	6:00:50	0:10:41				215	11.0	15.7	25611	35	19.1			400		56
Event164	6:00:51	0:10:40				215	10.9	15.6	25556	35	19.0			400		56
Event165	6:00:53	0:10:38				215	10.8	15.4	25444	35	18.8			400		56

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event166	6:01:01	0:10:30			250	215	10.3	14.7	25000	35	17.9			400		80
Event167	6:01:03	0:10:28				215	10.1	14.5	24840	35	17.7			400		80
Event168	6:01:06	0:10:25				215	9.9	14.2	24600	35	17.3			400		80
Event169	6:01:11	0:10:20				215	9.6	13.7	24200	35	16.8			400		80
Event170	6:01:16	0:10:15				215	9.3	13.3	23800	35	16.2			400		80
Event171	6:01:26	0:10:05			230	215	8.7	12.4	23000	35	15.1			400		80
Event172	6:01:38	0:09:53				215	7.9	11.3	22418	35	13.8			400		48
Event173	6:01:42	0:09:49				215	7.6	10.9	22224	35	13.3			400		48
Event174	6:01:47	0:09:44				215	7.3	10.5	21982	35	12.8			400		48
Event175	6:01:56	0:09:35				215	6.8	9.6	21545	35	11.8			400		48
Event176	6:02:02	0:09:29				215	6.4	9.1	21255	35	11.1			400		48
Event177	6:02:04	0:09:27				215	6.2	8.9	21158	35	10.9			400		48
Event178	6:02:09	0:09:22				215	5.9	8.5	20915	35	10.3			400		48
Event179	6:02:42	0:08:49				215	3.8	5.5	19315	35	6.7			400		48
Event180	6:02:49	0:08:42				215	3.4	4.8	18976	35	5.9			400		48

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event181	6:02:59	0:08:32				215	2.7	3.9	18491	35	4.8			400		48
Event182	6:03:05	0:08:26				215	2.4	3.4	18200	35	4.1			400		48
Event183	6:03:08	0:08:23				215	2.2	3.1	18055	35	3.8			400		48
Event184	6:03:10	0:08:21				215	2.0	2.9	17958	35	3.6			400		48
Event185	6:03:12	0:08:19				215	1.9	2.7	17861	35	3.3			400		48
Event186	6:03:16	0:08:15	25			205	1.2	2.6	17667	25	2.9			400		48
Event187	6:03:24	0:08:07				205	0.8	1.8	17279	25	2.0			400		48
Event188	6:03:34	0:07:57				205	0.4	0.8	16794	25	0.9			400		48
Event189	6:03:38	0:07:53				205	0.2	0.4	16600	25	0.4			400		48
Event190	6:03:42	0:07:49		0		207	0.0	0.0	16406	205	0.0	0	16406	253	253	48
Event191	6:03:53	0:07:38				207	-0.3	-0.7	15873	205	0.8	0	15873	253	253	48
Event192	6:03:57	0:07:34				207	-0.4	-1.0	15679	205	1.1	0	15679	253	253	48
Event193	6:04:01	0:07:30				207	-0.6	-1.2	15485	205	1.3	0	15485	253	253	48
Event194	6:04:02	0:07:29				207	-0.6	-1.3	15436	205	1.4	0	15436	253	253	48
Event195	6:04:03	0:07:28	205			207	-0.6	-1.3	15388	205	1.5	0	15388	253	253	48

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event196	6:04:06	0:07:25				207	-0.7	-1.5	15242	205	1.7	0	15242	253	253	48
Event197	6:04:10	0:07:21				207	-0.8	-1.8	15048	205	2.0	0	15048	253	253	48
Event198	6:04:11	0:07:20			150	207	-0.9	-1.8	15000	205	2.0	0	15000	253	253	28
Event199	6:04:13	0:07:18				207	-0.9	-2.0	14943	205	2.2	0	14943	253	253	28
Event200	6:04:15	0:07:16				207	-1.0	-2.1	14886	205	2.3	0	14886	253	253	28
Event201	6:04:17	0:07:14				207	-1.0	-2.2	14830	205	2.5	0	14830	253	253	28
Event202	6:04:19	0:07:12				207	-1.1	-2.4	14773	205	2.6	0	14773	253	253	28
Event203	6:04:24	0:07:07				207	-1.2	-2.7	14631	205	3.0	0	14631	253	253	28
Event204	6:04:32	0:06:59				207	-1.5	-3.2	14403	205	3.5	0	14403	253	253	28
Event205	6:04:35	0:06:56				207	-1.6	-3.4	14318	205	3.7	0	14318	253	253	28
Event206	6:04:41	0:06:50				207	-1.8	-3.8	14148	205	4.2	0	14148	253	253	28
Event207	6:04:43	0:06:48				207	-1.8	-3.9	14091	205	4.3	0	14091	253	253	28
Event208	6:04:46	0:06:45				207	-1.9	-4.1	14006	205	4.5	0	14006	253	253	28
Event209	6:04:48	0:06:43				207	-2.0	-4.2	13949	205	4.6	0	13949	253	253	28
Event210	6:04:53	0:06:38				207	-2.1	-4.5	13807	205	5.0	0	13807	253	253	28

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event211	6:04:54	0:06:37				207	-2.1	-4.6	13778	205	5.1	0	13778	253	253	28
Event212	6:04:55	0:06:36				207	-2.2	-4.7	13750	205	5.1	0	13750	253	253	28
Event213	6:05:01	0:06:30				207	-2.3	-5.0	13580	205	5.6	0	13580	253	253	28
Event214	6:05:10	0:06:21				207	-2.6	-5.6	13324	205	6.2	0	13324	253	253	28
Event215	6:05:15	0:06:16				207	-2.8	-5.9	13182	205	6.5	0	13182	253	253	28
Event216	6:05:28	0:06:03				207	-3.2	-6.8	12813	205	7.5	0	12813	253	253	28
Event217	6:05:35	0:05:56				207	-3.4	-7.2	12614	205	7.9	0	12614	253	253	28
Event218	6:05:43	0:05:48				180	-3.3	-7.8	12386	203	8.5	21	12365	258	253	28
Event219	6:05:45	0:05:46				180	-3.3	-7.9	12330	203	8.6	24	12305	258	253	28
Event220	6:05:47	0:05:44				180	-3.3	-8.1	12273	202	8.7	27	12246	258	253	28
Event221	6:05:54	0:05:37				180	-3.3	-8.6	12074	201	9.2	37	12037	258	253	28
Event222	6:05:55	0:05:36				180	-3.3	-8.6	12045	201	9.2	38	12007	258	253	28
Event223	6:05:58	0:05:33				180	-3.3	-8.8	11960	200	9.4	43	11918	258	253	28
Event224	6:06:02	0:05:29				180	-3.3	-9.1	11847	200	9.7	48	11798	258	253	28
Event225	6:06:02	0:05:29				180	-3.3	-9.1	11847	200	9.7	48	11798	258	253	28

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event226	6:06:05	0:05:26				180	-3.3	-9.4	11761	199	9.9	53	11709	258	253	28
Event227	6:06:05	0:05:26				180	-3.3	-9.4	11761	199	9.9	53	11709	258	253	28
Event228	6:06:07	0:05:24				180	-3.3	-9.5	11705	199	10.0	56	11649	258	253	28
Event229	6:06:12	0:05:19				180	-3.3	-9.9	11563	198	10.4	63	11500	258	253	28
Event230	6:06:19	0:05:12				180	-3.3	-10.4	11364	197	10.9	73	11291	258	253	28
Event231	6:06:23	0:05:08				180	-3.2	-10.6	11250	197	11.1	78	11172	258	253	28
Event232	6:06:27	0:05:04				180	-3.2	-10.9	11136	196	11.4	84	11052	258	253	28
Event233	6:06:36	0:04:55				180	-3.2	-11.6	10881	196	12.0	97	10784	258	253	28
Event234	6:06:41	0:04:50				180	-3.2	-11.9	10739	195	12.3	104	10635	258	253	28
Event235	6:06:48	0:04:43				180	-3.2	-12.4	10540	194	12.8	114	10426	258	253	28
Event236	6:06:50	0:04:41				180	-3.2	-12.6	10483	194	13.0	117	10366	258	253	28
Event237	6:07:07	0:04:24			100	180	-3.1	-13.8	10000	193	14.1	141	9859	258	253	26
Event238	6:07:14	0:04:17				180	-3.1	-14.3	9817	192	14.6	151	9666	258	253	26
Event239	6:07:18	0:04:13				180	-3.1	-14.6	9713	192	14.9	157	9556	258	253	26
Event240	6:07:27	0:04:04				180	-3.1	-15.2	9478	191	15.5	170	9308	258	253	26

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event241	6:07:30	0:04:01				180	-3.1	-15.4	9400	191	15.7	174	9226	258	253	26
Event242	6:07:33	0:03:58				180	-3.1	-15.6	9322	191	15.9	178	9143	258	253	26
Event243	6:07:34	0:03:57				180	-3.1	-15.7	9296	191	16.0	180	9116	258	253	26
Event244	6:08:32	0:02:59				180	-2.9	-19.9	7783	188	20.1	394	7389	258	253	26
Event245	6:08:37	0:02:54				180	-2.9	-20.2	7652	188	20.4	394	7258	258	253	26
Event246	6:08:41	0:02:50				180	-2.9	-20.5	7548	188	20.7	394	7154	258	253	26
Event247	6:08:45	0:02:46		21		180	-2.9	-20.8	7443	188	21.0	394	7050	258	253	26
Event248	6:08:53	0:02:38				180	-2.9	-21.3	7235	188	21.5	394	6841	229	224	26
Event249	6:08:57	0:02:34				180	-2.9	-21.6	7130	188	21.8	394	6737	229	224	26
Event250	6:08:59	0:02:32				180	-2.9	-21.7	7078	188	21.9	419	6659	229	224	26
Event251	6:09:02	0:02:29			70	180	-2.9	-21.9	7000	187	22.1	472	6528	229	224	26
Event252	6:09:05	0:02:26				180	-2.9	-22.1	6913	187	22.3	525	6388	229	224	29
Event253	6:09:14	0:02:17				180	-2.8	-22.6	6650	187	22.8	683	5968	229	224	29
Event254	6:09:20	0:02:11				180	-2.8	-23.0	6476	187	23.2	788	5687	229	224	29
Event255	6:09:24	0:02:07				180	-2.8	-23.3	6359	187	23.5	1078	5281	229	224	29

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event256	6:09:28	0:02:03				180	-2.8	-23.5	6243	187	23.7	1398	4844	229	224	29
Event257	6:09:32	0:01:59				180	-2.8	-23.8	6126	187	24.0	1686	4440	229	224	29
Event258	6:09:34	0:01:57				180	-2.8	-23.9	6068	187	24.1	1812	4256	229	224	29
Event259	6:09:36	0:01:55				180	-2.8	-24.0	6010	187	24.2	1937	4073	229	224	29
Event260	6:09:39	0:01:52				180	-2.8	-24.2	5922	187	24.4	2009	3914	229	224	29
Event261	6:09:40	0:01:51				180	-2.8	-24.3	5893	187	24.5	2012	3881	229	224	29
Event262	6:09:40	0:01:51				180	-2.8	-24.3	5893	187	24.5	2012	3881	229	224	29
Event263	6:09:40	0:01:51				180	-2.8	-24.3	5893	187	24.5	2012	3881	229	224	29
Event264	6:10:30	0:01:01				180	-2.6	-27.5	4437	186	27.6	2805	1632	229	224	29
Event265	6:10:34	0:00:57				180	-2.6	-27.7	4320	185	27.9	3199	1122	229	224	29
Event266	6:10:38	0:00:53				180	-2.6	-28.0	4204	185	28.1	3199	1005	229	224	29
Event267	6:10:39	0:00:52				180	-2.6	-28.1	4175	185	28.2	3199	976	229	224	29
Event268	6:10:41	0:00:50				180	-2.6	-28.2	4117	185	28.3	3199	918	229	224	29
Event269	6:10:42	0:00:49				180	-2.6	-28.2	4087	185	28.4	3199	889	229	224	29
Event270	6:10:45	0:00:46			40	180	-2.6	-28.4	4000	185	28.6	3199	801	229	224	29

Table 1: Flight Parameters and Communications

	Time		Navigation				Coordinate							Speed		
	GMT	TBI	VOR	DME	FL	heading	e	n	z	bearing	range	GL	AGL	GS	AS	DS
Event271	6:10:46	0:00:45				180	-2.6	-28.5	3972	185	28.6	3199	773	229	224	28
Event272	6:10:50	0:00:41				180	-2.6	-28.8	3870	185	28.9	3199	671	229	224	23
Event273	6:10:52	0:00:39		29		180	-2.6	-28.9	3827	185	29.0	3199	628	229	224	20
Event274	6:10:54	0:00:37				180	-2.6	-29.0	3789	185	29.1	3199	590	229	224	18
Event275	6:11:01	0:00:30				180	-2.6	-29.5	3696	185	29.6	3199	497	229	224	9
Event276	6:11:06	0:00:25				180	-2.6	-29.8	3668	185	29.9	3199	469	229	224	3
Event277	6:11:08	0:00:23				180	-2.6	-29.9	3665	185	30.0	3199	466	229	224	0
Event278	6:11:16	0:00:15				190	-2.6	-30.4	3706	185	30.5	3431	275	228	224	-10
Event279	6:11:22	0:00:09				198	-2.7	-30.8	3789	185	30.9	3625	164	226	224	-18
Event280	6:11:31	0:00:00			40	210	-2.93	-31.27	4000	185	31.4	4000	0	224	224	-29
Event281	6:11:41															
Event282			186	31.8		210	-2.99	-30.80	4000							

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event001	5:34:50	0:36:10	N204C -- Johnston	Sector	Kinabalu Control Gulfstream Novermber two zero four Charlie position.
Event002	5:34:56	0:36:04	Sector	N204C	November two zero four Charlie go ahead position.
Event003	5:35:04	0:35:56	N204C -- Johnston	Sector	November two zero four Charlie we're over PR zero five two five flight level four three zero estimating at time FIR zero five four four next will be Kudat.
Event004	5:35:19	0:35:41	Sector	N204C	November two zero four Charlie request estimate for Kinabalu.
Event005	5:35:24	0:35:36	N204C -- Johnston	Sector	Ok, standby.
Event006	5:35:44	0:35:16	N204C -- Johnston	Sector	Kinabalu November two zero four Charlie estimating Kota Kinabalu at ...zero six zero one.
Event007	5:35:52	0:35:08	Sector	N204C	Two zero four Charlie report FIR boundry.
Event008	5:36:03	0:34:57	N204C -- Johnston	Sector	...Roger, will report the boundry zero four Charlie.
Event009	5:36:06	0:34:54	Approach	Sector	Go ahead.
Event010	5:36:10	0:34:50	Sector	Approach	Revision on two zero four Charlie. Estimate Kinabalu zero six zero one now.
Event011	5:36:10	0:34:50	Approach	Sector	zero one ... ok copy.
Event012	5:36:10	0:34:50	Sector	Approach	Affirmative.
Event013	5:40:15	0:31:16	Sector	MH551	Five five one report DME now
Event014	5:40:18	0:31:13	MH551	Sector	Four two, Malaysian five five one.
Event015	5:40:20	0:31:11	Sector	MH551	Five five one. Report passing five zero DME.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event016	5:40:23	0:31:08	MH551	Sector	Malaysian five five one.
Event017	5:40:46	0:30:45	MH551	Sector	Five five one we are now at 45 DME.
Event018	5:40:49	0:30:42	Sector	MH551	Five five one.
Event019	5:41:15	0:30:16	MH551	Sector	Malaysian five five one, five zero DME.
Event020	5:41:19	0:30:12	Sector	MH551	Five five one, contact one one one eight one.
Event021	5:41:22	0:30:09	MH551	Sector	One one eight one (to)?
Event022	5:41:24	0:30:07	Sector	MH551	Right.
Event023	5:42:31	0:29:00	MH630	Sector	Malaysian six three zero request runway two zero.
Event024	5:42:37	0:28:54	Sector	MH630	Six three zero keep me advised. Report DME and level passing now.
Event025	5:42:42	0:28:49	MH630	Sector	Malaysian six three zero - uh - we left Flight Level two two zero, DME six one.
Event026	5:42:52	0:28:39	Sector	MH630	Malaysian -uh- six three zero.
Event027	5:45:14	0:26:17	?	?	(Malaysian)
Event028	5:45:17	0:26:14	?	?	(Malaysian) Go ahead.
Event029	5:45:19	0:26:12	?	?	(Malaysian)
Event030	5:45:20	0:26:11	?	?	(Malaysian)

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event031	5:45:22	0:26:09	?	?	(Malaysian)
Event032	5:45:26	0:26:05	?	?	(Malaysian)
Event033	5:45:30	0:26:01	?	?	(Malaysian)
Event034	5:45:32	0:25:59	?	?	(Malaysian)
Event035	5:45:36	0:25:55	Sector	MH630	Six three zero DME and level passing now.
Event036	5:45:40	0:25:51	MH630	Sector	Malaysian six three zero, level - uh - one -- Flight Level one - uh -one three zero and - uh - four zero DME.
Event037	5:45:48	0:25:43	Sector	MH630	Six three zero, continue descent to four thousand feet. Contact Approach one one eight decimal three.
Event038	5:45:53	0:25:38	?	?	(Malaysian)
Event039	5:45:55	0:25:36	MH630	Sector	Malaysian six three zero, continue descent to four thousand, contact one one eight decimal three. Good day.
Event040	5:46:01	0:25:30	Sector	MH630	Good day.
Event041	5:46:06	0:25:25	N204C -- Johnston	Sector	Kinabalu Gulfstream November two zero four Charlie just past the FIR at zero five four four flight level four three oh.
Event042	5:46:15	0:25:16	?	?	(Malaysian)
Event043	5:46:20	0:25:11	?	?	(Malaysian)
Event044	5:46:27	0:25:04	MH391	Sector	Kinabalu Control, good afternoon. Malaysia three nine one.
Event045	5:46:29	0:25:02	?	?	(Malaysian)

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event046	5:46:31	0:25:00	?	?	(Malaysian)
Event047	5:46:39	0:24:52	?	?	(Malaysian)
Event048	5:46:44	0:24:47	Sector	N204C	November two zero four Charlie report for decent, you are number two in traffic, expected approach time zero six zero five runway zero two.
Event049	5:46:53	0:24:38	?	Sector	(Malaysian)
Event050	5:46:57	0:24:34	N204C -- Johnston	Sector	Ok -- huh -- expected approach at zero six zero five for - uh- runway two?
Event051	5:47:03	0:24:28	Sector	N204C	That is correct runway zero two. Kinabalu weather surface wind two nine zero degrees one zero knots; one zero kilometers or more; hazy one octa one thousand six hundred feet; one octa cb one thousand seven hundred feet, direction north east; QNH one zero zero niner; temperature three one.
Event052	5:47:25	0:24:06	?	?	(Malaysian)
Event053	5:47:28	0:24:03	N204C -- Johnston	Sector	Zero four Charlie
Event054	5:47:33	0:23:58	?	?	(Malaysian)
Event055	5:47:37	0:23:54	MH391	Sector	Kinabalu Control, Malaysia three nine one.
Event056	5:47:41	0:23:50	Sector	MH391	Three nine one, Kinabalu; you are cleared to Victor Juliet November from on the inbound radial zero nine one, Flight Level one six five, number three in traffic, expected approach time is zero six one five, Runway zero two.
Event057	5:47:56	0:23:35			
Event058	5:47:57	0:23:34	MH391	Sector	Malaysian three nine one Roger, cleared to Victor Juliet November on the zero nine one on the radial, Flight Level one six five, expected approach time for runway zero two is zero six one five, number three in traffic, copy - uh - your weather one zero zero nine, and confirm your - uh - wind is one nine zero degrees one zero knots.
Event059	5:47:58	0:23:33			
Event060	5:48:01	0:23:30			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event061	5:48:02	0:23:29			
Event062	5:48:05	0:23:26			
Event063	5:48:17	0:23:14	Sector	MH391	Two eight zero degrees at nine knots now.
Event064	5:48:25	0:23:06	MH391	Sector	That's at two eight zero degrees at nine knots and we were approved at Sandakan two zero miles -- up to two zero miles left of track due weather, and confirm that's - uh - acceptable?
Event065	5:48:36	0:22:55	Sector	MH391	Three nine one affirmative, two zero miles - uh - left of track.
Event066	5:48:40	0:22:51	MH391	Sector	Malaysian three nine one.
Event067	5:48:44	0:22:47	MH78	Sector	Malaysian seven eight, passing five thousand five hundred for Flight Level two five sero.
Event068	5:48:54	0:22:37	Sector	MH78	Seven eight, climb initially to five zero, request radial outbound for Victor Jouliet November.
Event069	5:49:00	0:22:31			
Event070	5:49:03	0:22:28	?	?	(Malaysian)
Event071	5:49:03	0:22:28			
Event072	5:49:14	0:22:17			
Event073	5:49:51	0:21:40	Sector	MH78	Malaysian seven eight, Kinabalu.
Event074	5:49:57	0:21:34	MH78	Sector	Malaysian seven eight, go ahead.
Event075	5:49:59	0:21:32	Sector	MH78	Request radial outbound for Victor Jouliet November.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event076	5:50:03	0:21:28	MH78	Sector	Stand by.
Event077	5:50:08	0:21:23	MH78	Sector	The radial is - uh - zero one nine.
Event078	5:50:14	0:21:17	Sector	MH78	Seven eight, maintain radial zero one nine.
Event079	5:50:17	0:21:14	MH78	Sector	Roger, maintaining.
Event080	5:50:23	0:20:37	Sector	Approach	November two zero four Charlie will be number two. Your lowest for him?
Event081	5:50:23	0:20:37	Approach	Sector	Number two for ... Ok, lowest is five thousand feet.
Event082	5:50:23	0:20:37	Sector	Approach	Five thousand ... Ok. Release contact to you passing flight level two five zero estimate zero one given expected approach time zero five runway zero two.
Event083	5:50:23	0:20:37	Approach	Sector	Ok copy.
Event084	5:51:09	0:20:22	Sector	MH391	Three nine one report DME for Victor Jouliet November.
Event085	5:51:09	0:20:22			
Event086	5:51:13	0:20:18	MH391	Sector	Malaysian three niner one is - uh - six two D uh - correction - uh - negative - uh - DME reading on - uh - Victor Jouliot November you are six two DME Victor Jouliet November.
Event087	5:51:18	0:20:13			
Event088	5:51:28	0:20:03	Sector	MH391	Three nine one.
Event089	5:51:32	0:19:59	MH391	Sector	And three nine one, we now have DME lockin at five niner. DME Victor Jouliet November.
Event090	5:51:38	0:19:53	Sector	MH391	Three nine one.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event091	5:52:13	0:19:18	N204C -- Fox	IEF	Kota Kinabalu Gulfstream November two zero four Charlie calling I.E.F.SDN. Brothers one three zero seven, go ahead.
Event092	5:52:24	0:19:07	IEF -- Flynn	N204C	Uh - November two zero four Charlie, good afternoon. Go ahead.
Event093	5:52:29	0:19:02	N204C -- Fox	IEF	Uh - Yes sir, we're inbound at this time - uh - we should be on the ground at Kota in about - uh - fifteen minutes for -- huh -- fuel.
Event094	5:52:35	0:18:56	IEF -- Flynn	N204C	Uh - Roger, copied. Anything else you need?
Event095	5:52:39	0:18:52	N204C -- Fox	IEF	Uh, I beleive that's gonna do right now. We'll just need some trash pick up and - uh - basically we're out of fuel.
Event096	5:52:45	0:18:46	IEF -- Flynn	N204C	Uh Roger, see you on the ground. And you will be pumped at the new terminal.
Event097	5:52:49	0:18:42	N204C -- Fox	IEF	Ok, I understand this will be the new terminal.
Event098	5:52:51	0:18:40	IEF -- Flynn	N204C	Affirmative.
Event099	5:52:57	0:18:34			
Event100	5:53:40	0:17:51			
Event101	5:53:46	0:17:45			
Event102	5:53:47	0:17:44			
Event103	5:53:48	0:17:43			
Event104	5:54:08	0:17:23			
Event105	5:54:15	0:17:16	N204C -- Johnston	Sector	Kinabalu Control. Gulfstream November two zero four Charlie. We'd just like to start down now for the decent.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event106	5:54:21	0:17:10	Sector	N204C	November two zero four Charlie decend to Flight Level one eight zero.
Event107	5:54:25	0:17:06	N204C -- Johnston	Sector	Flight Level one eight zero.
Event108	5:54:30	0:17:01	Sector	N204C	November two zero four Charlie request radial inbound to Victor Juliet November.
Event109	5:54:36	0:16:55			
Event110	5:54:39	0:16:52	N204C -- Johnston	Sector	We are on the - uh - zero three five radial.
Event111	5:54:45	0:16:46	Sector	N204C	November two zero four Charlie reclear Flight Level two six zero.
Event112	5:54:50	0:16:41	N204C -- Johnston	Sector	Ok, understand two six zero -- huh -- on the Flight Level.
Event113	5:54:55	0:16:36	MH391	Sector	Malaysian - uh - three niner one, checking inbound at five two, level one six five, es - revised estimnate at Victor Jouliet November at - uh -zero seven, requesting descent. We are four five DME now.
Event114	5:55:11	0:16:20	Sector	MH391	Three nine one, duh - descend to - five thousand feet.
Event115	5:55:17	0:16:14	MH391	Sector	Five thousand, Malaysian three nine one.
Event116	5:55:42	0:15:18	Sector	Approach	November two zero four Charlie release contact passing Flight Level two five zero. Decending to Flight Level one five zero. Estimate at time zero six zero eight. Also given expected approach time one eight runway zero two.
Event117	5:55:42	0:15:18	Approach	Sector	Roger.
Event118	5:55:43	0:15:48			
Event119	5:55:44	0:15:47			
Event120	5:56:01	0:15:30			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event121	5:56:04	0:15:27			
Event122	5:56:06	0:15:25			
Event123	5:56:17	0:15:14	Sector	N204C	November two zero four Charlie report DME from Victor Juliet November.
Event124	5:56:22	0:15:09	N204C -- Johnston	Sector	Ok, we're showing uh five one DME.
Event125	5:56:29	0:15:02	Sector	N204C	November two zero four Charlie.
Event126	5:56:32	0:14:59	?	?	(Noise)
Event127	5:56:48	0:14:43	MH391	Sector	Malaysian three nine one is leaving uh Flight Level one six five.
Event128	5:56:54	0:14:37	Sector	MH391	Three nine one. Report passing - uh - Flight Level one four zero, your no delay now Runway zero two.
Event129	5:57:01	0:14:30	MH391	Sector	Wilco, Malaysian three nine one and we're uh presently crossing the one zero six on the radial and uh well left of track.
Event130	5:57:09	0:14:22	Sector	MH391	Three nine one.
Event131	5:57:38	0:13:53	Sector	MH78	Malaysian seven eight, report DME for Victor Jouliet November.
Event132	5:57:43	0:13:48	MH78	Sector	Uh - Malaysian seven eight, seven five DME, passing Flight Level two zero five.
Event133	5:57:51	0:13:40	Sector	MH78	Malaysian seven eight, reclear now Flight Level three three zero.
Event134	5:57:56	0:13:35	MH78	Sector	Uh - Roger, now cleared Flight Level three three zero, thank you.
Event135	5:58:02	0:13:29	Sector	N204C	November two zero four Charlie decend to Flight Level one seven zero. Report DME now.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event136	5:58:09	0:13:22	N204C -- Johnston	Sector	Ok three seven DME and uh cleared down to one seven uh DME -- or, uh -- Flight Level.
Event137	5:58:16	0:13:15	Sector	N204C	Roger, November two zero four Charlie.
Event138	5:58:24	0:13:07	Sector	MH391	Three nine one report DME.
Event139	5:58:26	0:13:05	MH391	Sector	Three nine one is three two DME.
Event140	5:58:32	0:12:59	Sector	N204C	November two zero four Charlie slow down appraoch speed, number two in traffic, expected approach time now one eight runway zero two.
Event141	5:58:41	0:12:50	N204C -- Johnston	Sector	Ok, slow down expect-- uh -- approach time - uh - one eight.
Event142	5:58:47	0:12:44	Sector	N204C	November four Charlie.
Event143	5:58:51	0:12:40	BR068	Sector	Kinabalu, good afternoon, Brunei zero six eight.
Event144	5:58:55	0:12:36	Sector	BR068	Brunei zero six eight, Kinabalu. Your cleared for Moumoo direct to Brunei, Flight Level three nine zero and - uh - number two in traffic, expected approach time zero six three zero, Runway zero two -- correction Runway two one.
Event145	5:59:09	0:12:22	BR068	Sector	Cleared for Moumoo, check Brunei three nine zero, number two, expect appraoch time zero six uh three zero, and we've been cleared by Jakarta to descend below -- to two five zero and requesting descent at time zero six.
Event146	5:59:24	0:12:07	Sector	BR068	Brunei zero six eight, Roger. Cleared to descend to two five zero before Moumoo and uh report Moumoo.
Event147	5:59:32	0:11:59	BR068	Sector	To descend below - two - two. Correction, to descend to Flight Level two five zero before Moumoo, report Moumoo, Brunei zero six eight.
Event148	5:59:40	0:11:51	Sector	BR068	Zero six eight.
Event149	5:59:55	0:11:36			
Event150	5:59:57	0:11:34			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event151	6:00:02	0:11:29	Sector	MH391	Three nine one report level passing now.
Event152	6:00:05	0:11:26	MH391	Sector	Three nine one out of uh one two thousand now two six DME, and tracking direct to the omni on the radial of one one two.
Event153	6:00:12	0:11:19	Sector	MH391	Three nine one contact Approach one one eight decimal three.
Event154	6:00:15	0:11:16	MH391	Sector	Going to one one eight decimal three, Malaysian three nine one.
Event155	6:00:20	0:11:11	Sector	N204C	November two zero four Charlie decend to Flight Level one five zero and uh report level passing now.
Event156	6:00:25	0:11:06	N204C -- Johnston	Sector	Ohh... we're Flight Level two seven oh and down to one five oh.
Event157	6:00:31	0:11:00	Sector	N204C	November two zero four Charlie. Report passing Flight Level two five zero.
Event158	6:00:36	0:10:55	N204C -- Johnston	Sector	Roger.
Event159	6:00:36	0:10:55			
Event160	6:00:36	0:10:55			
Event161	6:00:36	0:10:55			
Event162	6:00:47	0:10:44	Sector	MH78	Malaysian seven eight can you maintain three three zero (bi-lada)?
Event163	6:00:50	0:10:41			
Event164	6:00:51	0:10:40			
Event165	6:00:53	0:10:38			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event166	6:01:01	0:10:30	N204C -- Johnston	Sector	Gulfstream two zero four Charlie out of uh two five oh for one five oh.
Event167	6:01:03	0:10:28			
Event168	6:01:06	0:10:25	Sector	N204C	November two zero four Charlie contact Approach Control one one eight decimal three.
Event169	6:01:11	0:10:20	N204C -- Johnston	Sector	... three
Event170	6:01:16	0:10:15	MH78	Sector	Malaysian seven eight Kinaba ...
Event171	6:01:26	0:10:05	N204C -- Johnston	Approach	Kinabalu Approach Gulfstream November two zero four Charlie descending to Flight Level one five zero passing through - ah - twenty three.
Event172	6:01:38	0:09:53	Approach	N204C	November two zero four Charlie say again your level level passing.
Event173	6:01:42	0:09:49	N204C -- Johnston	Approach	Passing .ah.. two three oh and descending to one five oh.
Event174	6:01:47	0:09:44	Approach	N204C	November two zero four Charlie runway zero two. Report reaching Flight Level one five zero.
Event175	6:01:56	0:09:35	N204C -- Johnston	Approach	Roger report reaching one five zero.
Event176	6:02:02	0:09:29			
Event177	6:02:04	0:09:27			
Event178	6:02:09	0:09:22			
Event179	6:02:42	0:08:49			
Event180	6:02:49	0:08:42	N204C -- Johnston	Approach	Approach two zero four Charlie -- uh -- you want us to track outbound on the two five eight degree radial or uh hold over the VOR?

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event181	6:02:59	0:08:32	Approach	N204C	November two zero four Charlie report radial maintaining now.
Event182	6:03:05	0:08:26			
Event183	6:03:08	0:08:23			
Event184	6:03:10	0:08:21			
Event185	6:03:12	0:08:19	Approach	N204C	Zero four Charlie report radial maintaining now.
Event186	6:03:16	0:08:15	N204C -- Johnston	Approach	Ok, zero four Charlie, we're on the -- ah -- zero two five radial.
Event187	6:03:24	0:08:07	Approach	N204C	Maintain radial zero two five to Victor Juliet November.
Event188	6:03:34	0:07:57			
Event189	6:03:38	0:07:53			
Event190	6:03:42	0:07:49	N204C -- Johnston	Approach	Ok, uh two zero four Charlie we're passing uh over the VOR and -- uh -- you want us to go outbound on that two five eight radial?
Event191	6:03:53	0:07:38	Approach	N204C	Confirm you are over the Victor Juliet November VOR now?
Event192	6:03:57	0:07:34			
Event193	6:04:01	0:07:30			
Event194	6:04:02	0:07:29			
Event195	6:04:03	0:07:28	N204C -- Johnston	Approach	That's affirmative, we are over the VOR.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event196	6:04:06	0:07:25	Approach	MH391	Malaysian three nine one report uh level passing.
Event197	6:04:10	0:07:21			
Event198	6:04:11	0:07:20	N204C -- Johnston	Approach	We're level one five thousand.
Event199	6:04:13	0:07:18	Approach	MH391	Malaysian three nine one Kinabalu.
Event200	6:04:15	0:07:16	MH391	Approach	Three nine one go ahead
Event201	6:04:17	0:07:14	Approach	MH391	Report level passing now and DME.
Event202	6:04:19	0:07:12	MH391	Approach	Level eight thousand five, one one DME leaving for six thousand
Event203	6:04:24	0:07:07	Approach	N204C	November two zero four Charlie descend over the Victor Juliet November VOR to nine thousand five hundred.
Event204	6:04:32	0:06:59	N204C -- Johnston	Approach	We understand descend to nine thousand five hundred.
Event205	6:04:35	0:06:56	Approach	N204C	November two zero four Charlie that is affirmative. Report passing one zero thousand.
Event206	6:04:41	0:06:50			
Event207	6:04:43	0:06:48	N204C -- Johnston	Approach	Ok, report out of uh one zero thousand.
Event208	6:04:46	0:06:45	Approach	N204C	Affirmative.
Event209	6:04:48	0:06:43			
Event210	6:04:53	0:06:38			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event211	6:04:54	0:06:37			
Event212	6:04:55	0:06:36	MH413	Approach	Kinabalu Tower Malaysian four one three Mike Bravo Kilo Bay four requesting Sandakan Flight Level one seven zero push start, one zero minutes.
Event213	6:05:01	0:06:30	Approach	MH413	Four one three expect runway zero two surface wind three zero zero one zero knots QNH one zero zero nine temperature three zero.
Event214	6:05:10	0:06:21	Approach	MH413	Check QNH one zero zero nine for runway zero two. Malaysian four one three, thank you.
Event215	6:05:15	0:06:16	N204C -- Johnston	Approach	Two oh four Charlie, ah we're still uncertain. Do you want us to go outbound on the two five eight degree radial or do you want us to hold?
Event216	6:05:28	0:06:03	Approach	N204C	November two zero four Charlie decend south of the airfield to nine thousand five hundred.
Event217	6:05:35	0:05:56	N204C -- Johnston	Approach	Roger, understand you said south to nine thousand five hundred. And we're passing -- uh -- one five thousand now.
Event218	6:05:43	0:05:48	Approach	N204C	Roger, report passing one zero thousand.
Event219	6:05:45	0:05:46	N204C -- Johnston	Approach	Thank you.
Event220	6:05:47	0:05:44	MH391	Approach	(Noise) and we're visual sir.
Event221	6:05:54	0:05:37			
Event222	6:05:55	0:05:36	MJP	Approach	Mike Jouliet Pappa turning final zero two
Event223	6:05:58	0:05:33	Approach	MJP	Mike Jouliet Pappa clear for touch and go landing surface wind three zero zero one zero
Event224	6:06:02	0:05:29			
Event225	6:06:02	0:05:29	MJP	Approach	Mike Jouliet Pappa touch and go left turn.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event226	6:06:05	0:05:26			
Event227	6:06:05	0:05:26	Approach	MH391	Malaysian three nine one say again.
Event228	6:06:07	0:05:24	MH391	Approach	Three nine one is leaving five thousand five hundred now and we are visual sir.
Event229	6:06:12	0:05:19	Approach	MH391	Roger, continue descent to two thousand five hundred runway zero two and report passing four thousand.
Event230	6:06:19	0:05:12	MH391	Approach	Roger, three nine one two thousand five hundred, wilco.
Event231	6:06:23	0:05:08	Approach	MH391	Report DME.
Event232	6:06:27	0:05:04	Approach	MH391	Three nine one report DME.
Event233	6:06:36	0:04:55	Approach	MH391	Malaysian three nine one report DME.
Event234	6:06:41	0:04:50	MH391	Approach	Three nine one is five DME.
Event235	6:06:48	0:04:43	Approach	MH391	Malaysian three nine one position for - right base runway zero two.
Event236	6:06:50	0:04:41	MH391	Approach	Three nine one right base zero two.
Event237	6:07:07	0:04:24	N204C -- Johnston	Approach	Zero four Charlie passing through uh ten thousand.
Event238	6:07:14	0:04:17	Approach	N204C	November two zero four Charlie continue decent to six thousand.
Event239	6:07:18	0:04:13	N204C -- Johnston	Approach	Down to six thousand.
Event240	6:07:27	0:04:04	MH391	Approach	Three niner one has left three thousand right base zero two.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event241	6:07:30	0:04:01	Approach	MH391	Three nine cleared to final runway zero two.
Event242	6:07:33	0:03:58			
Event243	6:07:34	0:03:57	MH391	Approach	Three niner one, roger cleared to final runway zero two.
Event244	6:08:32	0:02:59	Approach	MH391	Malaysian three nine one cleared to land surface wind three zero zero one zero.
Event245	6:08:37	0:02:54	MH391	Approach	Three nine one cleared to land.
Event246	6:08:41	0:02:50	Approach	N204C	November two zero four Charlie report DME south.
Event247	6:08:45	0:02:46	N204C -- Johnston	Approach	Reportn' uh two one DME south.
Event248	6:08:53	0:02:38	Approach	N204C	November two zero four Charlie continue descent to three thousand.
Event249	6:08:57	0:02:34	N204C -- Johnston	Approach	Three thousand, zero four Charlie.
Event250	6:08:59	0:02:32	Approach	N204C	Zero four Charlie, level passing now?
Event251	6:09:02	0:02:29	N204C -- Johnston	Approach	Seven thousand.
Event252	6:09:05	0:02:26	Approach	N204C	November two zero four Charlie expect to turn final runway zero two after passing four thousand.
Event253	6:09:14	0:02:17	N204C -- Johnston	Approach	Ok, uh after four thousand expect to -- uh -- turn inbound to runway zero two?
Event254	6:09:20	0:02:11	Approach	N204C	November two zero four Charlie affirmative. Uh Report passing four thousand.
Event255	6:09:24	0:02:07	N204C -- Johnston	Approach	Roger.

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event256	6:09:28	0:02:03	MJP	Approach	Mike Jouliet Pappa left hand down wind runway zero two, like to go around on this one.
Event257	6:09:32	0:01:59	Approach	MJP	Roger, cleared to final runway zero two.
Event258	6:09:34	0:01:57	MJP	Approach	Mike Jouliet Pappa.
Event259	6:09:36	0:01:55	AK563	Approach	Uh Kinabalu, Ankasa five six three.
Event260	6:09:39	0:01:52	Approach	AK563	Six three go ahead.
Event261	6:09:40	0:01:51	AK563	Approach	Ankasa six three will be shutting down, aircraft unserviceable.
Event262	6:09:40	0:01:51	Approach	AK563	Call in again when ready.
Event263	6:09:40	0:01:51	AK563	Approach	Five six three.
Event264	6:10:30	0:01:01	Approach	MH391	Three nine one clear to back track via Golf, Charlie and Bay six.
Event265	6:10:34	0:00:57	MH391	Approach	Roger clear to back track via Golf, Charlie, and uh Jouliet - confirm?
Event266	6:10:38	0:00:53	Approach	MH391	Jouliet affirmative.
Event267	6:10:39	0:00:52			
Event268	6:10:41	0:00:50			
Event269	6:10:42	0:00:49	MH391	Approach	Roger Golf, Charlie, Jouliet Malaysian three nine one.
Event270	6:10:45	0:00:46			

Table 1: Flight Parameters and Communications

	RTF Communication				
	GMT	TBI	From	To	Text
Event271	6:10:46	0:00:45	N204C -- Johnston	Approach	Two oh four Charlie is four thousand.
Event272	6:10:50	0:00:41	Approach	N204C	Report DME now.
Event273	6:10:52	0:00:39	N204C -- Johnston	Approach	... two nine DME.
Event274	6:10:54	0:00:37	Approach	N204C	You are cleared to ... join final for runway zero two, descend to two thousand five hundred.
Event275	6:11:01	0:00:30	N204C -- Johnston	Approach	Ok, final descent for runway zero two, two thousand five hundred.
Event276	6:11:06	0:00:25			
Event277	6:11:08	0:00:23			
Event278	6:11:16	0:00:15			
Event279	6:11:22	0:00:09			
Event280	6:11:31	0:00:00			
Event281	6:11:41				
Event282					

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event001	5:34:50	0:36:10		
Event002	5:34:56	0:36:04		
Event003	5:35:04	0:35:56		
Event004	5:35:19	0:35:41		
Event005	5:35:24	0:35:36		
Event006	5:35:44	0:35:16		
Event007	5:35:52	0:35:08		
Event008	5:36:03	0:34:57		
Event009	5:36:06	0:34:54		
Event010	5:36:10	0:34:50		
Event011	5:36:10	0:34:50		
Event012	5:36:10	0:34:50		
Event013	5:40:15	0:31:16		
Event014	5:40:18	0:31:13		
Event015	5:40:20	0:31:11		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event016	5:40:23	0:31:08		
Event017	5:40:46	0:30:45		
Event018	5:40:49	0:30:42		
Event019	5:41:15	0:30:16		
Event020	5:41:19	0:30:12		
Event021	5:41:22	0:30:09		
Event022	5:41:24	0:30:07		
Event023	5:42:31	0:29:00		
Event024	5:42:37	0:28:54		
Event025	5:42:42	0:28:49		
Event026	5:42:52	0:28:39		
Event027	5:45:14	0:26:17		
Event028	5:45:17	0:26:14		
Event029	5:45:19	0:26:12		
Event030	5:45:20	0:26:11		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event031	5:45:22	0:26:09		
Event032	5:45:26	0:26:05		
Event033	5:45:30	0:26:01		
Event034	5:45:32	0:25:59		
Event035	5:45:36	0:25:55		
Event036	5:45:40	0:25:51		
Event037	5:45:48	0:25:43		
Event038	5:45:53	0:25:38		
Event039	5:45:55	0:25:36		
Event040	5:46:01	0:25:30		
Event041	5:46:06	0:25:25		
Event042	5:46:15	0:25:16		
Event043	5:46:20	0:25:11		
Event044	5:46:27	0:25:04		
Event045	5:46:29	0:25:02		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event046	5:46:31	0:25:00		
Event047	5:46:39	0:24:52		
Event048	5:46:44	0:24:47		
Event049	5:46:53	0:24:38		
Event050	5:46:57	0:24:34		
Event051	5:47:03	0:24:28		
Event052	5:47:25	0:24:06		
Event053	5:47:28	0:24:03		
Event054	5:47:33	0:23:58		
Event055	5:47:37	0:23:54		
Event056	5:47:41	0:23:50	Johnston	He didn't give us any.... or anything else did he?
Event057	5:47:56	0:23:35	Fox	What did he say the ceiling was?
Event058	5:47:57	0:23:34		
Event059	5:47:58	0:23:33	Johnston	One octa at a thousand feet.
Event060	5:48:01	0:23:30	Fox	Ok a thousand scattered.

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event061	5:48:02	0:23:29	Johnston	Yeh.
Event062	5:48:05	0:23:26	Johnston	Sounds like there was a CB north east of the field though.
Event063	5:48:17	0:23:14		
Event064	5:48:25	0:23:06		
Event065	5:48:36	0:22:55		
Event066	5:48:40	0:22:51		
Event067	5:48:44	0:22:47		
Event068	5:48:54	0:22:37		
Event069	5:49:00	0:22:31	Johnston	When do you want to start down?
Event070	5:49:03	0:22:28		
Event071	5:49:03	0:22:28	Fox	(clear throat) Uh - Let's wait a while.
Event072	5:49:14	0:22:17	Fox	If we're gonna have to hold I'd rather stay up here and keep the fuel.
Event073	5:49:51	0:21:40	Johnston	(before Pilot 1 finishes) Yeah
Event074	5:49:57	0:21:34		
Event075	5:49:59	0:21:32		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event076	5:50:03	0:21:28		
Event077	5:50:08	0:21:23		
Event078	5:50:14	0:21:17		
Event079	5:50:17	0:21:14		
Event080	5:50:23	0:20:37		
Event081	5:50:23	0:20:37		
Event082	5:50:23	0:20:37		
Event083	5:50:23	0:20:37		
Event084	5:51:09	0:20:22		
Event085	5:51:09	0:20:22	Johnston	Shall I try and call in?
Event086	5:51:13	0:20:18		
Event087	5:51:18	0:20:13	Fox	Nah, I'll try and give 'em a call you monitor the descent.
Event088	5:51:28	0:20:03		
Event089	5:51:32	0:19:59	Johnston	(ZutTut)
Event090	5:51:38	0:19:53		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event091	5:52:13	0:19:18		
Event092	5:52:24	0:19:07		
Event093	5:52:29	0:19:02		
Event094	5:52:35	0:18:56		
Event095	5:52:39	0:18:52		
Event096	5:52:45	0:18:46		
Event097	5:52:49	0:18:42		
Event098	5:52:51	0:18:40		
Event099	5:52:57	0:18:34	Fox	Well evidently they've changed - gone to the new terminal now
Event100	5:53:40	0:17:51	Johnston	What do you do? Just go to the VOR and just let down out over here?
Event101	5:53:46	0:17:45	Fox	Yeh. That's what I said though.
Event102	5:53:47	0:17:44	Johnston	You know get on that arc?
Event103	5:53:48	0:17:43	Fox	Yeh and go outbound on it.
Event104	5:54:08	0:17:23	Fox	Would ya tell 'em we're ready for the decent.
Event105	5:54:15	0:17:16		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event106	5:54:21	0:17:10		
Event107	5:54:25	0:17:06		
Event108	5:54:30	0:17:01		
Event109	5:54:36	0:16:55	Fox	Thirty five looks like - zero three five.
Event110	5:54:39	0:16:52		
Event111	5:54:45	0:16:46		
Event112	5:54:50	0:16:41		
Event113	5:54:55	0:16:36		
Event114	5:55:11	0:16:20		
Event115	5:55:17	0:16:14		
Event116	5:55:42	0:15:18		
Event117	5:55:42	0:15:18		
Event118	5:55:43	0:15:48	Johnston	One twenty five’s your v-ref.
Event119	5:55:44	0:15:47	Fox	Ok.
Event120	5:56:01	0:15:30	Johnston	Uh we might want ... You want any anti-ice?

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event121	5:56:04	0:15:27	Fox	Yeah - wouldn't hurt.
Event122	5:56:06	0:15:25	Johnston	Ok, I'll turn the engine on - maybe I'll turn those seat belts on too. (Tone.)
Event123	5:56:17	0:15:14		
Event124	5:56:22	0:15:09		
Event125	5:56:29	0:15:02		
Event126	5:56:32	0:14:59		
Event127	5:56:48	0:14:43		
Event128	5:56:54	0:14:37		
Event129	5:57:01	0:14:30		
Event130	5:57:09	0:14:22		
Event131	5:57:38	0:13:53		
Event132	5:57:43	0:13:48		
Event133	5:57:51	0:13:40		
Event134	5:57:56	0:13:35		
Event135	5:58:02	0:13:29		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event136	5:58:09	0:13:22		
Event137	5:58:16	0:13:15		
Event138	5:58:24	0:13:07		
Event139	5:58:26	0:13:05		
Event140	5:58:32	0:12:59		
Event141	5:58:41	0:12:50		
Event142	5:58:47	0:12:44		
Event143	5:58:51	0:12:40		
Event144	5:58:55	0:12:36		
Event145	5:59:09	0:12:22		
Event146	5:59:24	0:12:07		
Event147	5:59:32	0:11:59		
Event148	5:59:40	0:11:51		
Event149	5:59:55	0:11:36	Johnston	Is the wing ice on?
Event150	5:59:57	0:11:34	Fox	Yeh. You can go turn it off if you want.

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event151	6:00:02	0:11:29		
Event152	6:00:05	0:11:26		
Event153	6:00:12	0:11:19		
Event154	6:00:15	0:11:16		
Event155	6:00:20	0:11:11		
Event156	6:00:25	0:11:06		
Event157	6:00:31	0:11:00		
Event158	6:00:36	0:10:55		
Event159	6:00:36	0:10:55		
Event160	6:00:36	0:10:55		
Event161	6:00:36	0:10:55		
Event162	6:00:47	0:10:44		
Event163	6:00:50	0:10:41	Fox	(Whistling.)
Event164	6:00:51	0:10:40	Fox	You need toiletries or anything like that?
Event165	6:00:53	0:10:38	Johnston	[Comment on NTSB transcript : "Slow it down (?)."]

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event166	6:01:01	0:10:30		
Event167	6:01:03	0:10:28	Fox	Say again.
Event168	6:01:06	0:10:25		
Event169	6:01:11	0:10:20		
Event170	6:01:16	0:10:15		
Event171	6:01:26	0:10:05		
Event172	6:01:38	0:09:53		
Event173	6:01:42	0:09:49		
Event174	6:01:47	0:09:44		
Event175	6:01:56	0:09:35		
Event176	6:02:02	0:09:29	Johnston	Well we probably don’t need that heat on now - do we?
Event177	6:02:04	0:09:27	Fox	Nah - you can shut it off I think.
Event178	6:02:09	0:09:22	Johnston	Ok - everthing’s coming off.
Event179	6:02:42	0:08:49	Fox	Ask him if we can track outbound on the two fifty eight or if he wants us to stop over the VOR.
Event180	6:02:49	0:08:42		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event181	6:02:59	0:08:32		
Event182	6:03:05	0:08:26	Fox	Radial.
Event183	6:03:08	0:08:23	Johnston	What?
Event184	6:03:10	0:08:21	Fox	What radial you're on?
Event185	6:03:12	0:08:19		
Event186	6:03:16	0:08:15		
Event187	6:03:24	0:08:07		
Event188	6:03:34	0:07:57	Fox	I didn't hear what he said on it.
Event189	6:03:38	0:07:53	Johnston	I didn't either. ?
Event190	6:03:42	0:07:49		
Event191	6:03:53	0:07:38		
Event192	6:03:57	0:07:34	Fox	Yes!
Event193	6:04:01	0:07:30	Johnston	Affirmative?
Event194	6:04:02	0:07:29	Fox	Yeah. We're over the VOR!
Event195	6:04:03	0:07:28		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event196	6:04:06	0:07:25		
Event197	6:04:10	0:07:21	Fox	Fifteen.
Event198	6:04:11	0:07:20		
Event199	6:04:13	0:07:18		
Event200	6:04:15	0:07:16		
Event201	6:04:17	0:07:14		
Event202	6:04:19	0:07:12		
Event203	6:04:24	0:07:07		
Event204	6:04:32	0:06:59		
Event205	6:04:35	0:06:56		
Event206	6:04:41	0:06:50	Fox	I didn’t - uhh.
Event207	6:04:43	0:06:48		
Event208	6:04:46	0:06:45		
Event209	6:04:48	0:06:43	Fox	I still didn’t understand - did he say we could go outbound on the VOR or do we have to hold?
Event210	6:04:53	0:06:38	Johnston	I don’t know.

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event211	6:04:54	0:06:37	Fox	I gotta know!
Event212	6:04:55	0:06:36	Johnston	Yeah.
Event213	6:05:01	0:06:30		
Event214	6:05:10	0:06:21		
Event215	6:05:15	0:06:16		
Event216	6:05:28	0:06:03		
Event217	6:05:35	0:05:56		
Event218	6:05:43	0:05:48		
Event219	6:05:45	0:05:46		
Event220	6:05:47	0:05:44		
Event221	6:05:54	0:05:37	Johnston	Ok, transition level's thirteen -- one zero - one zero zero nine.
Event222	6:05:55	0:05:36		
Event223	6:05:58	0:05:33		
Event224	6:06:02	0:05:29	Fox	Ok, what are we cleared down to - what altitude - nine thousand?
Event225	6:06:02	0:05:29		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event226	6:06:05	0:05:26	Johnston	Yeah.
Event227	6:06:05	0:05:26		
Event228	6:06:07	0:05:24		
Event229	6:06:12	0:05:19		
Event230	6:06:19	0:05:12		
Event231	6:06:23	0:05:08		
Event232	6:06:27	0:05:04		
Event233	6:06:36	0:04:55		
Event234	6:06:41	0:04:50		
Event235	6:06:48	0:04:43		
Event236	6:06:50	0:04:41		
Event237	6:07:07	0:04:24		
Event238	6:07:14	0:04:17		
Event239	6:07:18	0:04:13		
Event240	6:07:27	0:04:04		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event241	6:07:30	0:04:01		
Event242	6:07:33	0:03:58	Fox	Could you fix that - so it'll stop that blinking.
Event243	6:07:34	0:03:57		
Event244	6:08:32	0:02:59		
Event245	6:08:37	0:02:54		
Event246	6:08:41	0:02:50		
Event247	6:08:45	0:02:46		
Event248	6:08:53	0:02:38		
Event249	6:08:57	0:02:34		
Event250	6:08:59	0:02:32		
Event251	6:09:02	0:02:29		
Event252	6:09:05	0:02:26		
Event253	6:09:14	0:02:17		
Event254	6:09:20	0:02:11		
Event255	6:09:24	0:02:07		

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event256	6:09:28	0:02:03		
Event257	6:09:32	0:01:59		
Event258	6:09:34	0:01:57		
Event259	6:09:36	0:01:55		
Event260	6:09:39	0:01:52		
Event261	6:09:40	0:01:51		
Event262	6:09:40	0:01:51		
Event263	6:09:40	0:01:51		
Event264	6:10:30	0:01:01		
Event265	6:10:34	0:00:57		
Event266	6:10:38	0:00:53		
Event267	6:10:39	0:00:52	Johnston	We’re getting pretty close to the hills here.
Event268	6:10:41	0:00:50	Fox	Yeh, I know.
Event269	6:10:42	0:00:49		
Event270	6:10:45	0:00:46	Fox	Tell ’em we’re through four.

Table 1: Flight Parameters and Communications

	Flight Deck Conversations and Sounds			
	GMT	TBI	Source	Text
Event271	6:10:46	0:00:45		
Event272	6:10:50	0:00:41		
Event273	6:10:52	0:00:39		
Event274	6:10:54	0:00:37		
Event275	6:11:01	0:00:30		
Event276	6:11:06	0:00:25	Fox	Boy.
Event277	6:11:08	0:00:23	Fox	I'm gonna turn to the right.
Event278	6:11:16	0:00:15	Fox	God. I'll tell you.
Event279	6:11:22	0:00:09	Fox	I don't like what we've got (Johnston: "Uh.") here. I'm climbing this sucker out of here.
Event280	6:11:31	0:00:00	Johnston	(Impact.) Uhhh.
Event281	6:11:41			(Click.)
Event282				

Table 2: Crash Site Survey

Table 2: Crash Site Survey

		Line 1									
		Station1	Station2	Station3	Station4	Station5	Station6	Station7	Station8	Station9	Station10
Survey Data	length	50	50	100	60	40	50	50	50	50	50
	azimuth	215	218	216	216	216	216	216	216	216	216
	elevation	-55	-34	-37	-27	-31	-35	-25	-25	-29	-21
Coordinate Differential	dr	29	41	80	53	34	41	45	45	44	47
	de	-16	-26	-47	-31	-20	-24	-27	-27	-26	-27
	dn	-23	-33	-65	-43	-28	-33	-37	-37	-35	-38
	dz	-41	-28	-60	-27	-21	-29	-21	-21	-24	-18
Coordinate	e	-16	-42	-89	-120	-140	-165	-191	-218	-244	-271
	n	-23	-56	-121	-164	-192	-225	-262	-298	-334	-371
	z	3959	3931	3871	3844	3823	3794	3773	3752	3728	3710
	range	29	70	150	203	238	279	324	369	413	460
	bearing	215	217	216	216	216	216	216	216	216	216
Note		Origin at Station0 -- the LZ1 marker pole.									

Table 2: Crash Site Survey

		Line 1									
		Station11	Station12	Station13	Station14	Station15	Station16	Station17	Station18	Station19	Station20
Survey Data	length	50	50	50	50	50	50	50	50	50	36
	azimuth	216	216	216	216	180	180	180	221	230	225
	elevation	0	-11	-19	25	0	-19	-4	0	0	0
Coordinate Differential	dr	50	49	47	45	50	47	50	50	50	36
	de	-29	-29	-28	-27	0	0	0	-33	-38	-25
	dn	-40	-40	-38	-37	-50	-47	-50	-38	-32	-25
	dz	0	-10	-16	21	0	-16	-3	0	0	0
Coordinate	e	-300	-329	-357	-384	-384	-384	-384	-416	-455	-480
	n	-412	-452	-490	-526	-576	-624	-674	-711	-743	-769
	z	3710	3700	3684	3705	3705	3689	3686	3686	3686	3686
	range	510	559	606	651	692	732	775	824	872	907
	bearing	216	216	216	216	214	212	210	210	211	212
Note		Luggage and Door.		Creek.		Line over a small ridge. Average dip is zero.					

Table 2: Crash Site Survey

		Line 1					Line 2				
		Station21	Station22	Station23	Station24	Station25	Station26	Station27	Station28	Station29	Station30
Survey Data	length	50	50	50	50	50	100	100	100	100	100
	azimuth	280	278	160	222	258	278	256	205	207	217
	elevation	-34	-34	14	12	0	-25	-24	2	0	-39
Coordinate Differential	dr	41	41	49	49	50	91	91	100	100	78
	de	-41	-41	17	-33	-49	-90	-89	-42	-45	-47
	dn	7	6	-46	-36	-10	13	-22	-91	-89	-62
	dz	-28	-28	12	10	0	-42	-41	3	0	-63
Coordinate	e	-521	-562	-545	-578	-627	-361	-449	-492	-537	-584
	n	-762	-756	-802	-838	-848	-359	-381	-471	-561	-623
	z	3658	3630	3642	3652	3652	3668	3627	3631	3631	3568
	range	923	942	970	1018	1055	509	589	681	776	853
	bearing	214	217	214	215	216	225	230	226	224	223
Note					Line over a small valley. Average dip is zero.		Origin at Station10 (Line 1).	Tail.	Line over a small valley. Average dip is up, two degrees.		

Table 2: Crash Site Survey

		Line 2						Line 3		Line 4	
		Station31	Station32	Station33	Station34	Station35	Station36	Station37	Station38	Station39	Station40
Survey Data	length	100	150	100	65	35	110	100	65	96	50
	azimuth	200	219	216	225	225	225	316	18	285	301
	elevation	1	14	-8	18		30	-25	4	-19	-21
Coordinate Differential	dr	100	146	99	62	35	95	91	65	91	47
	de	-34	-92	-58	-44	-25	-67	-63	20	-88	-40
	dn	-94	-113	-80	-44	-25	-67	65	62	23	24
	dz	2	36	-14	20	0	55	-42	5	-31	-18
Coordinate	e	-618	-710	-768	-811	-836	-904	-899	-879	-987	-1027
	n	-717	-830	-910	-953	-978	-1046	-913	-851	-890	-865
	z	3569	3606	3592	3612	3612	3667	3570	3574	3538	3520
	range	946	1092	1190	1252	1287	1382	1281	1224	1329	1343
	bearing	221	221	220	220	221	221	225	226	228	230
Notes		Line over a small valley. Average dip is up, one degrees. Bees in tree, creek, and part of the fuselage.				Dip is down, and small (the value was not recorded).	LZ2	Origin at Station 35 (Line 2). An engine starter.	Major part of fhe fuselage.	Origin at Station 37 (Line 3).	

Table 2: Crash Site Survey

		Line 4		Line 5	Line 6		Line 7			Line 8
		Station41	Station42	Station43	Station44	Station45	Station46	Station47	Station48	Station49
Survey Data	length	112	30	60	115	100	150	50	248	225
	azimuth	320	100	69	349	15	30	157.5	35	45
	elevation	-47	0	-6	24	25	0	22	-5	-1
Coordinate Differential	dr	76	30	60	105	91	150	46	247	225
	de	-49	30	56	-20	23	75	18	141	159
	dn	59	-5	21	103	88	130	-43	202	159
	dz	-82	0	-6	47	42	0	19	-22	-4
Coordinate	e	-1076	-1046	-1020	-140	-117	75	93	234	234
	n	-807	-812	-786	-61	27	130	87	289	289
	z	3438	3438	3432	3890	3933	4000	4019	3997	3996
	range	1345	1325	1288	153	120	150	127	372	372
	bearing	233	232	232	247	283	30	47	39	39
Note		A main turbine engine.	Location of Ann's seat December 31, 1991.	Origin at Station41 (Line 4). Part of the fuselage beside creek.	Origin at Station4 (Line 1).	Part of a wing.	Stake #1 near ground impact point.. Origin at LZ1 marker pole (Station0)	Stake #2 on Radio Hill.	Trees cut by the intitial impact, from Stake #2..	Trees cut by the intial impact, from Stake #1.

Table 3: Fuselage Trajectory Calculations

Table 3: Fuselage Trajectory Calculations

			Case
			C1
Crash Model	Model Parameters	r1	-35
		h1	140
	Last Contact	r	94
	r-Error	dr	0.41
Phase 0	Position	e0	205
		n0	306
		z0	3978
	Velocity	v0	379
		v0e	-189
		v0n	-327
		v0z	29
	Climb Angle	i0	4.4
Phase 1	Position	e1	52
		n1	80
		z1	4047
	Velocity	v1	177
		v1e	-102
		v1n	-102
		v1z	103
	Climb Angle	i1	35.7
Phase 2	Position	e2	-879
		n2	-851
		z2	3649
	Velocity	v2	238
		v2e	-102
		v2n	-102
		v2z	-190
	Climb Angle	i2	-52.9
	Distance	d2	1317
Time	Phase 1	t1e	1.1
		t1n	1.1
		t1z	1.1
	Phase 2	t2	9.2
Acceleration	f/s^2	a	241
		ae	83
		an	215
		az	71
	G's	G	7.5
		Ge	2.6
		Gn	6.7
		Gz	2.2

Table 4: Fuselage Trajectory

Table 4: Fuselage Trajectory

	t	e	n	z	GL	TL
Event0	0	205	306	3978	3856	4006
Event1	0.1	187	274	3981	3879	4029
Event2	0.2	169	244	3985	3902	4052
Event3	0.3	152	217	3990	3922	4072
Event4	0.4	136	192	3995	3942	4092
Event5	0.5	121	169	4001	3960	4110
Event6	0.6	107	148	4008	3977	4127
Event7	0.7	93	129	4015	3992	4142
Event8	0.8	81	113	4024	3997	4147
Event9	0.9	69	98	4033	3990	4140
Event10	1	58	86	4042	3983	4133
Event11	1.1	47	75	4052	3978	4128
Event12	1.2	37	65	4062	3972	4122
Event13	1.3	27	55	4072	3967	4117
Event14	1.4	17	45	4081	3961	4111
Event15	1.5	7	35	4090	3956	4106
Event16	1.6	-3	25	4099	3950	4100
Event17	1.7	-13	14	4108	3945	4095
Event18	1.8	-24	4	4116	3939	4089
Event19	1.9	-34	-6	4123	3934	4084
Event20	2	-44	-16	4131	3928	4078
Event21	2.1	-54	-26	4138	3923	4073
Event22	2.2	-64	-36	4145	3917	4067
Event23	2.3	-74	-47	4151	3912	4062
Event24	2.4	-85	-57	4157	3906	4056
Event25	2.5	-95	-67	4163	3901	4051
Event26	2.6	-105	-77	4169	3895	4045
Event27	2.7	-115	-87	4174	3889	4039
Event28	2.8	-125	-97	4179	3881	4031
Event29	2.9	-135	-107	4184	3872	4022
Event30	3	-146	-118	4188	3863	4013
Event31	3.1	-156	-128	4192	3855	4005
Event32	3.2	-166	-138	4195	3846	3996
Event33	3.3	-176	-148	4199	3837	3987
Event34	3.4	-186	-158	4202	3829	3979
Event35	3.5	-196	-168	4204	3820	3970
Event36	3.6	-207	-179	4207	3811	3961
Event37	3.7	-217	-189	4209	3803	3953
Event38	3.8	-227	-199	4210	3794	3944
Event39	3.9	-237	-209	4212	3785	3935
Event40	4	-247	-219	4213	3776	3926
Event41	4.1	-257	-229	4213	3768	3918
Event42	4.2	-267	-240	4214	3759	3909
Event43	4.3	-278	-250	4214	3750	3900
Event44	4.4	-288	-260	4214	3742	3892
Event45	4.5	-298	-270	4213	3733	3883
Event46	4.6	-308	-280	4212	3724	3874
Event47	4.7	-318	-290	4211	3716	3866
Event48	4.8	-328	-300	4210	3707	3857

Table 4: Fuselage Trajectory

	t	e	n	z	GL	TL
Event49	4.9	-339	-311	4208	3698	3848
Event50	5	-349	-321	4206	3690	3840
Event51	5.1	-359	-331	4203	3681	3831
Event52	5.2	-369	-341	4200	3672	3822
Event53	5.3	-379	-351	4197	3664	3814
Event54	5.4	-389	-361	4194	3657	3807
Event55	5.5	-400	-372	4190	3649	3799
Event56	5.6	-410	-382	4186	3641	3791
Event57	5.7	-420	-392	4182	3634	3784
Event58	5.8	-430	-402	4177	3627	3777
Event59	5.9	-440	-412	4172	3628	3778
Event60	6	-450	-422	4166	3628	3778
Event61	6.1	-460	-433	4161	3629	3779
Event62	6.2	-471	-443	4155	3630	3780
Event63	6.3	-481	-453	4148	3630	3780
Event64	6.4	-491	-463	4142	3631	3781
Event65	6.5	-501	-473	4135	3631	3781
Event66	6.6	-511	-483	4128	3631	3781
Event67	6.7	-521	-494	4120	3631	3781
Event68	6.8	-532	-504	4112	3631	3781
Event69	6.9	-542	-514	4104	3631	3781
Event70	7	-552	-524	4095	3631	3781
Event71	7.1	-562	-534	4086	3631	3781
Event72	7.2	-572	-544	4077	3620	3770
Event73	7.3	-582	-554	4068	3609	3759
Event74	7.4	-593	-565	4058	3597	3747
Event75	7.5	-603	-575	4048	3585	3735
Event76	7.6	-613	-585	4037	3573	3723
Event77	7.7	-623	-595	4026	3564	3714
Event78	7.8	-633	-605	4015	3556	3706
Event79	7.9	-643	-615	4004	3548	3698
Event80	8	-654	-626	3992	3540	3690
Event81	8.1	-664	-636	3980	3532	3682
Event82	8.2	-674	-646	3968	3524	3674
Event83	8.3	-684	-656	3955	3516	3666
Event84	8.4	-694	-666	3942	3508	3658
Event85	8.5	-704	-676	3929	3500	3650
Event86	8.6	-714	-687	3915	3492	3642
Event87	8.7	-725	-697	3901	3484	3634
Event88	8.8	-735	-707	3887	3476	3626
Event89	8.9	-745	-717	3872	3468	3618
Event90	9	-755	-727	3857	3460	3610
Event91	9.1	-765	-737	3842	3452	3602
Event92	9.2	-775	-747	3826	3444	3594
Event93	9.3	-786	-758	3810	3454	3604
Event94	9.4	-796	-768	3794	3467	3617
Event95	9.5	-806	-778	3778	3479	3629
Event96	9.6	-816	-788	3761	3492	3642
Event97	9.7	-826	-798	3743	3504	3654

Table 4: Fuselage Trajectory

	t	e	n	z	GL	TL
Event98	9.8	-836	-808	3726	3517	3667
Event99	9.9	-847	-819	3708	3529	3679
Event100	10	-857	-829	3690	3542	3692
Event101	10.1	-867	-839	3671	3555	3705
Event102	10.2	-877	-849	3653	3567	3717
Event103	10.3	-887	-859	3634	3580	3730