NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

September 23, 2011

Flight Data Recorder - 10

Group Chairman's Factual Report
By Greg Smith

1. EVENT SUMMARY

Location: Jackson Hole, Wyoming
Date: December 29, 2010
Aircraft: B-757-200, N668AA
Operator: American Airlines, Flight 2253
NTSB Number: DCA11IA015

On December 29, 2010, at approximately 11:38 am mountain standard time, American Airlines flight 2253, a Boeing 757-200, registration N668AA, overran runway 19 upon landing at Jackson Hole Airport (KJAC), Jackson Hole, Wyoming. The airplane came to rest approximately 730 feet past the end of the runway in deep snow. There were no injuries to the 179 passengers and 6 crew members on board and the airplane received minor damage. The 14 Code of Federal Regulations Part 121 regularly scheduled passenger flight had originated from Chicago O'Hare International Airport, Chicago, Illinois.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was convened on 7 Jan 2011.

Chairman: Greg Smith
Aerospace Engineer/Flight Recorder Specialist
National Transportation Safety Board

Member: Nathan Rohrbaugh
Flight Data Analyst, AVP-100
Federal Aviation Administration

Member: Anna W. Cushman
Flight Data Lab Manager, AVP-100
Federal Aviation Administration

Member: Brian K. Predmore, PE
Lead – Avionics/Recording Systems
Service Engineering, Commercial Aviation Services
The Boeing Company

Member: First Officer Fred Toleman
Safety Committee – FOQA Gatekeeper
Allied Pilots Association

Member: First Officer Ken Lee
Safety Committee – Deputy Chairman, FOQA
Allied Pilots Association

3. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

On December 30, 2010, the Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **L-3 Communications Fairchild Model FA2100 128 Word**
Recorder Serial Number: **00816**

The recorder was in good condition, however, once the data was downloaded, the data decompression application created two data files, one of 256 word per second (wps) data and one of 64 wps data. As explained below, the correct data frame for the incident aircraft was the 256 wps data. The 64 wps data was recorded after the incident while the FDR was in the custody of American Airlines and in transit to the Vehicle Recorder Division laboratories.

3.1. Recorder Description

This model FDR records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100 can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 256 12-bit words of digital information every second. Each grouping of 256 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as either subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 256-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number(s) within the subframe. The FA2100 is designed to meet the crash-survivability requirements of TSO–C124a.

3.2. FDR Carriage Requirements

Federal regulations regarding the carriage requirements of FDRs on aircraft can be found in the following regulations: 14 CFR 121.343, 14 CFR 121.344, 14 CFR 121.344a and 14 CFR 135.152. Specifically, the incident aircraft, N668AA, was operating such that it was required to be equipped with an FDR meeting the requirements of 14 CFR 121.344. These requirements identify 91 categories of parameters to be recorded in the FDR. Each parameter category drives a requirement to include one or more data parameters[1] in the FDR data frame. Various paragraphs of 14 CFR 121.344 identify which parameter categories are required for an aircraft of a specific age or type. The incident aircraft was manufactured after October 11, 1991 and before August 18, 2000 making it subject to the requirements of paragraph (d). Subparagraph (d)(1) requires categories 1 through 34 to be recorded. Additionally subparagraph (d)(2) requires that "Commensurate with the capacity

[1] For example, parameter category 9, "Thrust/power of each engine -- primary flight crew reference," (14 CFR 121.344(a)(9)) requires that the FDR record two data parameters, one for each engine for the incident aircraft.

of the recording system, all additional parameters for which information sources are installed and which are connected to the recording system must be recorded…"

At the time of the incident, the vertical acceleration data parameter required by 14 CFR 121.344(a)(5) was not recording valid data. The data for the vertical acceleration parameter was intermittently invalid for the duration of the incident recording.

Additionally, the FDR group evaluated the data from the operator's last FDR reasonableness check and found that the vertical acceleration parameter was intermittently invalid as of October 17, 2010, the date of the download for the reasonableness check. The operator failed to identify the parameter as invalid and initiate corrective action when the data was evaluated on November 15, 2010. Attachment 1 to this report is the audit checklist from the evaluation.

3.3. FDR Documentation Requirements

Federal regulations regarding the documentation requirements of FDRs on the incident aircraft can be found in 14 CFR 121.344(j) and require that the certificate holder maintain documentation sufficient to convert recorded data into engineering units. The operator identified a generic Boeing data frame (specifically the 757-3B data frame) and the corresponding documentation as the correct documentation for the incident aircraft. The generic data frame is designed to be compatible with Boeing 757 aircraft of different ages and equipages and has documentary, aircraft specific, discrete parameters to identify various configurations. The incident aircraft was not configured per the standard configuration and the operator could not provide documentation of the differences from the generic configuration. In order to determine which parameters were connected, the FDR group evaluated the FDR system wiring diagrams, comparing them to the generic configuration and found the following problems/discrepancies:

1) The documentary discrete parameter "97 Rule" was set to the "Post 97" state which, according to the documentation, indicates that a set of additional parameters have been incorporated into the recording even though all of those parameters were not added to the installation.

2) The generic data frame documentation indicates that both left and right Air Data Computers (ADCs) are connected to port D5. According to the aircraft manufacturer, the standard wiring for port D5 includes a relay that switches between ADCs based on the state of the Captain's ADC source select switch. Aircraft wiring diagrams indicate that this relay and connections to the right ADC are not installed in the incident aircraft. The result is that regardless of the setting of the Captain's selection, the data from the left ADC is always recorded. The ADC is the source of altitude and airspeed data.

3) The wiring diagrams indicate that additional discrete parameters were installed in spare locations that are not included in the data frame definition.

4) Evaluation of the data indicated that the parameters from the Traffic Collision Avoidance System (TCAS) were active and valid although the wiring diagrams for the Digital Flight Data Acquisition Unit (DFDAU) do not show a connection to the TCAS or a reference to the TCAS wiring diagrams. The complete interface between

the TCAS computer and the DFDAU is all shown on wiring diagram 34-45-01. (It is not uncommon to show a complete interface on one set of drawings. In these cases there is a reference made to the interface found on the corresponding diagrams.) No corresponding reference to the TCAS interface to the DFDAU can be found on any flight recording system wiring diagram.

5) The wiring diagrams show that ports D25 and D26 are not connected to the data sources indicated by the data frame documentation. According to the documentation, port D25 should have been connected to the left and right Flight Management Computer (FMC) B-1 data buses and port D26 should have been connected to the right and center Electronic Flight Instrument System (EFIS). According to the wiring diagram for the incident aircraft, ports D25 and D26 were connected to the left and right EFIS Control Panels, respectively. This configuration made information recorded from ports D25 and D26 unuseable for the investigation.

6) Evaluation of the data indicated that data from port D13, identified as data from the left and right FMC D-4 data buses in both the data frame documentation and wiring diagrams, was not functional. The DFDAU chooses a source for positional, navigational and wind data from either the FMC D-4 source (D13) or the left Inertial Reference Unit (IRU) port D15 depending on bus activity, with the D13 port being the preferred source, and sets a discrete parameter to indicate which source it is using. This discrete parameter was set to the IRU state for all flights evaluated from the incident aircraft indicating that no data was available from port D13.

7) The specific versions and software loads of the various avionics components also influence which of the parameters in the generic data frame are available. The operator could not provide a list of parameters that were not functional due to hardware and software part numbers installed in the incident aircraft.

The operator did not have accurate data frame map and conversion documentation for the incident aircraft as required by 14 CFR 121.344(j).

3.4. Recording Description

The FDR recording contained approximately 43.9 hours of data which included 14 landings. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The incident flight was the last flight of the recording and its duration was approximately 2 hours and 55 minutes.

3.5. Time Correlation

Correlation of the FDR data from SRN to the incident local time was established using the recorded GMT time parameters. Recorded time data used for the correlation is from the Captain's Clock because the GPS time parameters included in the recorder documentation are not available as the incident aircraft did not have a GPS installed.

The incident flight data has been offset from SRN to local Mountain Standard Time. Previous landings from the incident recorder and data from other downloads are shown in relative FDR time (SRN).

3.6. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the aircraft manufacturer as referenced by the operator. Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).[2]

The operator's use of the generic manufacturer's documentation indicated that the recorder captured 1102 parameters. The FDR Group's examination of the documentation, wiring diagrams and list of installed equipment part numbers resulted in a parameter list of only 848 parameters. Of the 233 parameters identified by the FDR group as potentially relevant to the investigation that were documented as being recorded, 48 were parameters that were not installed, including brake pedals positions, brake pressures and auto-brake selection.

3.6.1. Parameters Verified and Provided

The FDR group evaluated all 848 parameters for validity and found several parameters beyond the required parameter set that recorded invalid or incorrect data. The following table lists the subset of FDR parameters that were reviewed and are provided as part of this report. The table includes the parameter name, plot label, documentation name, units and plots in which the parameter is shown. If a parameter listed in the table is associated with a required parameter category in 14 CFR 121.344, that category number is included with the parameter name. Parameters not included in any plots are only included in tabular form in Attachment 2 for the incident flight.

Table 1. Parameters Verified and Included.

Parameter (FAA #)	Plot Label	Documentation Name[3]	Units[4]	Plots
Post 1997 Rule Data Frame	97 Rule	PRE 97 RULE		
Lateral Acceleration (18)	Accel Lat	LATERAL ACCELERATION	g	1-14
Longitudinal Acceleration (11)	Accel Long	LONGITUDINAL ACCEL	g	1-14
Vertical Acceleration (5)	Accel Vert	VERTICAL ACCELERATION	g	2-15
Left Outboard Aileron Position (16)	Aileron-LOB	AILERON POSN-OUTER - L	deg	
Right Outboard Aileron Position (16)	Aileron-ROB	AILERON POSN-OUTER - R	deg	
Computed Airspeed (3)	Airspeed Comp	COMPUTED AIRSPEED	kts	1-15

[2] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

[3] Where more than one parameter is listed in this column, the data presented in the plots and tabular data has combined the individual documented parameters into a single parameter for ease of display and interpretation or those individually documented parameters are alternate sources.

[4] Parameters that have no units in the table are either discrete parameters whose state is indicated by a text value on the plots and in the tabular listing or a parameter that is a ratio and has no units such as Engine Pressure Ratio (EPR).

Parameter (FAA #)	Plot Label	Documentation Name[3]	Units[4]	Plots
Pressure Altitude (2)	Altitude Press	ALTITUDE (1013.25mB) COARSE, ALTITUDE (1013.25mB) FINE	ft	1
Radio Altitude (26)	Altitude Rad	RADIO HEIGHT CAPT, RADIO HEIGHT LRRA L-A-2, RADIO HEIGHT LRRA R-A-2, RADIO HEIGHT LRRA C-A-2	ft	1-15
Anti-Skid Alternate Fault	Anti-Skid Alt Fault	ANTI-SKID ALTN		
Anti-Skid Fault	Anti-Skid Fault	ANTI-SKID		
Anti-Skid Switch	Anti-Skid Switch	ANTI-SKID SWITCH		
Angle of Attack (32)	AOA - Ind	INDICATED AOA	deg	
Center Flight Control Computer Auto-pilot Engaged (10)	AP Engaged FCC-C	A/P ENGAGE DETENT FCC C-A-4		
Left Flight Control Computer Auto-pilot Engaged (10)	AP Engaged FCC-L	A/P ENGAGE DETENT FCC L-A-4		
Right Flight Control Computer Auto-pilot Engaged (10)	AP Engaged FCC-R	A/P ENGAGE DETENT FCC R-A-4		
Auto-throttle Engaged (25)	AT Engaged	A/T ENGAGE		
Auto-Brake Fault	Auto Brake Fault	AUTO BRAKE		1-14
Auto-Speedbrake Fault	Auto Spd Brk Fault	AUTO SPEEDBRAKE		
Control Column Position (12)	Ctrl Col Pos-L	CAPT CONT COLUMN POSN	deg	
Control Wheel Position (13)	Ctrl Whl Pos-L	CAPT CONT WHEEL POSN	deg	
Customer Unique Data Frame Definition	Customer Unique Frame	CUSTOMER UNIQUE FRAME		
Drift Angle (37)	Drift Angle	DRIFT ANGLE	deg	
Left Elevator Position (15)	Elevator-L	ELEVATOR POSN - L	deg	
Right Elevator Position (15)	Elevator-R	ELEVATOR POSN - R	deg	
Engine 1 Engine Pressure Ratio (9)	Eng1 EPR	ENG EPR-ACTUAL - L		
Engine 1 N1 (9)	Eng1 N1	ENG N1-ACTUAL - L	%RPM	1-14
Engine 1 Thrust Reverser Deployed (22)	Eng1 Rvrsr Deploy	T/R DEPLOYED - L		1-14
Engine 1 Thrust Reverser In Transit (22)	Eng1 Rvrsr In Trans	T/R INTRANSIT - L		1-14
Engine 1 Throttle Lever Angle (42)	Eng1 TLA EEC	EQUIV PLA-LEFT	deg	
Engine 1 Throttle Lever Angle (42)	Eng1 TLA EICAS	THR LVR ANG / EQUIV PLA-L	deg	1-14
Engine 2 Engine Pressure Ratio (9)	Eng2 EPR	ENG EPR-ACTUAL - R		
Engine 2 N1 (9)	Eng2 N1	ENG N1-ACTUAL - R	%RPM	1-14
Engine 2 Thrust Reverser Deployed (22)	Eng2 Rvrsr Deploy	T/R DEPLOYED - R		1-14
Engine 2 Thrust Reverser In Transit (22)	Eng2 Rvrsr In Trans	T/R INTRANSIT - R		1-14

Parameter (FAA #)	Plot Label	Documentation Name[3]	Units[4]	Plots
Engine 2 Throttle Lever Angle (42)	Eng2 TLA EEC	EQUIV PLA-RIGHT	deg	
Engine 2 Throttle Lever Angle (42)	Eng2 TLA EICAS	THR LVR ANG / EQUIV PLA-R	deg	1-14
Flap Handle Position (20, 85)	Flap Handle Pos	FLAP HANDLE POSN	deg	
Trailing Edge Flaps Disagree	Flaps TE Disagree	T.E. FLAPS DISAGREE		
Trailing Edge Flap Position (20, 85)	Flap TE AP Combined	A/P T.E. FLAP POSITION_MCP A-A-2, A/P T.E. FLAP POSITION_FCC R-A-4, A/P T.E. FLAP POSITION_FCC_ L-A-4, A/P T.E. FLAP POSITION_FCC C-A-4	deg	
Trailing Edge Flap Asymmetry	Flap TE Asym	T.E. FLAP ASYM		
Left FMC Fail (79)	FMC Fail - L	FMC FAIL - L		
Right FMC Fail (79)	FMC Fail - R	FMC FAIL - R		
FMC or IRU Data Source	FMC IRU Data Source	FMC/IRU DATA SOURCE		
Air/Ground Sensor (31)	Gear WOW	AIR/GROUND		1-15
Glideslope Deviation (28)	Glideslope Dev	GLIDESLOPE DEV CAPT, GLIDESLOPE DEV_ILS C, GLIDESLOPE DEV_ILS R, GLIDESLOPE DEV_ILS L	ddm	
Aircraft Gross Weight	Gross Weight	GROSS WEIGHT	lbs	
Ground Speed (34)	Ground Spd-L	GROUNDSPEED CAPT	kts	1-15
True or Magnetic Heading Displayed Discrete (4)	Heading Mag-True Disp-L	MAG/TRUE DATA CAPT		
Magnetic Heading (4)	Heading Mag-L	MAG HEADING CAPT	deg	
Hydraulic Brake Source	Hyd Brake Source	HYD BRAKE SOURCE		
Center Hydraulic System Pressure (77)	Hyd Press-C	HYD PRES - C	psi	
Left Hydraulic System Pressure (77)	Hyd Press-L	HYD PRES - L	psi	
Right Hydraulic System Pressure (77)	Hyd Press-R	HYD PRES - R	psi	
Center Hydraulic System Quantity	Hyd Qty-C	HYD QUANT - C	%	
Left Hydraulic System Quantity	Hyd Qty-L	HYD QUANT - L	%	
Right Hydraulic System Quantity	Hyd Qty-R	HYD QUANT - R	%	
Center Hydraulic System Low Pressure (33)	Hyd Lo Press-C	HYD SYS LO PRESS - C		
Left Hydraulic System Low Pressure (33)	Hyd Lo Press-L	HYD SYS LO PRESS - L		
Right Hydraulic System Low Pressure (33)	Hyd Lo Press-R	HYD SYS LO PRESS - R		

Parameter (FAA #)	Plot Label	Documentation Name[3]	Units[4]	Plots
Center Hydraulic System Low Quantity	Hyd Lo Qty-C	HYD SYS LO QTY - C		
Left Hydraulic System Low Quantity	Hyd Lo Qty-L	HYD SYS LO QTY - L		
Right Hydraulic System Low Quantity	Hyd Lo Qty-R	HYD SYS LO QTY - R		
Left VHF Radio Keyed (8)	Key VHF-1	VHF LEFT KEYING		
Right VHF Radio Keyed (8)	Key VHF-2	VHF RIGHT KEYING		
Center VHF Radio Keyed (8)	Key VHF-3	VHF CENTER KEYING		
Present Position Latitude (39)	Latitude	PRES POSN LAT-LSData, PRES POSN LAT-MSData	deg	
Landing Configuration Warning Gear	Ldg Config Gear	LDG CONFIG - GEAR		
Landing Configuration Warning Speed Brake	Ldg Config Spd Brk	LDG CONFIG-SPD BK		
Leading Edge Slats Asymmetry	LE Slats Asym	LE SLATS ASYM		
Leading Edge Slats Disagree	LE Slats Disagree	L.E. SLAT DISAGREE		
Leading Edge Slats Extended (21)	LE Slats Extend	L.E. SLATS EXTEND		
Leading Edge Slats Partially Extended (21)	LE Slats Part Extend	L.E. SLATS PART EXTEND		
Leading Edge Slats Retracted (21)	LE Slats Retracted	L.E. SLATS RETRACTED		
Localizer Deviation (27)	Localizer Dev	LOCALIZER DEV CAPT, LOCALIZER DEV_ILS C, LOCALIZER DEV_ILS R, LOCALIZER DEV_ILS L	ddm	
Present Position Longitude (39)	Longitude	PRES POSN LONG-LSData, PRES POSN LONG-MSData	deg	
Master Caution	Master Caution	MASTER CAUTION LIGHT		
Left Master Warning (30)	Master Warn- L	MASTER WARNING CAPT		
Right Master Warning (30)	Master Warn- R	MASTER WARNING F/O		
Pitch Attitude (6)	Pitch-L	PITCH ANGLE CAPT	deg	1-14
Roll Attitude (7)	Roll-L	ROLL ANGLE CAPT	deg	1-14
Rudder Position (17)	Rudder	RUDDER POSITION	deg	
Rudder Pedal Position (14)	Rudder Ped Pos	RUDDER PEDAL POSITION	deg	
Speed Brake Handle Position (23)	Spd Brk Hdl Pos	SPD BRK HDL POSN_FCC C-A-4, SPD BRK HDL POSN_FCC L-A-4, SPD BRK HDL POSN_FCC R-A-4, SPD BRK HDL POSN_MCP A-A-2	deg	1-14
Spoiler Module Fault	Spoiler Module	SPOILER MODULE		1-14
Spoiler System Fault	Spoiler Sys Fault	SPOILER SYSTEM		
Stabilizer Position (19)	Stab Pos	STAB POSITION	deg	
Total Air Temperature (24)	Temp TAT	TOTAL TEMP	deg C	15
Captain's Clock Hours (1)	Time GMT Hrs	GMT HOURS	hrs	15
Captain's Clock Minutes (1)	Time GMT Min	GMT MINUTES	min	15
Captain's Clock Seconds (1)	Time GMT Sec	GMT SECONDS	sec	15

3.6.2. Pressure Altitude

This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

3.7. FDR Plots and Corresponding Tabular Data

Table 1 lists all of the FDR parameters plotted and provides a cross reference between the name of the parameter in the plots and tabular data, the name of the parameter from the manufacturer's documentation and the full name of the parameter with a reference to the FAR requirements when applicable.

Additionally, these plots are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The first 14 of the following plots contain FDR data recorded during the December 29, 2010 event and the previous landings recorded on the incident FDR. These plots are time aligned such that the plot starts approximately 7 seconds prior to initial touchdown of each landing. The vertical acceleration parameter, not valid for the incident landing, was intermittently valid for other landings on the recording and is included in Plots 2 through 14.

Plot 1 shows selected parameters for the incident landing for a 60 second window beginning at 11:37:36 MST, approximately 7.5 seconds prior to touchdown. The recording indicates that the aircraft touched down at approximately 11:37:43.5 MST. At touchdown, the recorded airspeed was 132.5 knots, pitch angle was 3.69 degrees, ground speed was 145 knots, engine 1 and 2 throttle lever angels were 50.2 and 49.9 degrees, respectively, and speed brake handle position was about 8 degrees, which is the "Armed" position. Approximately one second later (11:37:44.5 MST) the weight-on-wheels parameter indicates "Air" again for .5 seconds before going back to "Ground". During this time, the speed brake handle position parameter indicates that the speed brake handle begins to retract to about two degrees, just above the "Down" position. At the time the weight-on-wheels indication shows "Ground" again, the engine 1 thrust reverser in transit discrete indicates that the thrust reverser is in transit followed by the engine 2 thrust reverser showing in transit.[5] The speed brake handle reached the two degree point and moved back to the eight degree point at about the same time the thrust reversers transitioned. The thrust reversers show "In Transit" and "Not Deployed" for ten seconds before returning to "Not In Transit" for one second then back to "In Transit" for an additional six seconds before changing to "Not In Transit" and "Deployed". At 11:38:18 MST, there is a large downward spike in longitudinal acceleration and minor oscillations begin in the pitch parameter. At 11:38:30, MST deceleration is no longer indicated in the longitudinal

[5] Both sets of thrust reverse discrete parameters are sampled once per second with engine 1 parameters near the beginning of the second and engine 2 parameters sampled near the middle of the second. Most likely the indications are showing nearly simultaneous movements if they occur within a 1 second window of each other. The exact timing of the movement is most closely represented by the first of the parameters that changes state.

acceleration parameter and ground speed reaches one knot where it remains until the end of the recording. Data shown in Plot 1 is included in the tabular data in Attachment 2.

Plots 2 through 14 are plots of the same parameters as Plot 1 (without pressure altitude and including vertical acceleration) for the other landings recorded on the incident recorder. They are included for comparison purposes. Tabular listings of data shown in Plots 2 through 14 are included in Attachment 3.

Plots 5 and 13 show other landings where the weight-on-wheels indication toggled back to "Air" for a period before settling in the "Ground" state. In these plots, the relationship between the toggle and thrust reverser deployment is not nearly simultaneous as in the incident flight. During the landing shown in Plot 13, the speed brake handle retracts slightly while the aircraft is in the air then extends to the "Armed" position once the thrust reversers are deployed.

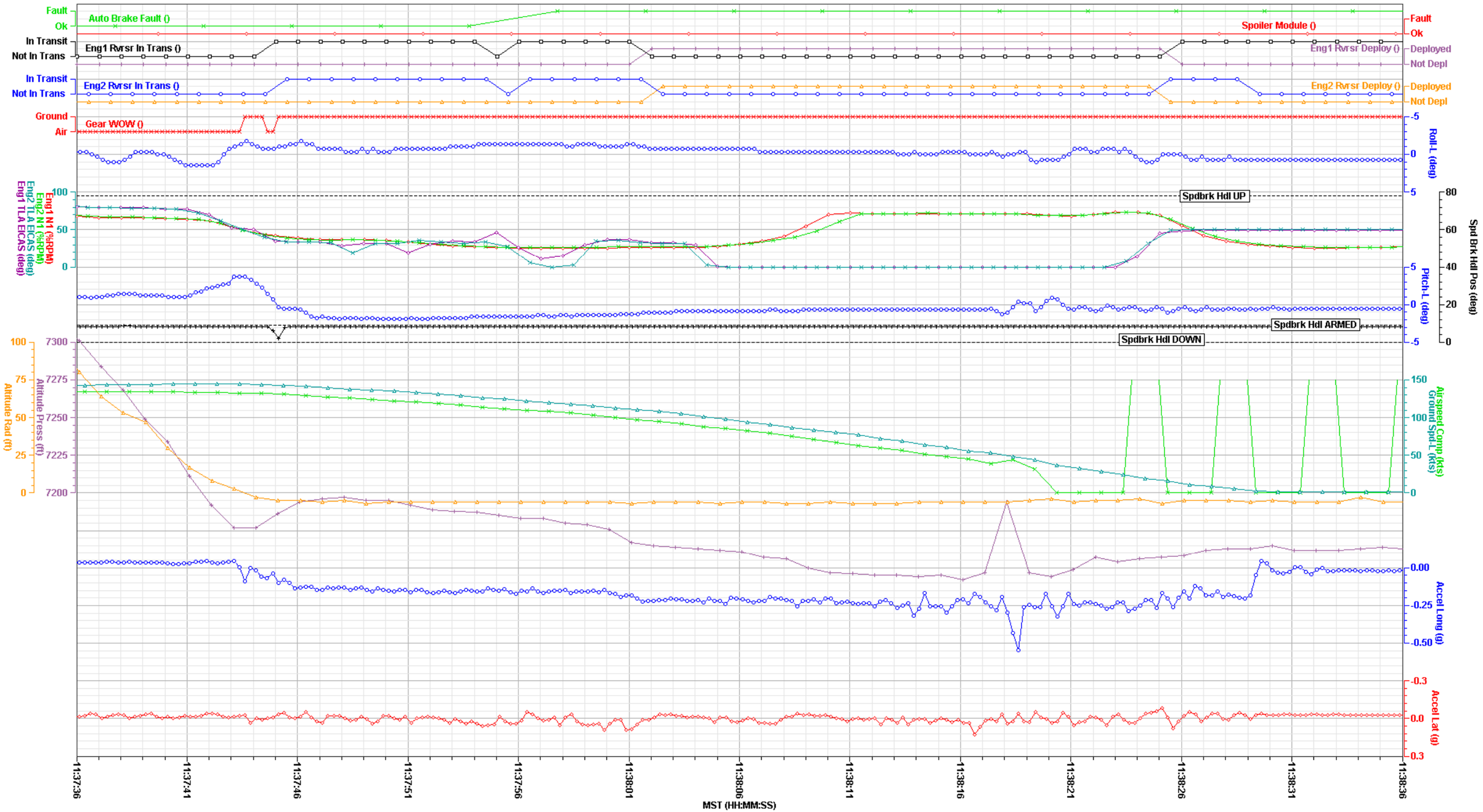
Plot 15 shows data from the last hour of the FDR reasonableness check download created on 17 October 2010. The parameters plotted are those required by 14 CFR 121.344 for parameter categories 1 (time), 3 (airspeed), 5 (vertical acceleration), 24 (air temperature), 26 (radio altitude), 31 (air/ground sensor), and 34 (ground speed). The vertical acceleration data was not in a normal flight range (about 1 G) for the duration of the last hour of the data. A tabular listing of the data shown in Plot 15 is included in Attachment 4.

The tabular data provided in Attachments 2 through 4 are only available in electronic format. Each of these attachments is a compressed zip file containing one or more comma separated variable (csv) formatted files. Data in Attachment 2 has a time base of seconds since midnight in MST. Data in Attachments 3 and 4 has a time base of FDR SRN.

American Airlines, Boeing 757-200, Flt 2253, N668AA

Location, Date: Jackson Hole, WY, 12/29/10

NTSB No. DCA11IA015



Revised: 26 July 2011

Incident Landing - Touchdown & Rollout

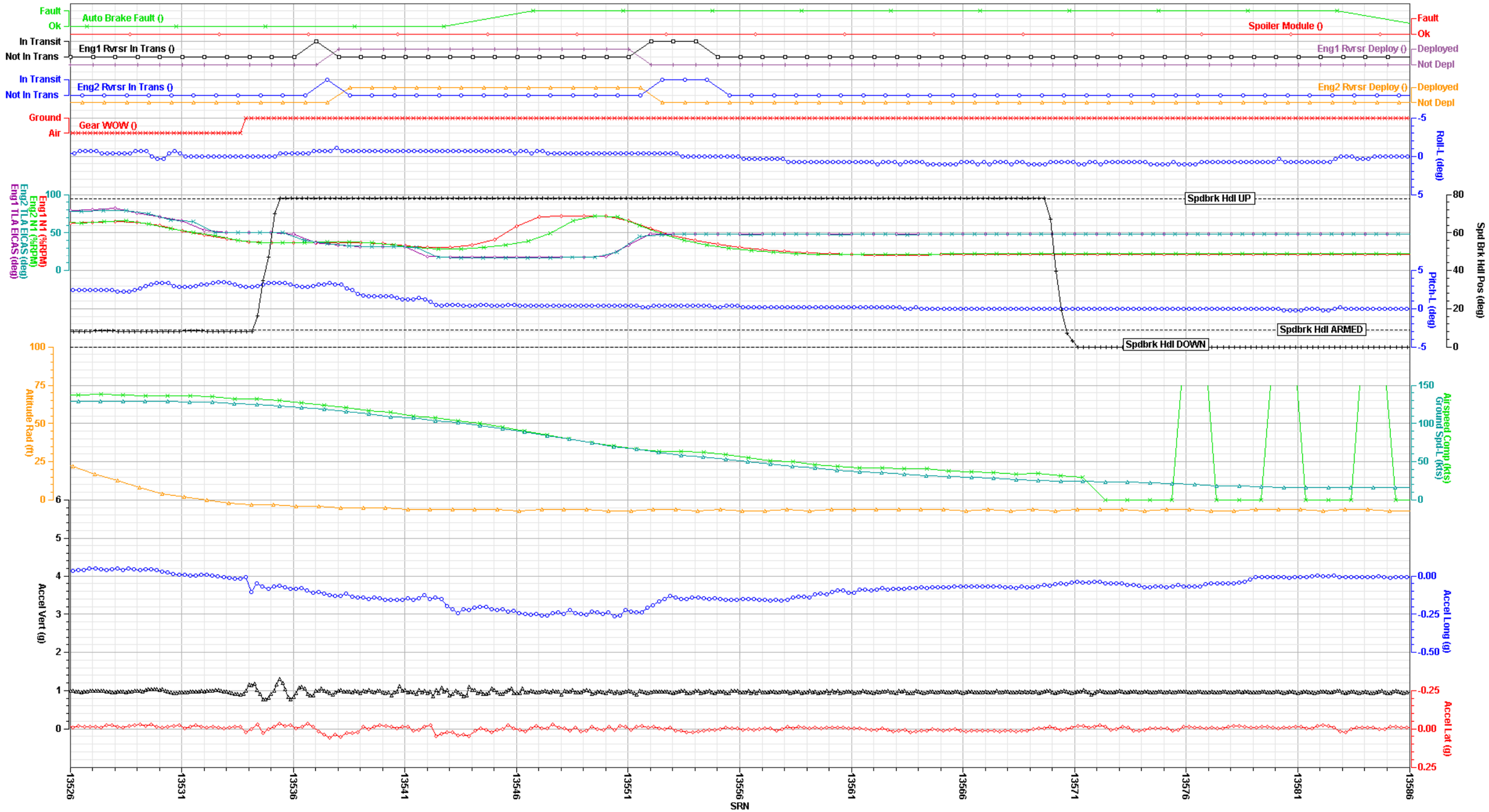
National Transportation Safety Board

Plot 1

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 1

NTSB No. DCA11IA015



Revised: 21 July 2011

1st Landing - Touchdown & Rollout

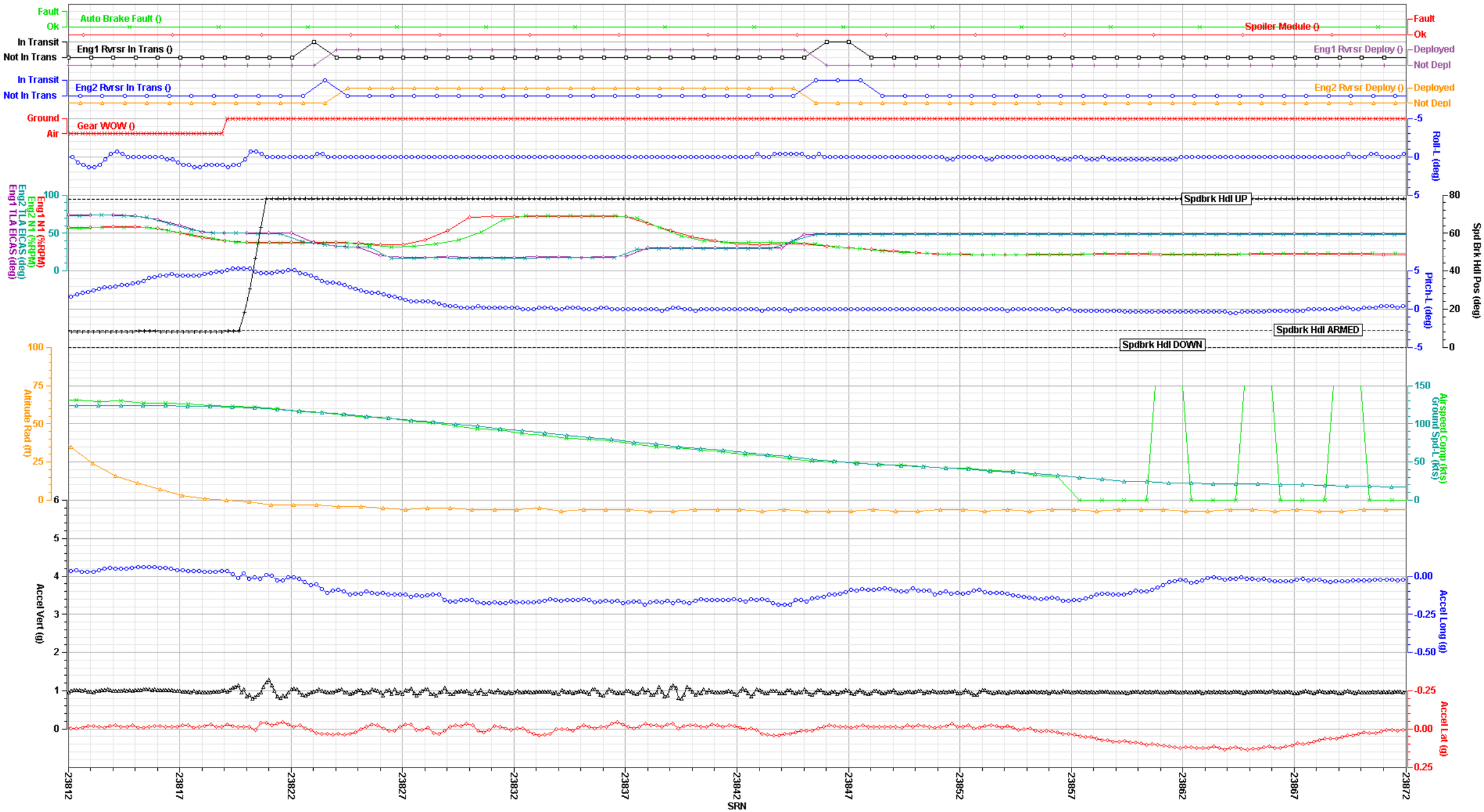
National Transportation Safety Board

Plot 2

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 2

NTSB No. DCA11IA015



Revised: 21 July 2011

2nd Landing - Touchdown & Rollout

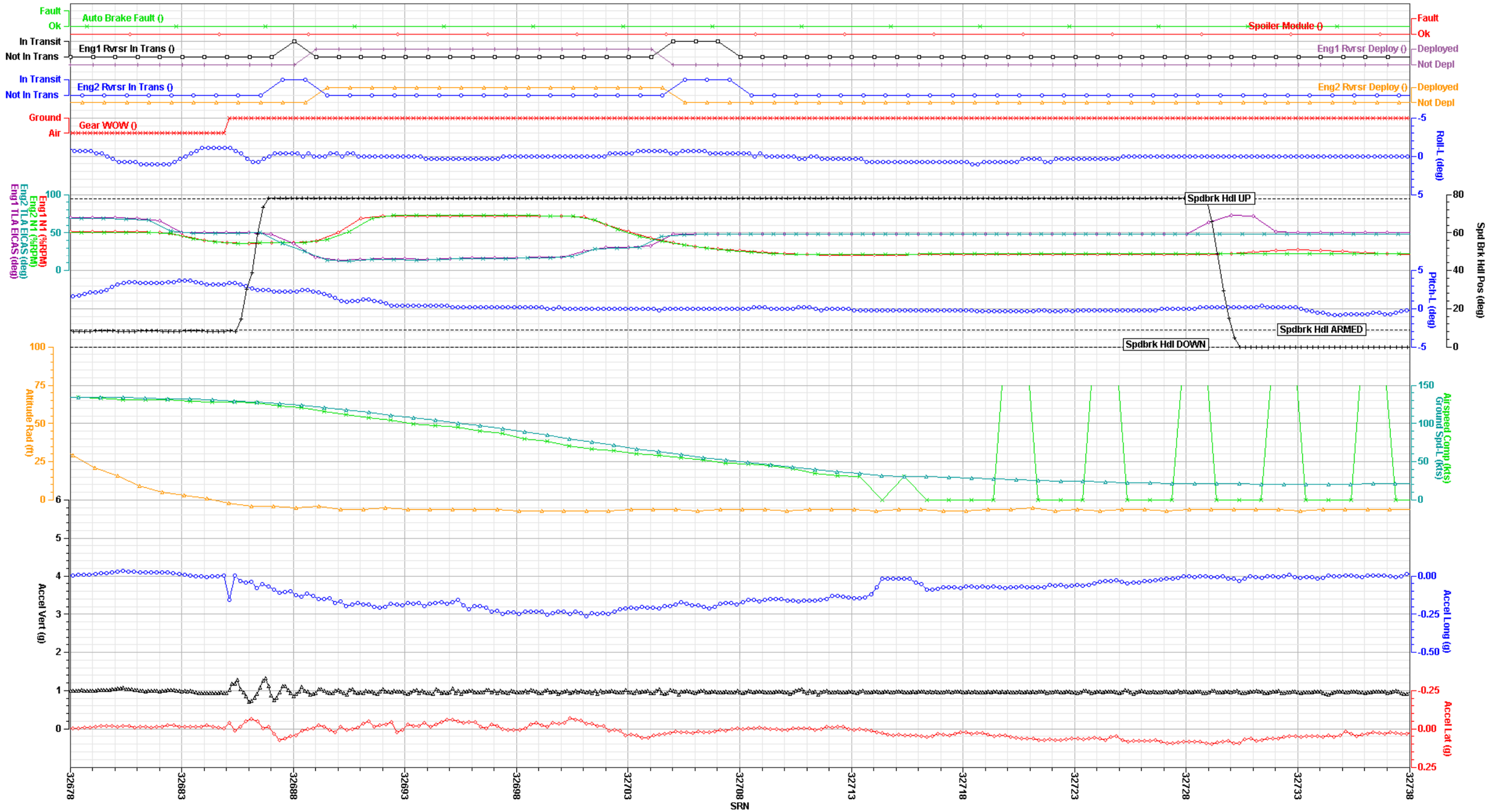
National Transportation Safety Board

Plot 3

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 3

NTSB No. DCA11IA015



Revised: 21 July 2011

3rd Landing - Touchdown & Rollout

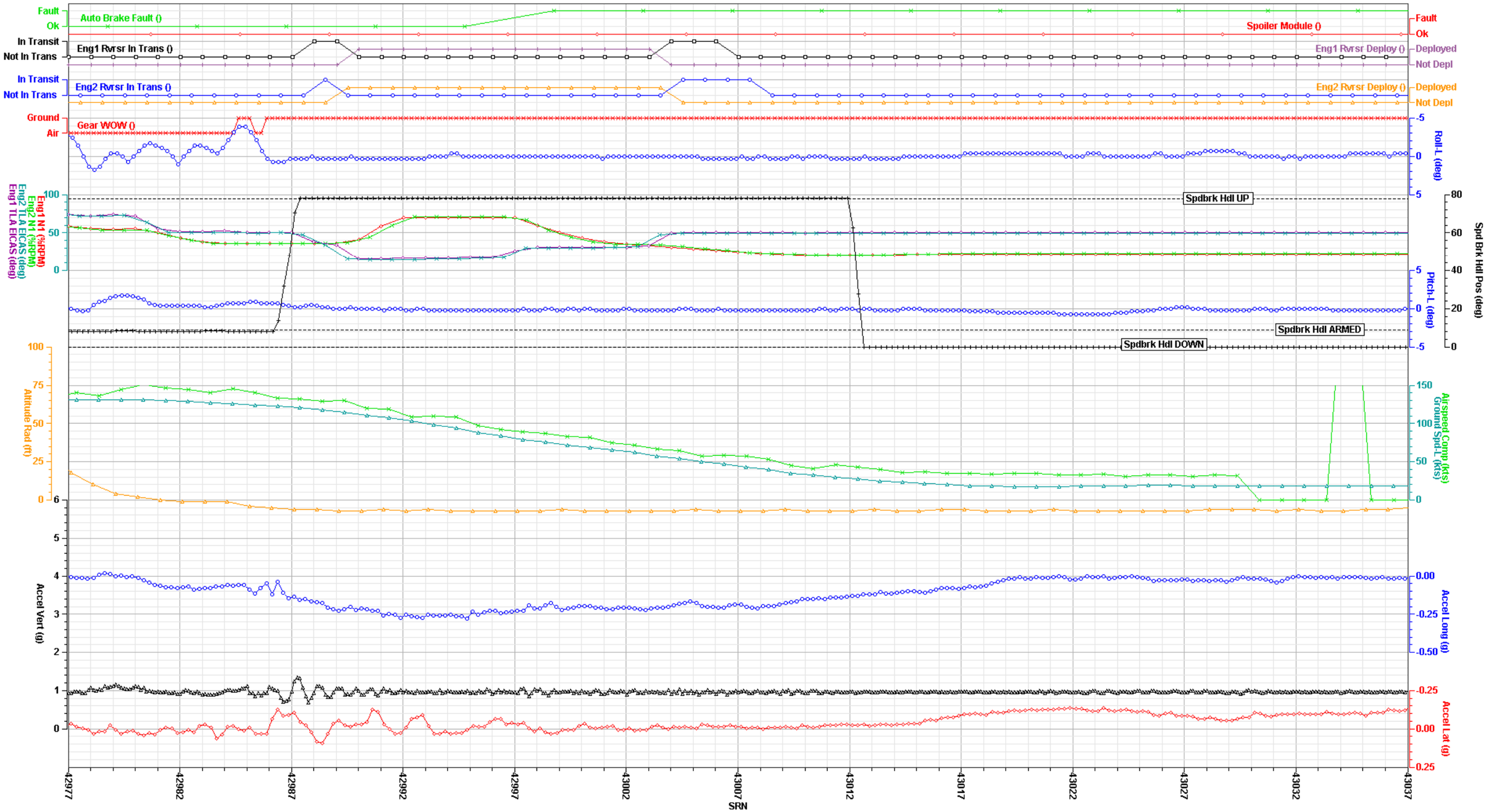
National Transportation Safety Board

Plot 4

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 4

NTSB No. DCA11IA015



Revised: 21 July 2011

4th Landing - Touchdown & Rollout

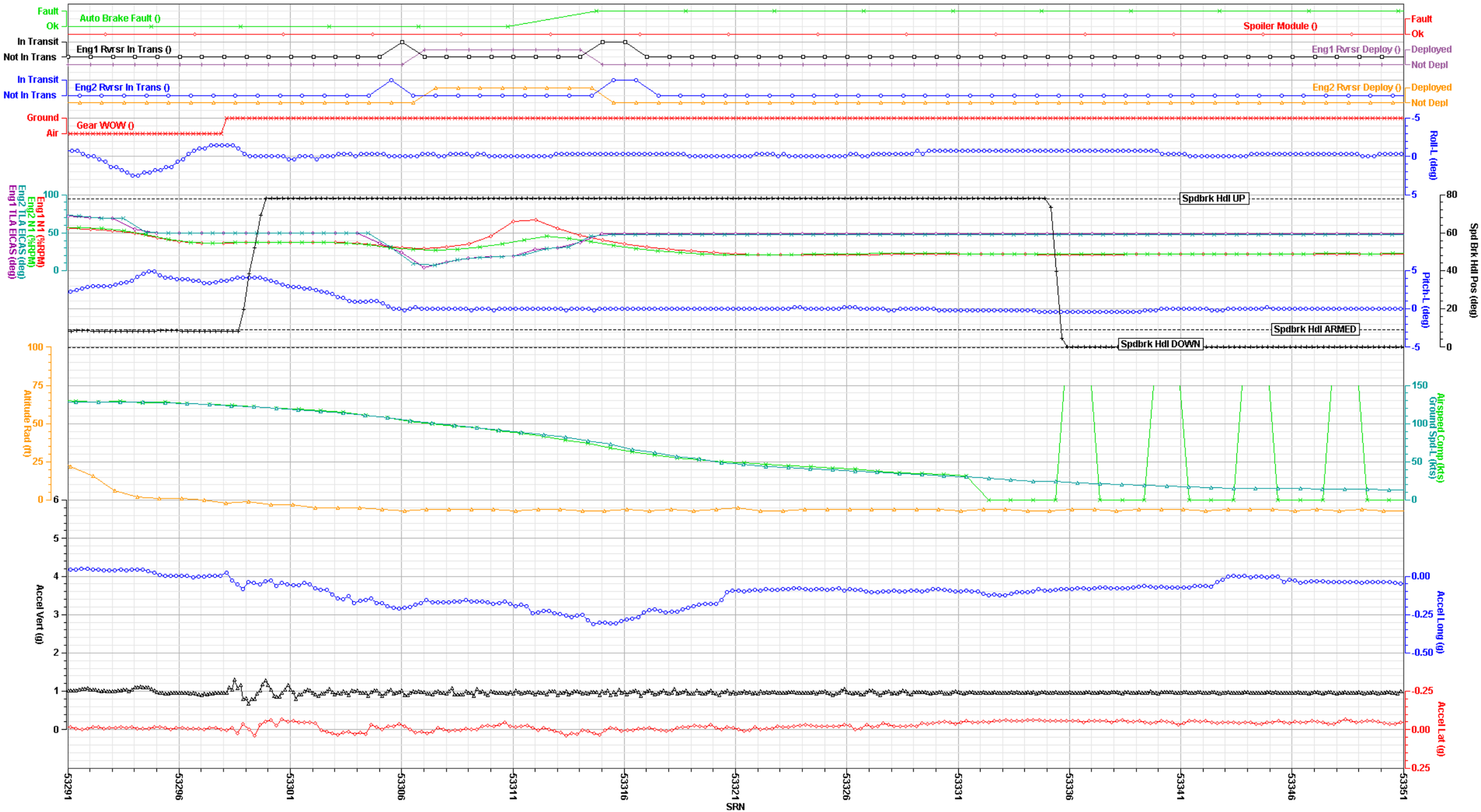
National Transportation Safety Board

Plot 5

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 5

NTSB No. DCA11IA015



Revised: 21 July 2011

5th Landing - Touchdown & Rollout

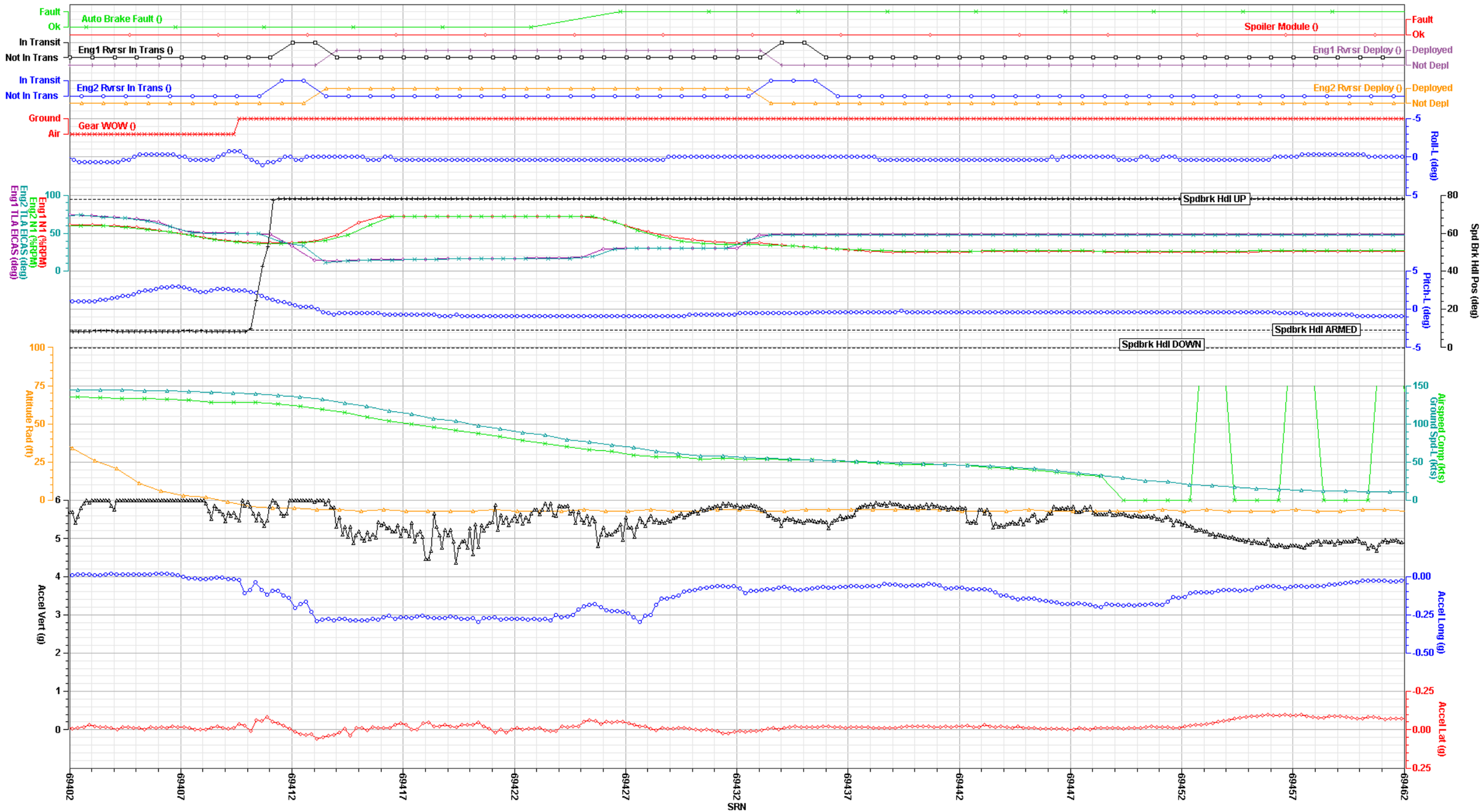
National Transportation Safety Board

Plot 6

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 6

NTSB No. DCA11IA015



Revised: 21 July 2011

6th Landing - Touchdown & Rollout

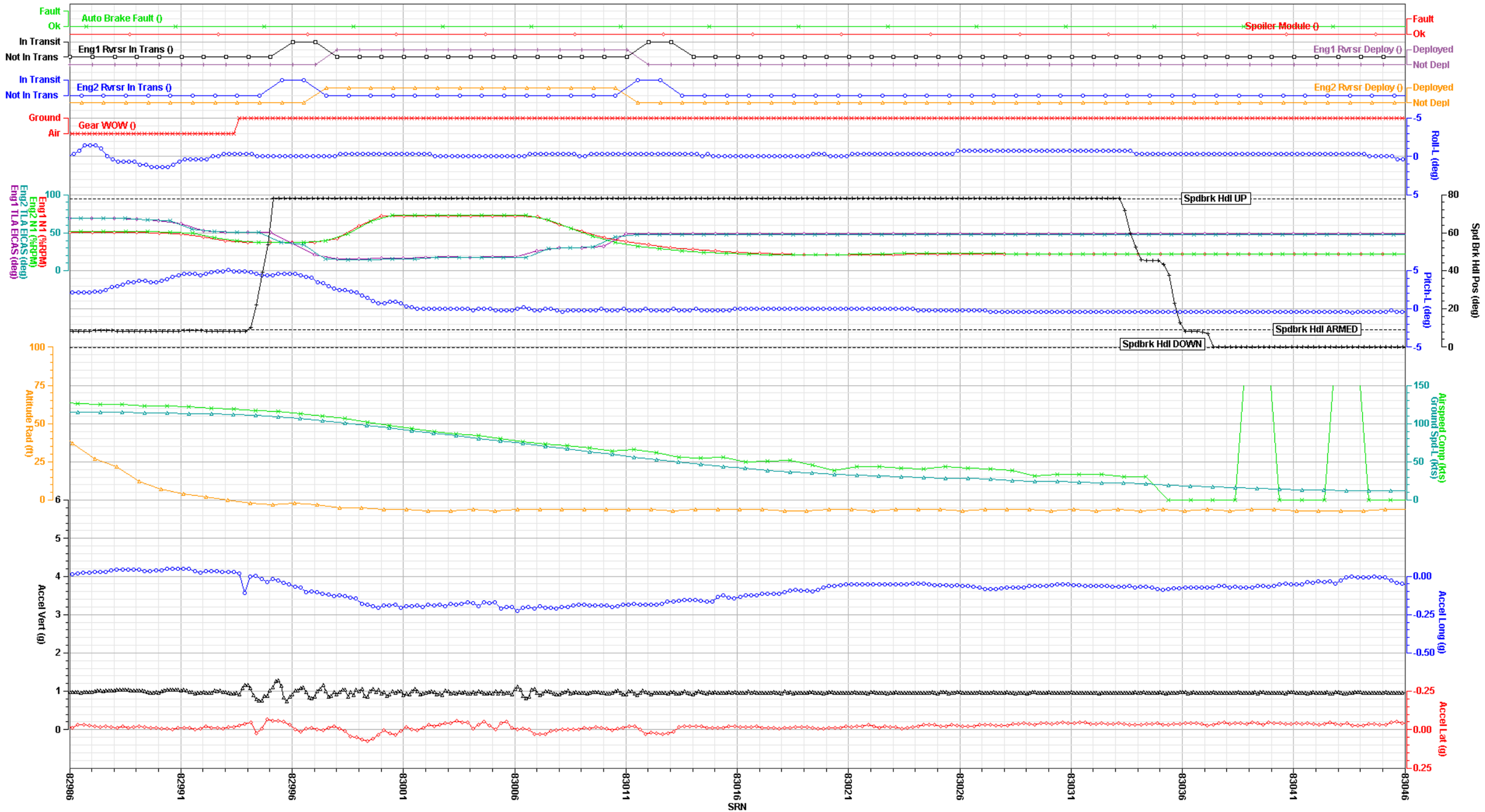
National Transportation Safety Board

Plot 7

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 7

NTSB No. DCA11IA015



Revised: 21 July 2011

7th Landing - Touchdown & Rollout

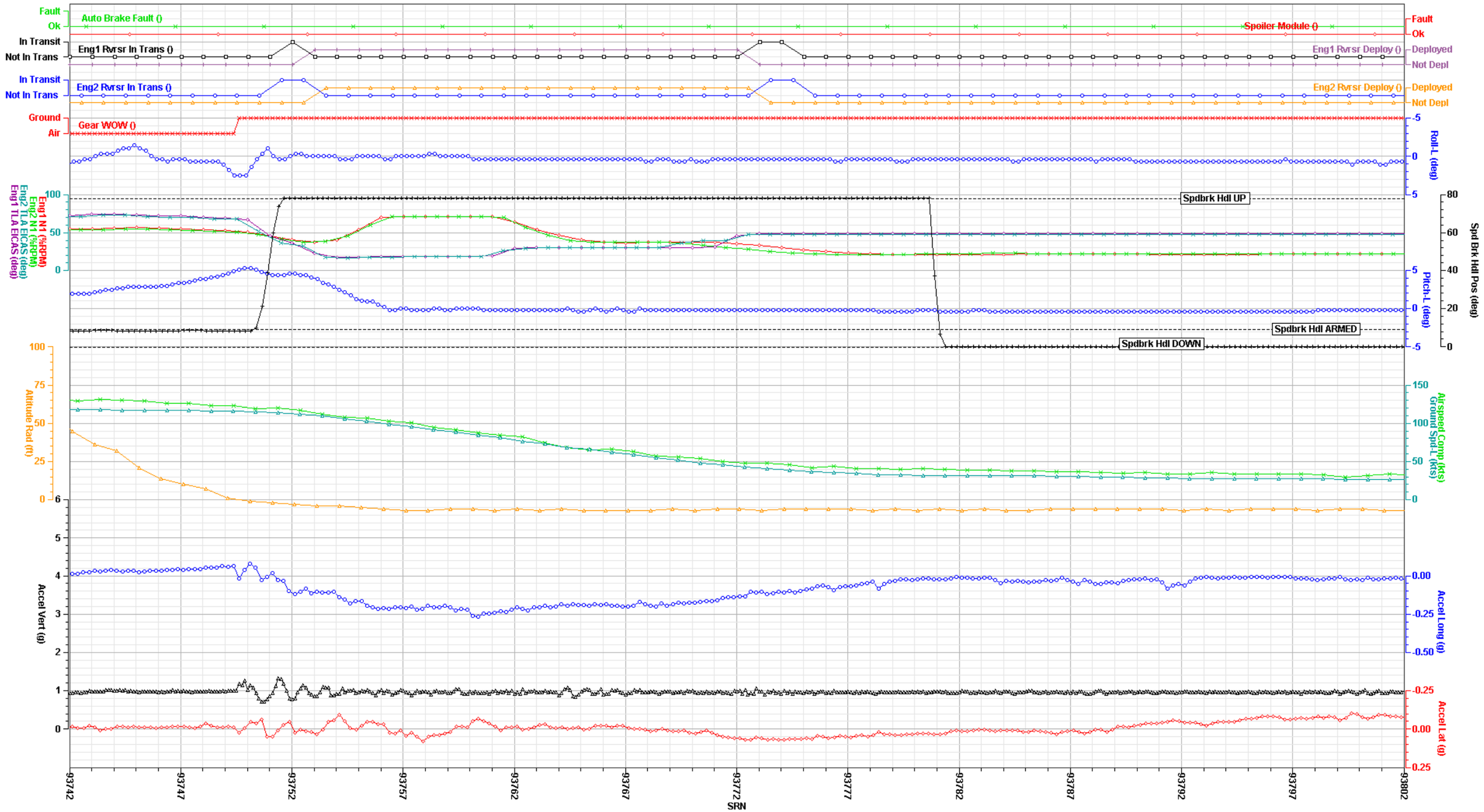
National Transportation Safety Board

Plot 8

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 8

NTSB No. DCA11IA015



Revised: 21 July 2011

8th Landing - Touchdown & Rollout

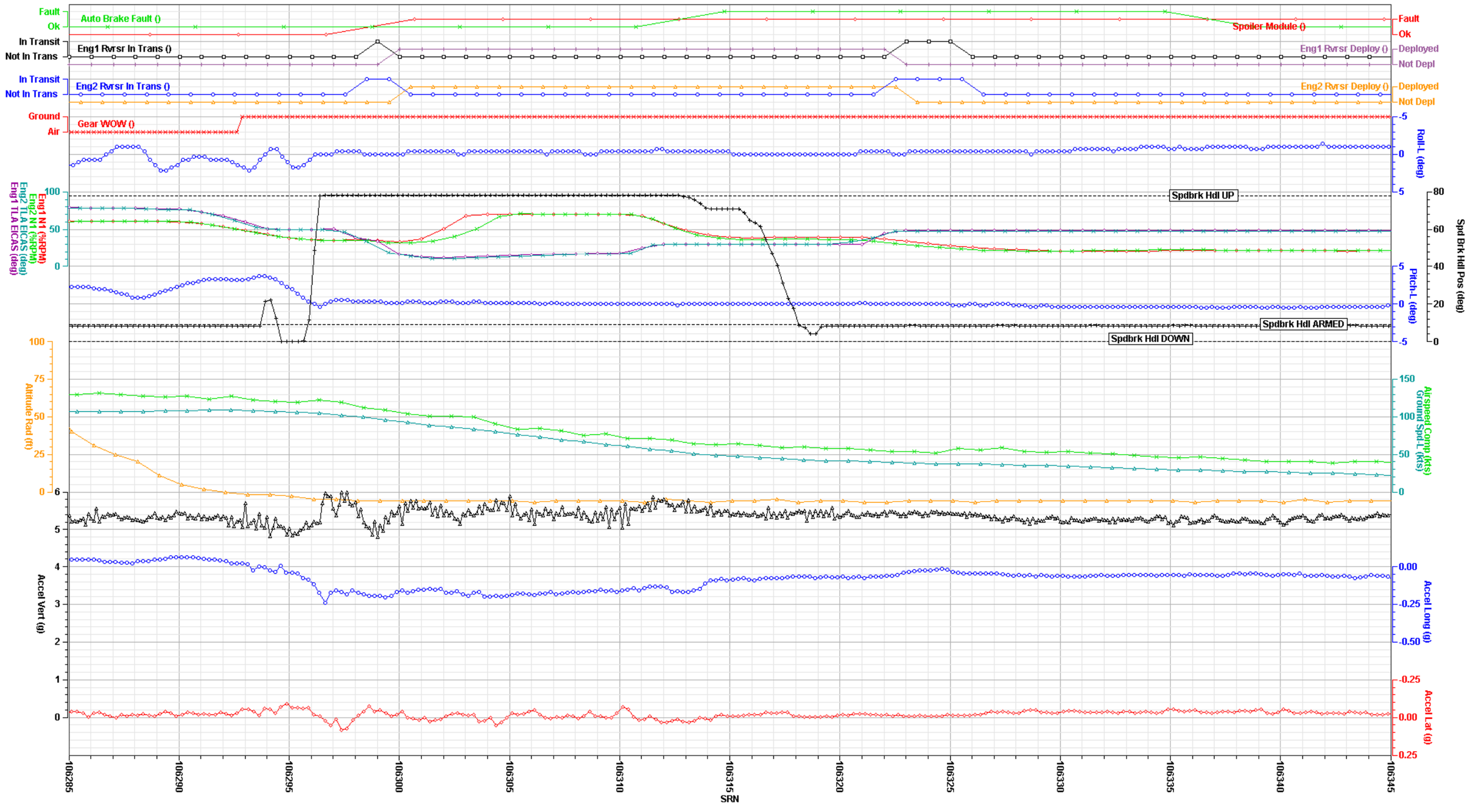
National Transportation Safety Board

Plot 9

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 9

NTSB No. DCA11IA015



Revised: 21 July 2011

9th Landing - Touchdown & Rollout

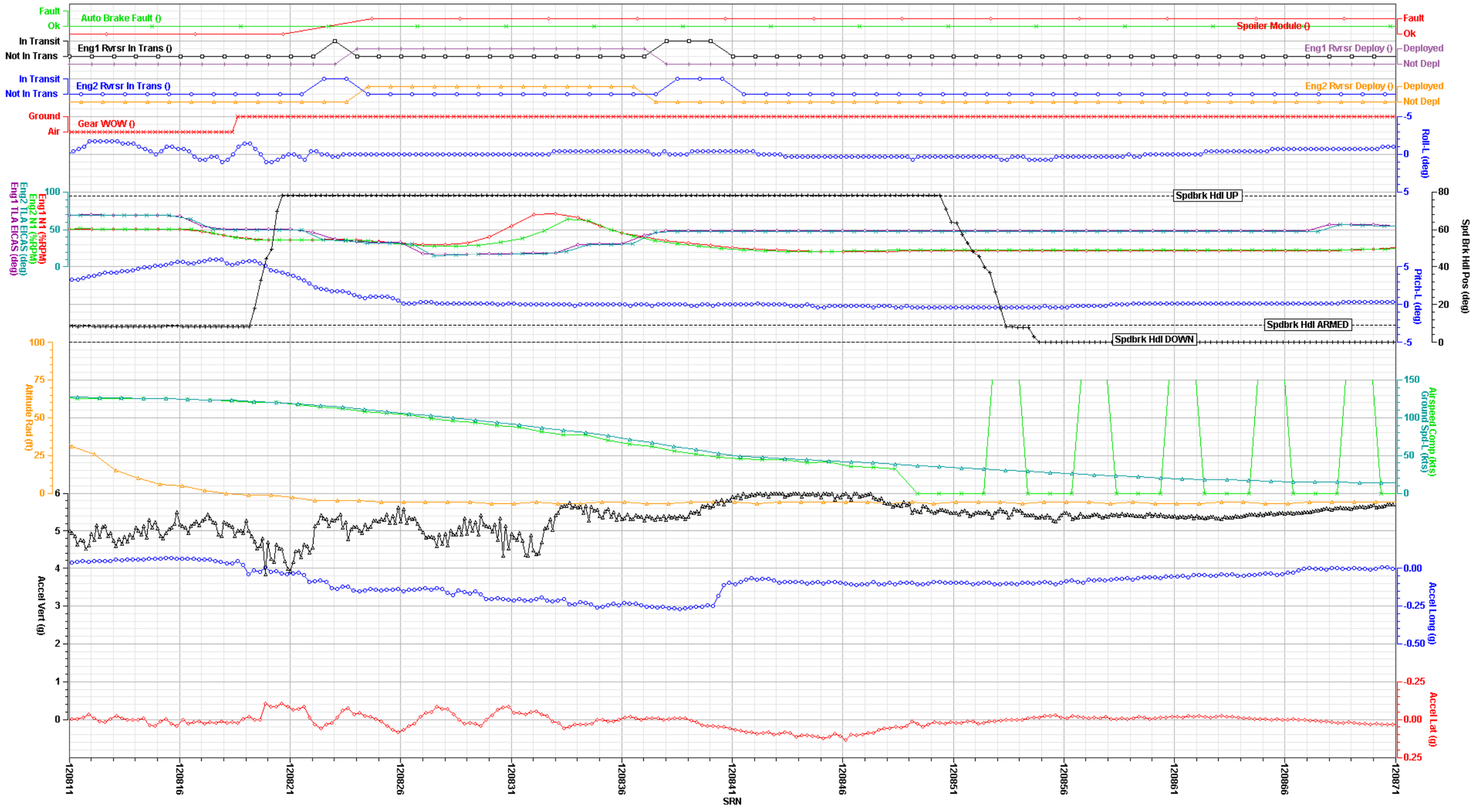
National Transportation Safety Board

Plot 10

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 10

NTSB No. DCA11IA015



Revised: 21 July 2011

10th Landing - Touchdown & Rollout

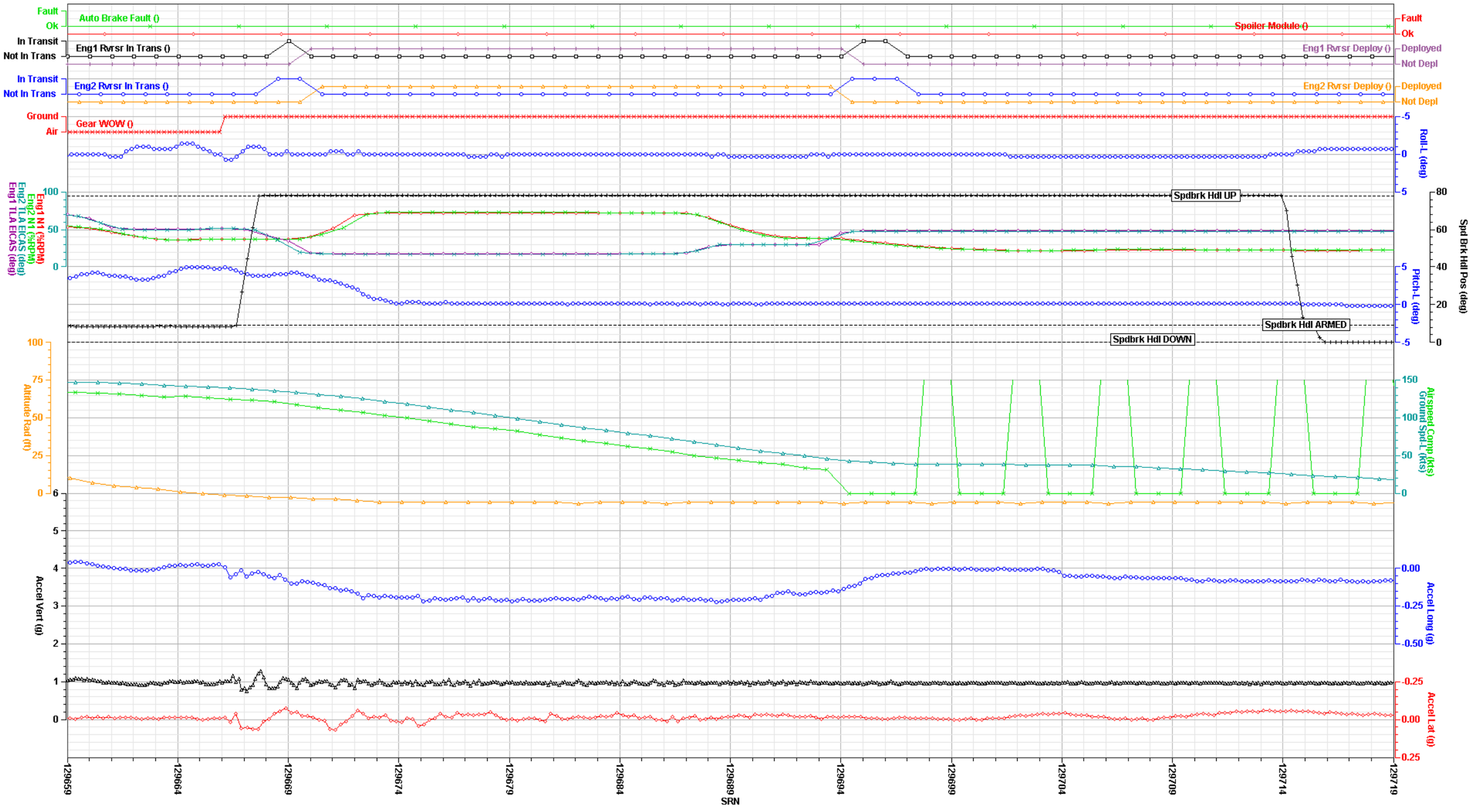
National Transportation Safety Board

Plot 11

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 11

NTSB No. DCA11IA015



Revised: 21 July 2011

11th Landing - Touchdown & Rollout

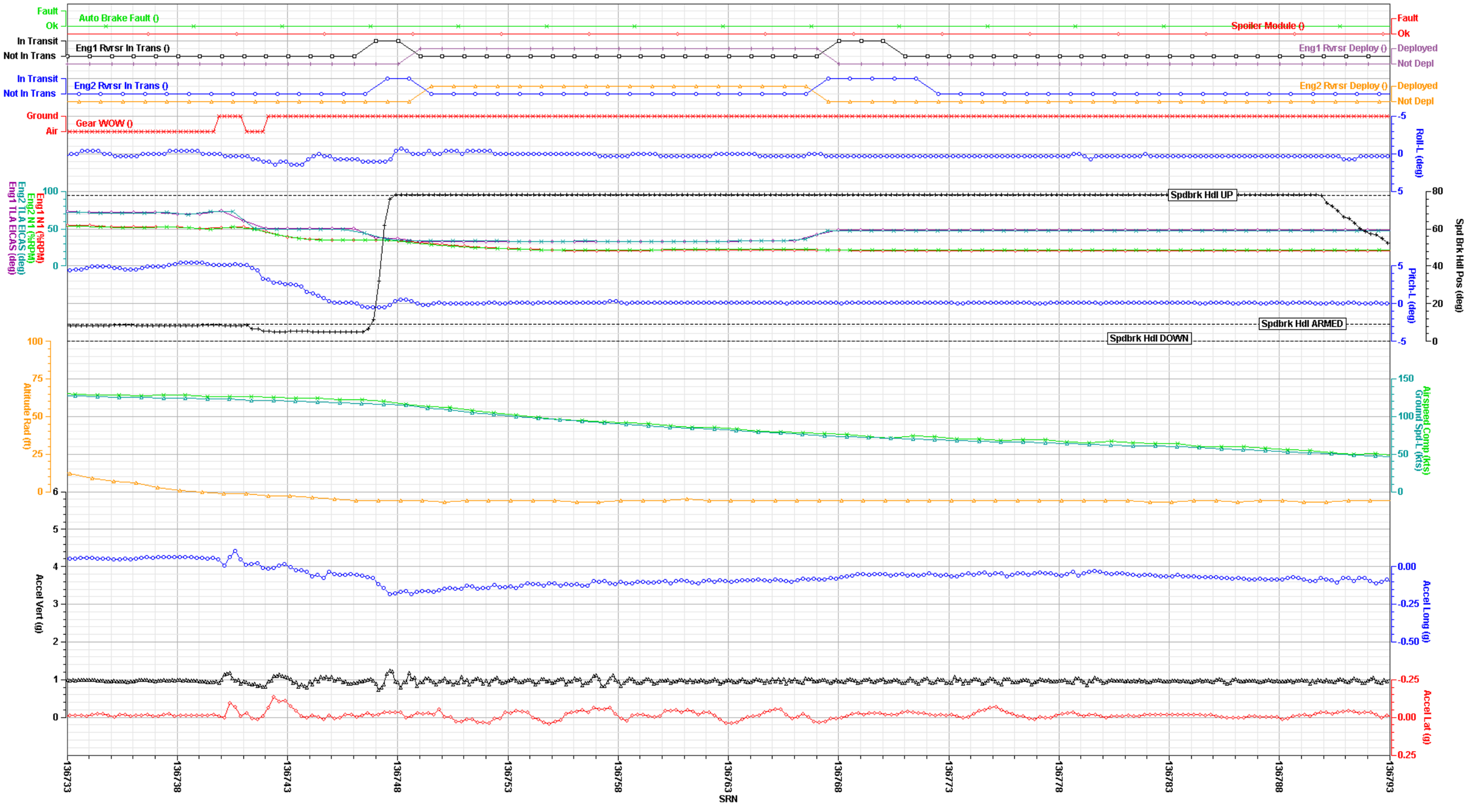
National Transportation Safety Board

Plot 12

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 12

NTSB No. DCA11IA015



Revised: 21 July 2011

12th Landing - Touchdown & Rollout

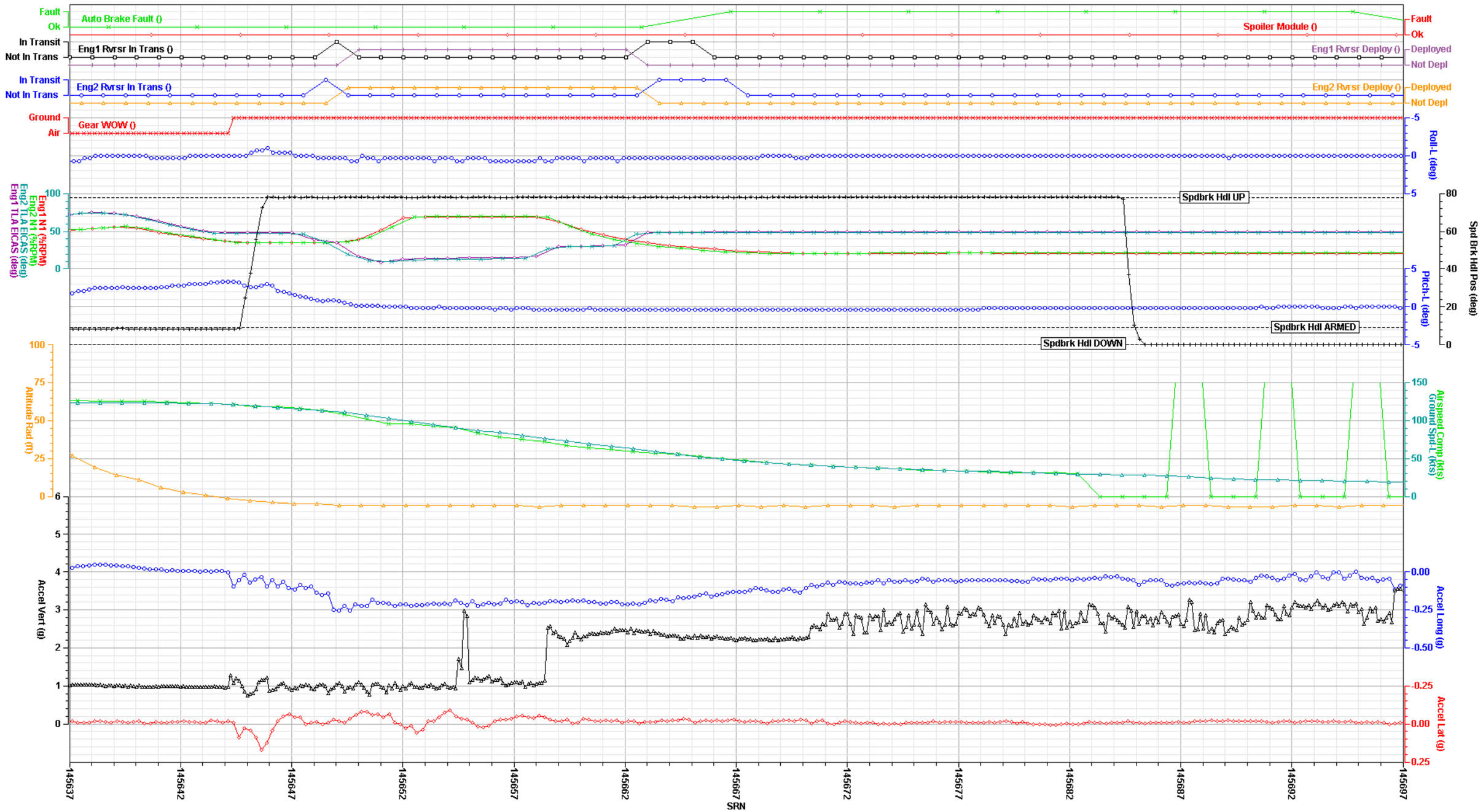
National Transportation Safety Board

Plot 13

Other Landings from American Airlines, Boeing 757-200, N668AA

Incident FDR - Landing 13

NTSB No. DCA11IA015



Revised: 21 July 2011

13th Landing - Touchdown & Rollout

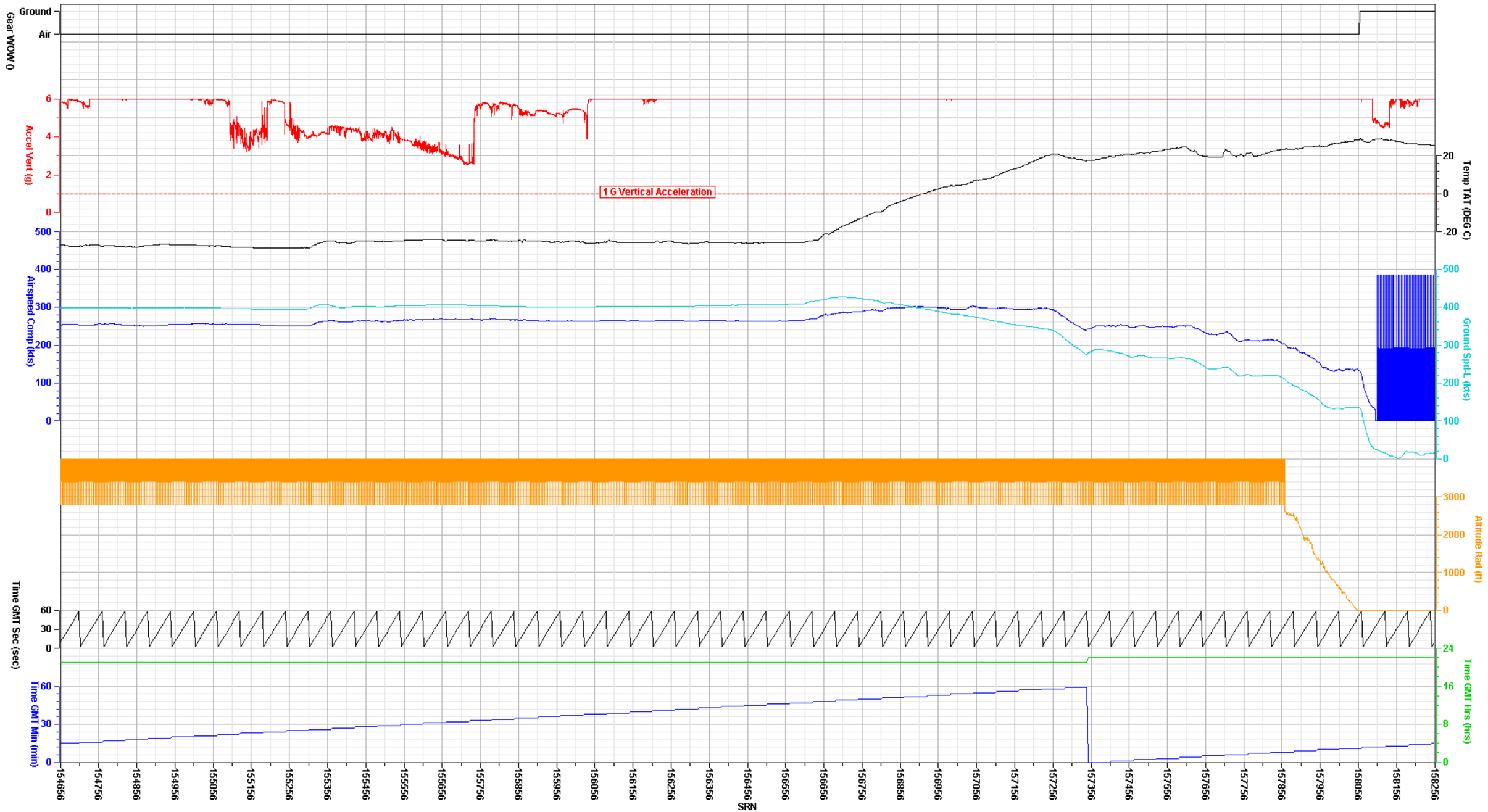
National Transportation Safety Board

Plot 14

American Airlines, Boeing 757-200, N668AA

Maintenance Download, 10/17/10

NTSB No. DCA11IA015



Revised: 21 September 2011

Reasonableness Check

National Transportation Safety Board

Plot 15