In-Flight Left Engine Fire
American Airlines Flight 1400
McDonnell Douglas DC-9-82, N454AA
St. Louis, Missouri
September 28, 2007

Accident Report

NTSB/AAR-09/03
PB2009-910403

National
Transportation
Safety Board

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490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2009. *In-Flight Left Engine Fire, American Airlines Flight 1400, McDonnell Douglas DC-9-82, N454AA, St. Louis, Missouri, September 28, 2007*. Aircraft Accident Report NTSB/AAR-09/03. Washington, DC.

Abstract: This report explains the September 28, 2007, accident involving a McDonnell Douglas DC-9-82, N454AA, operated as American Airlines flight 1400. The airplane experienced an in-flight engine fire during departure climb from Lambert St. Louis International Airport, St. Louis, Missouri, and the flight crew conducted an emergency landing. The safety issues discussed in this report relate to the following: characteristics of the “Air Turbine Starter Valve (ATSV) Open” light; emergency task allocation guidance; guidance and training on the interrelationship between pneumatic crossfeed valves and engine fire handles; multiple simultaneous emergencies training; guidance on evacuation preparation on the ground; guidance and training on communications between flight and cabin crews during emergency and unusual situations; ATSV air filter replacement intervals; and American Airlines’ Continuing Analysis and Surveillance System. Safety recommendations concerning these issues are addressed to the Federal Aviation Administration and American Airlines.

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Abbreviations and Acronyms

AC	advisory circular
AFFF	aqueous firefighting foam
AGB	accessory gearbox
agl	above ground level
AMM	aircraft maintenance manual
AOL	all operators letter
AOM	aircraft operating manual
APU	auxiliary power unit
AQP	Advanced Qualification Program
ARFF	aircraft rescue and firefighting
ASRS	Aviation Safety Reporting System
ATBT	action to be taken
ATC	air traffic control
ATCT	air traffic control tower
ATS	air turbine starter
ATSV	air turbine starter valve

C	Celsius
CAM	cockpit area microphone
CASS	Continuing Analysis and Surveillance System
CFR	*Code of Federal Regulations*
CMM	component maintenance manual
CPAP	continuous positive airway pressure
CRM	crew resource management
CVR	cockpit voice recorder
DFGS	digital flight guidance system
DFW	Dallas/Fort Worth International Airport
EAS	Emergency and Abnormal Situations
F	Fahrenheit
FAA	Federal Aviation Administration
FAM	flight attendant manual
FCOM	flight crew operating manual
FDR	flight data recorder
FOM	flight operations manual
IC	incident commander

ICAS	integrated crew advisory system
LOE	line operational evaluation
LOSA	line operations safety audit
MEL	minimum equipment list
NASA	National Aeronautics and Space Administration
P&W	Pratt & Whitney
P/N	part number
PA	public address
PIC	pilot-in-command
POI	principal operations inspector
psi	pounds per square inch
PTU	power transfer unit
QRH	quick reference handbook
SAFO	safety alert for operators
SIC	second-in-command
SLC	Salt Lake City International Airport
SMS	Safety Management System
STL	Lambert-St. Louis International Airport

Executive Summary

On September 28, 2007, about 1313 central daylight time, American Airlines flight 1400, a McDonnell Douglas DC-9-82, N454AA, experienced an in-flight engine fire during departure climb from Lambert-St. Louis International Airport (STL), St. Louis, Missouri. During the return to STL, the nose landing gear failed to extend, and the flight crew executed a go-around, during which the crew extended the nose gear using the emergency procedure. The flight crew conducted an emergency landing, and the 2 flight crewmembers, 3 flight attendants, and 138 passengers deplaned on the runway. No occupant injuries were reported, but the airplane sustained substantial damage from the fire. The scheduled passenger flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 on an instrument flight rules flight plan. Visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determines that the probable cause of this accident was American Airlines' maintenance personnel's use of an inappropriate manual engine-start procedure, which led to the uncommanded opening of the left engine air turbine starter valve, and a subsequent left engine fire, which was prolonged by the flight crew's interruption of an emergency checklist to perform nonessential tasks. Contributing to the accident were deficiencies in American Airlines' Continuing Analysis and Surveillance System (CASS) program.

The safety issues discussed in this report relate to the following: characteristics of the "Air Turbine Starter Valve (ATSV) Open" light; emergency task allocation guidance; guidance and training on the interrelationship between pneumatic crossfeed valves and engine fire handles; multiple simultaneous emergencies training; guidance on evacuation preparation on the ground; guidance and training on communications between flight and cabin crews during emergency and unusual situations; ATSV-air filter replacement intervals; and American Airlines' CASS. Safety recommendations concerning these issues are addressed to the Federal Aviation Administration and American Airlines.

1. Factual Information

1.1 History of Flight

On September 28, 2007, about 1313 central daylight time,[1] American Airlines flight 1400, a McDonnell Douglas DC-9-82 (MD-82),[2] N454AA, experienced an in-flight left engine fire during departure climb from Lambert-St. Louis International Airport (STL), St. Louis, Missouri. During the return to STL, the nose landing gear failed to extend, and the flight crew executed a go-around, during which the crew extended the nose gear using the emergency procedure. The flight crew conducted an emergency landing, and the 2 flight crewmembers, 3 flight attendants, and 138 passengers deplaned on the runway. No occupant injuries were reported, but the airplane sustained substantial damage from the fire. The scheduled passenger flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 on an instrument flight rules flight plan. Visual meteorological conditions prevailed at the time of the accident.

On the day of the accident, the flight crew reported to duty about 1140 for a scheduled departure time of 1240. The captain was the pilot flying, and the first officer was the pilot monitoring.

During the initial attempt to start the engines, the left engine did not start, and the flight crew notified American Airlines maintenance personnel of the problem. At 1238:55, the cockpit voice recorder (CVR) recorded a mechanic informing the captain that maintenance personnel were ready to manually start the left engine.[3] About 1241, the flight crew performed the Before Start checklist and the takeoff briefing. About 5 minutes later, maintenance personnel instructed the captain to initiate the manual engine-start sequence by holding the engine-start switch in the START position while the maintenance personnel manually opened the left engine's air turbine starter valve (ATSV). The captain informed the mechanic that he saw no indication that the left engine's ATSV had opened. About 1301, during the second attempt to start the left engine manually, the engine started. From about 1302 to 1308, the CVR recorded the flight crew engaging in nonpertinent conversation during the taxi for takeoff.[4]

[1] Unless otherwise indicated, all times in this report are central daylight time based on a 24-hour clock.

[2] Boeing Commercial Airplane Group bought McDonnell Douglas.

[3] If the engine does not start automatically, the engine can be started manually. See sections 1.6.2.1.1 and 1.6.2.1.2 of this report for information about manual engine-start procedures provided by American Airlines and Boeing, respectively. The accident airplane had a history of engine ATSV-related maintenance discrepancies, which are discussed in detail in section 1.6.7.

[4] According to 14 *Code of Federal Regulations* (CFR) 121.542, also known as the "sterile cockpit rule," during critical phases of flight (including taxi), crewmembers should not discuss anything unrelated to the operation of the airplane to ensure that their attention is directed to operational concerns and is not redirected to or degraded by nonessential activities or discussion. Further, the American Airlines flight operations manual (FOM) states, "Airport surface operations require strict attention and constant situational awareness. Sound cockpit operating discipline

During postaccident interviews, the flight crew stated that, during the taxi for takeoff, all of the cockpit indications were normal, and no warning lights were illuminated. The flight crew reported that the takeoff was uneventful until the airplane reached an altitude of about 1,000 to 1,500 feet mean sea level (about 380 to 880 feet above ground level [agl]). At 1312:49, the first officer reported to air traffic control (ATC) that the airplane was passing through an altitude of about 1,500 feet, and shortly thereafter, the first officer stated that the Left Engine “ATSV Open” light had illuminated. At 1313:55, the CVR recorded a sound similar to the Engine Fire warning bell and then, the first officer stating that the Left Engine Fire warning light had illuminated. The captain stated that the flight would need to return to STL, and he then asked the first officer to contact STL and declare an emergency, and the first officer complied with the instruction. The STL departure controller asked the first officer the nature of the emergency and whether the flight crew wanted aircraft rescue and firefighting (ARFF) trucks to be waiting at the runway upon landing, and the first officer reported that it was a left engine fire and requested ARFF presence.

At 1314:49, the first officer began performing the Engine Fire/Damage/Separation checklist. After the first officer completed the first two items on the checklist, disconnecting the autothrottles and placing the left engine throttle to idle, the captain stated that he wanted to brief the flight attendants. After the first officer handled communications with ATC regarding the nature of the emergency, the captain transferred control of the airplane to the first officer. Then, the captain briefed the flight attendants about the situation and informed them that the airplane would be returning to STL. After the briefing, the captain resumed control of the airplane. At 1316:22, the first officer stated that the Left Engine Fire warning light was still illuminated, and he then resumed conducting the Engine Fire/Damage/Separation checklist. During postaccident interviews, the captain stated that, about this time, the airplane began to experience some electrical malfunctions, which resulted in the loss of the captain’s primary flight and navigation display panels.

At 1317:01, the CVR again recorded a sound similar to the Left Engine Fire warning bell followed by the first officer stating that the warning light was still illuminated. Fourteen seconds later, the fire warning alerted again, and, 4 seconds later, the first officer stated, “just got power transfer too.”[5] At 1317:26, the CVR recorded the first officer stating, “I can’t even shut it off,”[6] and 10 seconds later that he was pulling the fire handle, which subsequently fired the first fire bottle.[7] At 1318:27, the first officer stated, “this will not discharge.” At 1319:07, he reported that

enables the flight crewmembers to properly plan taxi operations with the same level of attention given to planning other phases of flight…Do not allow other cockpit duties and non-ATC [non-air traffic control] communications to divert attention from the safe movement of the aircraft.”

[5] The first officer was likely referring to a condition in which loads normally powered by the left side of the electrical system start to be powered by the right side.

[6] In postaccident interviews, the first officer stated that he had difficulty turning the fuel lever to the OFF position, which was the next item on the Engine Fire/Damage/Separation checklist and had to be accomplished before the fire handles could be pulled.

[7] The airplane is equipped with a fire-extinguishing system that includes two fire-extinguishing agent containers (or bottles), deployment lines, and discharge controls and circuits, to extinguish fires in the engine and auxiliary power unit compartments. Two fire control handles (one for each engine) are mounted on the upper instrument panel.

both of the fire bottles were discharged. Subsequently, the CVR recorded the flight crew discussing preparing the flaps and landing gear for landing. Less than 1 minute later, the first officer stated, "we've lost all…power," and the CVR recorded the flight crew discussing problems keeping the cockpit door closed.

At 1319:58, the captain instructed the first officer to lower the landing gear, and, subsequently, the CVR recorded a sound similar to the landing gear handle being operated followed by a sound similar to the spoiler handle being armed. At 1320:40, the STL air traffic control tower (ATCT) cleared the flight to land on runway 30R.[8]

According to the CVR transcript, less than 1 minute later, the captain stated that he had tried to start the auxiliary power unit (APU) (which supplies the backup electrical power to the airplane systems), but that it would not start. He also stated that the landing gear position lights had not illuminated.[9] Shortly thereafter, the captain asked the STL ATCT controller to verify whether or not the landing gear had extended. The tower controller reported that the nose landing gear was not extended, and the first officer responded that they were going to go around. Soon after, the STL ATCT controller informed the flight crew, "there was quite a bit of black…soot…on that engine so….the fire was real."

During the go-around, the flight crew continued to experience problems with the nose landing gear and electrical systems, and the captain asked an off-duty company pilot to come to the cockpit to assist; this pilot arrived in the cockpit about 1323.[10] The captain decided it would be best to land on the longest runway, runway 30L, which was 2,000 feet longer than runway 30R. At 1325:09, the captain asked the controller if the airplane could land on runway 30L, and the controller complied and cleared the flight to land on runway 30L. At 1325:26, the off-duty company pilot asked the captain if they were going to evacuate the airplane, and the captain replied, "not unless we have to." Ten seconds later, the first officer began performing the Emergency Gear Extension checklist during the go-around. While the first officer was performing the checklist, the off-duty company pilot stated, "you've lost all…hydraulic pressure on the right side," and the first officer responded, "how did that happen?" At 1326:25, the first officer announced that he had completed the checklist. The captain stated that, although none of the landing gear indications had illuminated, he heard noise similar to the sound of the nose gear being extended. The CVR also recorded increased background noise consistent with the sound of the landing gear extending.

[8] About 1315, the CVR recorded the captain request to land on runway 30R because it was easier for ARFF truck access.

[9] Landing gear position and main landing gear door status are indicated by annunciator lights on the upper instrument panel. Normally, the gear position lights illuminate green to indicate that the gear and gear handle are in the down-and-locked position and red to indicate that the gear is in any intermediate position. A gear warning horn also alerts if an unsafe condition exists.

[10] An off-duty American Airlines pilot who had served as captain on the previous flight in the accident airplane was deadheading on the flight.

At 1327:33, the captain stated, "we've got no left engine; we've got no right hydraulic pressure…we don't have any hydraulics on left side." Shortly thereafter, the STL ATCT controller confirmed that the nose landing gear had extended. The off-duty company pilot used the public address (PA) system to brief the passengers on the situation. He then contacted the flight attendants on the interphone and stated, "not going to do ground evacuation…but be ready." The flight was cleared to land at 1329:20, and the captain landed the airplane successfully about 1332. After the airplane stopped on the runway, ARFF personnel applied fire-extinguishing agent to the left engine. (See figure 1.) Initially, the airplane was going to be towed to the airplane terminal. However, subsequent events, described in detail in section 1.15.2, led ARFF personnel to call for the passengers to be deplaned. The passengers were deplaned without incident about 1410.

Figure 1. Photograph of the left side of the airplane after fire-extinguishing efforts were completed.

1.2 Injuries to Persons

Table 1. Injury chart.

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	0	0	0	0
None	2	3	138	0	143
Total	2	3	138	0	143

1.3 Damage to Airplane

The airplane sustained substantial structural damage because of the fire.

1.4 Other Damage

No other damage resulted from this accident.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 59, was hired by American Airlines on August 6, 1990. He held a multiengine airline transport pilot certificate, issued July 5, 2001, with type ratings in Boeing 707, 757, 767, 777, and DC-9[11] airplanes. The captain flew 711 hours as pilot-in-command (PIC) on the MD-80 before he was assigned to the first officer position on Boeing 777 airplanes. He flew as first officer on Boeing 777 airplanes from October 2003 to August 1, 2007, at which time, he returned to the captain position on the MD-82.[12] The captain held a first-class Federal Aviation Administration (FAA) airman medical certificate, dated March 5, 2007, with the limitation that he "must wear corrective lenses; possess glasses for near/intermediate vision."[13]

The captain served as a pilot in the U.S. Air Force from June 1970 to August 1990. American Airlines records indicated that the captain had accumulated about 14,000 total flight

[11] The MD-80 airplane is a version of the DC-9.

[12] The MD-82 is a version of the MD-80.

[13] The captain was wearing his glasses during the flight.

hours, including 6,000 hours as PIC, 831 of which were as PIC in MD-80 airplanes. He had flown about 103, 71, and 0 hours in the 90 days, 30 days, and 24 hours, respectively, before the accident flight. The captain’s last recurrent ground training occurred on January 27, 2007, and his last MD-80 series proficiency check occurred on August 19, 2007. A search of FAA records revealed no accident or incident history, enforcement action, or pilot certificate or rating failure or retest history before the accident. A search of the National Driver Register found no record of driver’s license suspension or revocation.

On the day before the accident, the captain was on reserve duty at his home in Chicago, Illinois. He went to sleep about 2200 the night before the accident and awoke the next morning about 0700 when crew scheduling called to tell him that he was scheduled to fly the accident trip. He stated that he typically went to sleep about 2200 and awoke about 0700. He deadheaded to St. Louis, Missouri, for the flight. He stated that he had started using a continuous positive airway pressure (CPAP) machine in June 2006 to treat sleep apnea and that he used it the night before the accident. The FAA was aware of, and had evaluated, the captain’s diagnosis of sleep apnea and the effective use of the CPAP.

1.5.2 The First Officer

The first officer, age 43, was hired by American Airlines in January 1999. He held a multiengine commercial pilot certificate, issued November 28, 2005, with no type ratings. He had DC-9 second-in-command (SIC) privileges. The first officer held a first-class FAA airman medical certificate, dated March 19, 2007, with no limitations.

The first officer served as a pilot in the U.S. Air Force from May 1986 to July 1989 and as a pilot in the U.S. National Guard from August 1989 until at least the time of the accident. He worked as a pilot for General Motors Corporation from October 1989 to April 1998.

American Airlines records indicated that the first officer had accumulated about 7,000 total flight hours, including about 3,000 hours as SIC in MD-80 airplanes. He had flown about 116, 69, and 0 hours in the 90 and 30 days and 24 hours, respectively, before the accident flight. The first officer’s last MD-80 series proficiency check occurred on May 15, 2007, and his last recurrent ground training occurred on May 16, 2007. A search of FAA records revealed no accident or incident history, enforcement action, or pilot certificate or rating failure or retest history. A search of the National Driver Register found no record of driver’s license suspension or revocation.

On the night before the accident, the first officer went to sleep at his home in Grand Rapids, Michigan, about 2000 and woke about 0400 on the morning of the accident. He stated that he typically went to sleep about 2200 and woke about 0600. About 0600 on the morning of the accident, he commuted on his own time from Grand Rapids to Chicago and then deadheaded to STL for the accident flight. He stated that his health was “fine” and that he was not taking any medications at the time of the accident.

1.5.3 Flight Attendants

All three of the flight attendants were qualified and current on the MD-82 airplane. The No. 1 flight attendant (also referred to as the "lead" flight attendant) was seated on the forward jumpseat. She was hired by American Airlines in May 1999 and completed her last recurrent training on March 8, 2007. The No. 2 flight attendant was seated on the aft jumpseat near the tailcone exit. She was hired by American Airlines in March 1992 and completed her last recurrent training on July 19, 2007. The No. 4 flight attendant was seated on the left aft jumpseat.[14] She was hired by American Airlines in August 1992 and completed her last recurrent training on April 23, 2007.

1.6 Airplane Information

The accident airplane was manufactured by the McDonnell Douglas Company on February 28, 1988. American Airlines bought the airplane from McDonnell Douglas and put it on its Part 121 operating certificate on March 31, 1988. At the time of the accident, the airplane had accumulated 57,744 total flight hours and 30,254 total cycles.[15]

The airplane is configured with two flight crew seats and one observer seat in the cockpit. The airplane has 124 coach and 16 first-class passenger seats. The airplane has three flight attendant jumpseat positions: one in the forward, left side of the airplane; one in the aft galley; and one in front of the tailcone exit. The airplane has four floor-level doors: L1 (left forward), L2 (left aft), R1 (right forward), and the tailcone, and four overwing exits, two on each side of the airplane.

1.6.1 Pneumatic System

The airplane has a pneumatic system that consists of two identical subsystems, each of which is either independently operable or interconnected to provide a common pressure source for the using systems, including the engine start and air conditioning systems. When the system is operating, air is bled off the engines through ports into bleed air manifolds and then into the pneumatic system ducting. The left and right subsystems each contain a crossfeed valve, which isolates the interconnected ducting from the supply ducts. The right and left engines normally supply engine bleed air to the airplane's systems via a center manifold. The APU or an external pneumatic source can also supply pressure to the left or right system or to both. The pneumatic crossfeed valves are manually controlled from the cockpit by control levers that are mounted on the control pedestal and are connected through various mechanical linkages to the crossfeed valves located in the aft accessory compartment. The control cables extend along the centerline of the airplane above the lower cargo compartment ceiling.

[14] Only three flight attendants were on board the airplane. The flight attendants' No. designations represent their position on the airplane, not the number of flight attendants.

[15] An airplane cycle is one complete takeoff and landing sequence.

Pulling the fire control handles mounted on the upper instrument panel shuts off various aircraft systems to confine an existing fire to a local area. Movement of the fire control handle to the fully extended position closes the fuel fire shutoff valve and the hydraulic fire shutoff valve to restrict any additional fluid distribution, and the pneumatic crossfeed valve, to restrict any additional air distribution. Movement of the pneumatic crossfeed valve control lever back to the open position, after it has moved to the closed position because of a pulled fire control handle, will result in the retraction of the corresponding fire control handle. When the fire control handle is retracted, the fuel fire shutoff valve and the hydraulic fluid fire shutoff valve will open, allowing fuel and hydraulic fluid to flow. (Section 1.17.4 discusses the guidance provided to pilots on fire handle retraction.)

1.6.2 Engine Description

The airplane was equipped with two Pratt & Whitney (P&W) model JT8D-219 dual-rotor turbofan engines. At the time of the accident, the left engine had accumulated about 43,784 total flight hours, and its last major maintenance inspection and overhaul were conducted 5,339 flight hours before the accident. At the time of the accident, the right engine had accumulated about 59,507 total flight hours, and its last major maintenance inspection and overhaul were conducted 76 flight hours before the accident.

The engine core contains the compressor, combustor, and turbines and is surrounded by an inner bypass duct shroud. The bypass duct separates the inner bypass duct shroud from the outer bypass duct shroud. Ambient air is forced through the bypass duct by a fan. The cavity formed between the outer bypass duct and the nacelle skin contains the main engine gearbox, the air turbine starter (ATS), generator, oil and fuel pumps, fuel control unit, fuel manifolds, and bleed air ducts. The main oil tank is also in this cavity, and it can reach about 220º Fahrenheit (F). In addition, several engine bleed air lines pass through the cavity. The air temperature ranges from about -60º F (during high altitude flight) to about 130º F during hot ground operation. Air scoops and exit vents on the nacelle skin vent the cavity.

1.6.2.1 Engine Start System

The P&W JT8D engine start system includes a pneumatic ATS, which converts compressed air from the pneumatic pressure source into rotational power sufficient to accelerate the engine to start and to reach self-sustaining speed. The major components of the ATS include a scroll, a starter housing and mounting flange by which the housing is directly mounted to the engine accessory gearbox (AGB); a rotor assembly, which consists of an aft-side exducer and an integral turbine wheel; a reduction gear train; a splined output shaft; and an overrunning clutch.

The P&W JT8D engine start system also contains an ATSV; an ATSV-air filter assembly, an engine-start switch and ATSV-Open light, and an engine start system wiring harness.[16] Finally, the engine start system includes a 3-inch-diameter stainless steel starter pneumatic line, which draws airflow from the pneumatic power source and directs it to the inlet of the ATSV. Figure 2 is a schematic of the engine start system.

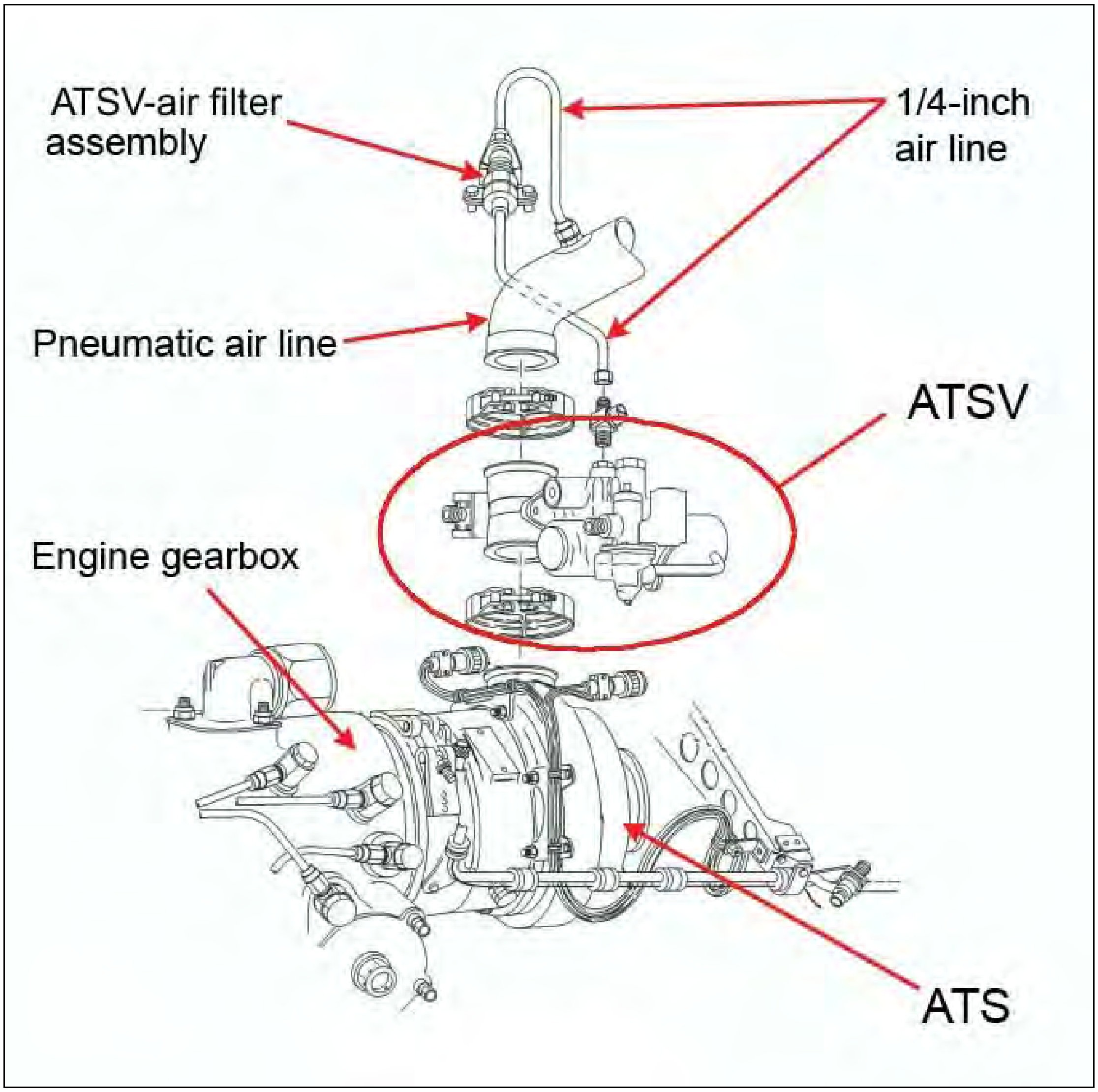

Figure 2. Schematic of the engine start system. (Not to scale.)

The ATSV is an electrically controlled and pneumatically operated butterfly-type valve that controls the flow of air to the ATS. Figure 3 is a schematic of the major components of the ATSV, which include a valve body housing with a butterfly-type closer element and end flanges by which the housing is directly mounted to the ATS and the starter pneumatic line; a

[16] The engine start system wiring harness is a small subcomponent of the main airframe wiring harness. Four wires run from the ATSV to the cockpit. Two wires are used to activate the solenoid of the ATSV via the engine-start switch, and the other two wires are used by the butterfly position microswitch on the ATSV to indicate an ATSV-Open condition on the annunciator panel in the cockpit.

diaphragm/piston-type actuator mechanically coupled through a lever arm to the butterfly shaft; a solenoid-operated, single-ball selector valve with a manual override button[17] for manual control in the event of an inoperative solenoid; a mechanical pointer for visual indication of the valve position; and an external pressure relief valve.

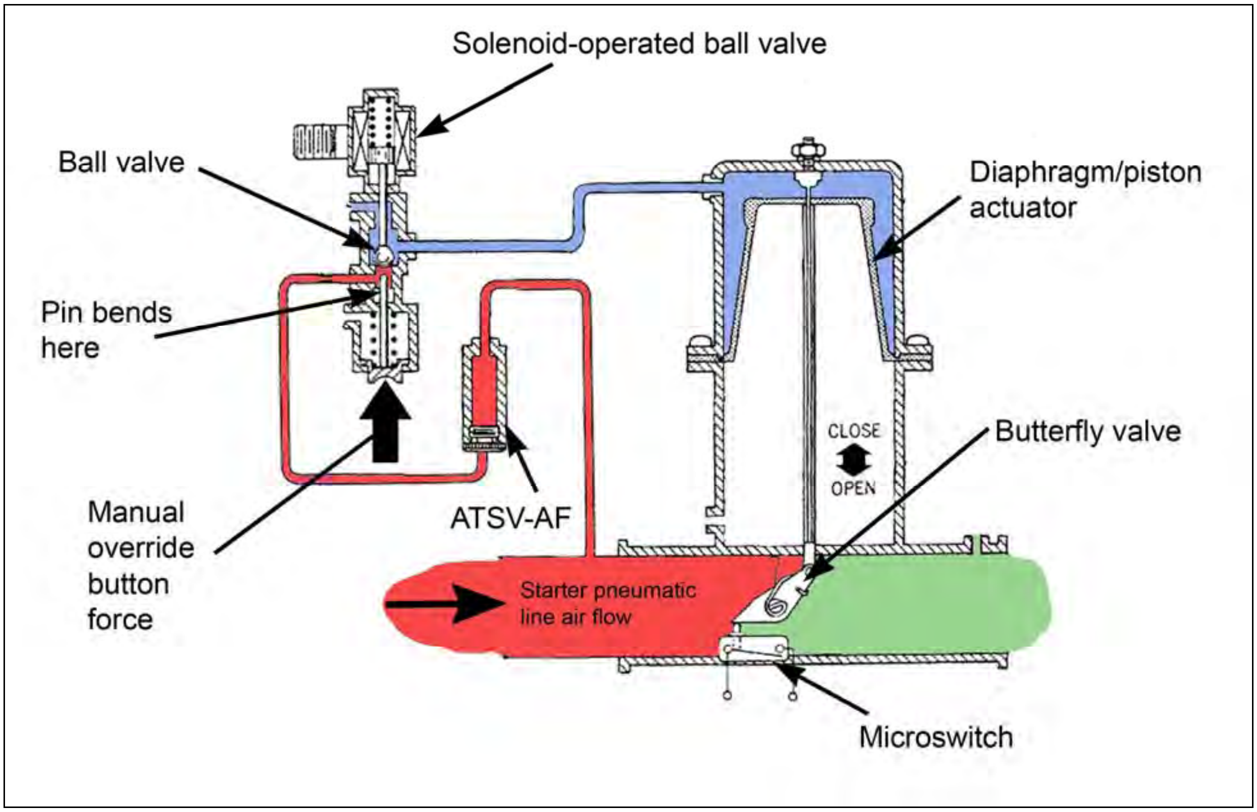

Figure 3. Schematic of the major components of the ATSV. (Not to scale.)

The ATSV-Open light is located on the annunciator panel,[18] located along the midline of the cockpit at the bottom of the overhead panel and just above the windshield, and consists of static amber words on a black background.[19] Typically, the ATSV-Open light illuminates when the ATSV butterfly valve is opened 3º or more from the closed position.

The ATSV also has an ATSV-air filter assembly to prevent particles in the pneumatic supply line from entering the ATSV ball valve and solenoid. The assembly comprises an inner screen consisting of a coarse stainless steel filter and an outer screen consisting of a finer stainless steel mesh. The ATSV-air filter element is corrugated, welded into a circular shape, and

[17] The manual override button consists of a button on the outside end and a slender pin on the inner end.

[18] The panel contains an array of lights with 7 rows and 14 columns.

[19] According to 14 CFR 25.1322, "Warning, Caution, and Advisory Lights," amber is used for caution lights, which indicate the possible need for future corrective action, and red is used for warning lights, which indicate a hazard which may require immediate corrective action.

then brazed onto the end cap and lower threaded fitting. See figure 4 for a photograph of an exemplar ATSV-air filter. The ATSV-air filter is mounted vertically with the fitting end facing downward via a bracket on the engine mount frame.[20]

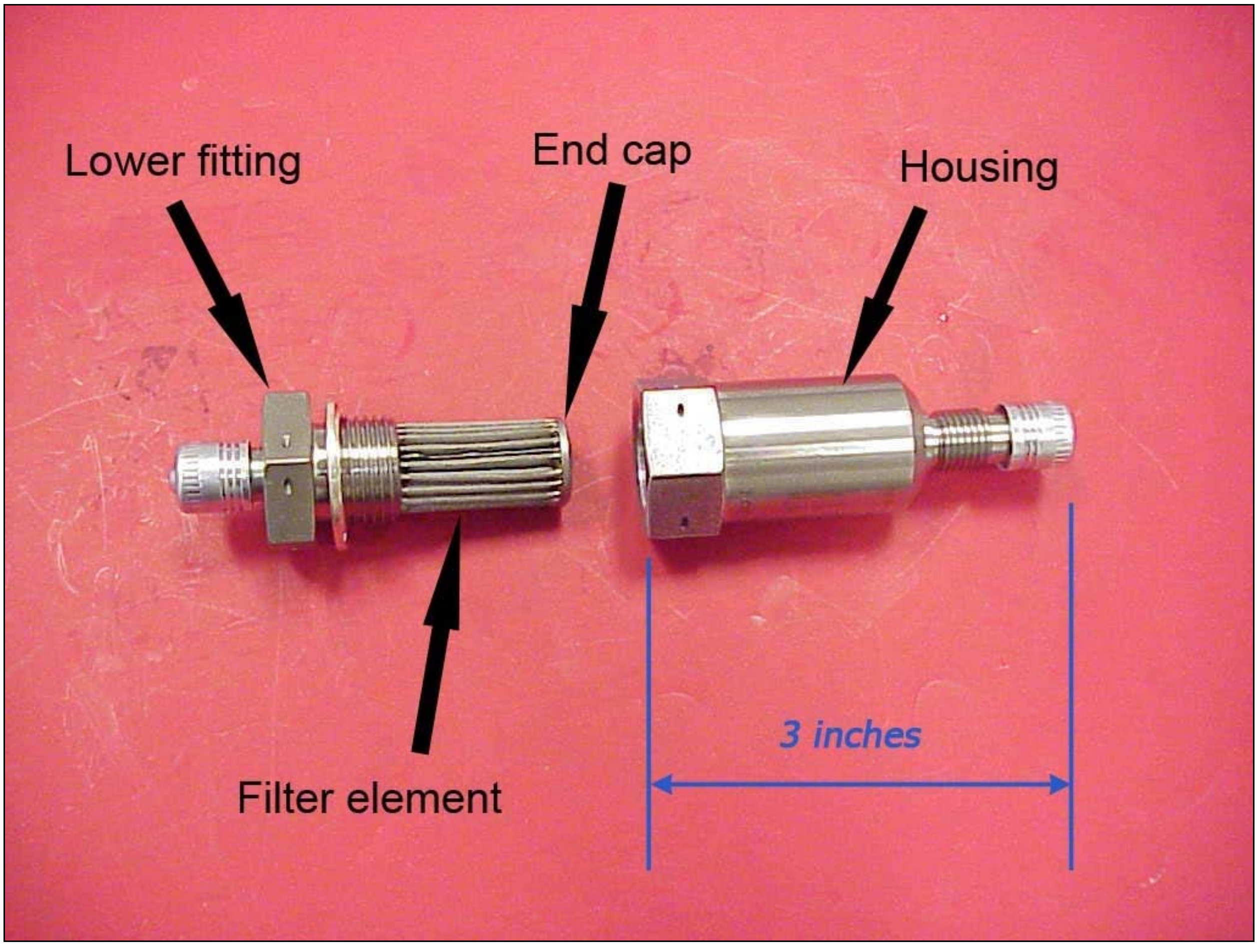

Figure 4. Photograph of an exemplar ATSV-air filter.

Normal operation of the ATS occurs when the electric start switch is held in the ON position and supplies 28 volts of electric power to the ATSV solenoid. When the solenoid retracts, it allows the ball valve to unseat and air to flow into the piston/diaphragm housing, causing the piston to move and the butterfly valve to open. When the ATSV butterfly valve is opened, airflow at a pressure of about 30 pounds per square inch (psi) is directed into the ATS inlet, causing the ATS turbine to rotate at a high speed and providing rotational power to the engine core. The opening of the butterfly valve closes the ATSV microswitch, completing the indicating light circuit and causing the ATSV-Open light to illuminate. Once the engine has reached self-sustaining speed and the pilot shuts off the engine-start switch, the ATSV solenoid

[20] All orientation and directional references, such as top and bottom, front and rear, right and left, and clockwise and counterclockwise, are made aft looking forward unless noted otherwise.

is deenergized, causing the ATSV to close and terminate the start cycle. The ATSV-Open light goes off and stays off as long as the ATSV remains in the closed position.

According to Boeing, during a normal start, air is typically supplied to the ATS at a pressure of about 30 to 40 psi and at a temperature of about 300° to 400° F. If the ATSV were inadvertently commanded open while the engines are at a high-power setting (for example, during takeoff), then the air supplied to the ATS would have a pressure of about 80 to 90 psi and a temperature of about 560° to 600° F. The ATS would not be connected to the engine if the ATSV were open during high power and, therefore, it will be in a "freewheeling" state.[21]

American Airlines overhauled the accident ATS on June 1, 2006, and installed it on the accident airplane on July 21, 2006. The ATS had accumulated 3,234 hours since overhaul. The ATSV was overhauled by American Airlines on August 29, 2007, and it was installed on the accident airplane on September 27, 2007, the day before the accident.

1.6.2.1.1 Company Manual Engine-Start Procedures

The American Airlines MD-80 Maintenance Procedures Manual contained one approved manual engine-start procedure, which stated that maintenance personnel must open the ATSV using an approved, specialized wrench to turn the wrenching flats on the upper end of the butterfly valve shaft and request that the flight crew activate the engine-start switch. The procedure further instructs maintenance personnel to close the ATSV using the wrenching flats and verify that the ATSV is closed.

During postaccident interviews, American Airlines maintenance personnel indicated that the approved procedure was very time consuming and could take about 20 to 40 minutes to perform because the required specialized wrench was not part of the standard tool kit and so had to be found; then, the cowl latches and lower door had to be opened, the engine start sequence performed, and the lower door closed. They stated that, instead of using the approved procedure, they usually chose to use a prying device to reach, depress and hold down the ATSV's manual override button, which is accessed through a small panel located on the forward lower cowl door.

According to American Airlines, mechanics can submit a paper or electronic copy of a Form E63, "Request for Services," to request a change to the maintenance procedures. Guidance regarding the form is contained in the general procedures manual, which describes procedures to be followed by all company maintenance and inspection personnel. American Airlines stated that, in 2008, it received 7,283 requests for maintenance changes. Although the company does not track the percentage of maintenance requests that result in maintenance manual changes, it estimated that about 75 percent of all manual changes have resulted from such requests. A

[21] If the engine start system is inadvertently activated after the engines have already been started, then the supply pressure air will cause the ATS to spin up to its maximum speed because the clutch has disengaged the ATS from the engine. This state is referred to as "freewheeling" because the ATS is not rotating the engine as designed, but is spinning freely.

review of the forms revealed no evidence of that a request to change the manual engine-start procedures had been submitted.

1.6.2.1.2 Manufacturer Manual Engine-Start Procedures

The Boeing MD-80 Aircraft Maintenance Manual (AMM), dated June 15, 2005, contains two approved manual engine start methods. One method, which is similar to the approved American Airlines procedure, involves manually opening the ATSV using a special wrench to turn the wrenching flats on the upper end of the butterfly valve shaft. A notch across the flats points to the words “Open” or “Closed” on the switch cover to indicate the butterfly valve position. The other method involves depressing the manual override button, which accomplishes the same function as normal electrical activation of the ATSV.

On December 16, 1997, Boeing issued All Operators Letter (AOL) 9-2549, applicable to all DC-9 and MD-80 airplanes, cautioning against the use of a tool to depress the manual override button. The AOL was the result of a December 1996 event in which an operator experienced an uncommanded ATSV-Open indication during climbout. An engine teardown inspection found that the manual override button’s internal pin was bent and that the button was stuck in the depressed (override) position, which allowed the valve to open uncommanded. The AOL informed operators that using a screwdriver or similar levering tool to depress the manual override button could deform the manual override button’s internal pin. In keeping with the AOL, Boeing added the following caution to its AMM:

> Use only hand pressure to depress override button. Use of screwdriver or other type of prying device to depress override button can deform slender pin mechanism inside valve. A deformed override button pin can hold solenoid switcher ball off its seat which allows valve to open uncommanded when air pressure is available to engine start valve. If undetected or uncorrected, this condition will result in significant damage to engine starter.

In April 2008, American Airlines received approval from Honeywell to redesign the internal override pin. The redesigned pin is shorter, and a prying tool cannot be used to push it because of its new geometry. American Airlines indicated that it began altering its MD-80 ATSVs on February 4, 2009, and that it expected that the accomplishment rate would be about 20 to 30 ATSVs monthly and that it would be completing the alterations on its entire MD-80 fleet by August 2010.

1.6.3 Hydraulic Power System

The hydraulic power system consists of two main (left and right) hydraulic systems and an auxiliary system, which provide primary and backup power, respectively, to the hydraulically actuated systems and subsystems on the airplane, including the landing gear. Each hydraulic system has a reservoir filled with about 16 quarts of hydraulic fluid. System return fluid, except for the hydraulic fluid used for the brakes, flows through the system return line filters into the reservoir. Each reservoir has a relief and bleed valve, direct fluid level indicator, fluid quantity transmitter, low-level switch, and temperature sensor. Postaccident, the left hydraulic reservoir was found empty; however, the indicator located on the left hydraulic reservoir was found indicating 16 quarts, and the cockpit fluid-level indicator showed that it was full. The right hydraulic reservoir was found full.[22]

Main hydraulic power is provided by separate left and right closed systems in which one engine-driven hydraulic pump, which is mounted on each engine's AGB, supplies power to the corresponding system. The hydraulic systems are normally pressurized by the engine-driven pumps to about 3,000 psi, and each pump is capable of a flow rate of 8 to 10 gallons per minute. Each hydraulic system supply line has a mechanically operated hydraulic fire shutoff valve, which is controlled by a lever in the cockpit and is normally placed in the open position. The fire shutoff valve in each system is also controlled by the fire control handle, so that when the fire handle is pulled, the fire shutoff valve is closed to stop the flow of hydraulic fluid to the engine-driven pumps.

An electric motor-driven auxiliary hydraulic pump provides backup pressurization to the right main hydraulic system, and a hydraulically operated power transfer unit (PTU) provides backup pressurization to both main hydraulic systems. The PTU transfers hydraulic power from one hydraulic system to the other without mixing the fluids and mechanically connects the two systems, enabling the hydraulic power from the higher pressure system to be transferred to the lower pressure system. Hydraulic fluid must be present in the depressurized system for the power transfer unit to be able to pressurize that system. The PTU supplies a flow of hydraulic fluid at a rate of about 8 gallons per minute at a pressure of 2,000 to 3,000 psi.

The PTU is controlled by a single motor operating two shutoff valves, one in each system. Operation is controlled by a separate switch located on the hydraulic control panel on the first officer's instrument panel. The motor-operated shutoff valves are also connected electrically to the low-level switch on each reservoir. The appropriate shutoff valve will automatically close if the indicated fluid level in either system reservoir is below 1 1/3 quarts.

1.6.4 American Airlines' Maintenance Program

The American Airlines MD-80 maintenance program in effect on the day of the accident included a fixed interval inspection and check program.[23] According to the American Airlines MD-82 Maintenance Inspection Program Manual, the fixed interval inspection and check program included, in part, a maintenance C check and inspection, which is to be accomplished

[22] American Airlines FOM indicates that the left reservoir is full when the cockpit indicator indicates 9.8 quarts at 2,000 psi of pressure, and that the right system is full when it indicates 11.3 quarts at 2,000 psi of pressure. At 0 psi of pressure, both systems indicate full with about 16 quarts of hydraulic fluid.

[23] The American Airlines maintenance program also included a supplemental structural inspection program, a corrosion prevention and control program, and a repair assessment for pressurized fuselages program.

every 5,000 flight hours. See section 1.6.6 for information about the American Airlines ATSV-air filter-related maintenance and inspection procedures.

The vice president for maintenance is responsible for the maintenance of American Airlines' fleet of airplanes. A defined group of personnel maintain its MD-80 airplanes. American Airlines assigns supervisors for all of the MD-80 maintenance bases with lines of responsibility throughout the maintenance organization, including fleet support from engineering, maintenance control, and logistical support. A review of the accident airplane's maintenance logbook entries from July to September 2007 revealed that all of the required maintenance checks had been completed.

During each shift at American Airlines' Technical Services, Maintenance Operations Control division, located in Tulsa, Oklahoma, two technical services personnel are assigned to review and act on "alert" items reported by line maintenance personnel. An alert is triggered automatically within American Airlines' computer maintenance system to flag repeat discrepancies, deferred items placed on minimum equipment list (MEL)[24] status, and other safety-related reports from line mechanics.[25] Alerts are reviewed by technical services personnel, who offer troubleshooting guidance to maintenance personnel and track fleetwide maintenance issues.

1.6.5 American Airlines' Continuing Analysis and Surveillance System

The FAA provides guidance to operators regarding the development and implementation of Continuing Analysis and Surveillance System (CASS) programs in Advisory Circular (AC) 120-79, "Developing and Implementing a Continuing Analysis and Surveillance System." The FAA states that it expects that operators will design their CASS program to ensure that, in following their manuals and program policies, they are producing consistently airworthy aircraft. The FAA also states that it expects that operators will design their CASS program to ensure that they conduct their inspection and maintenance programs according to regulations and operator manuals, ensuring that only airworthy aircraft are approved for return to service. American Airlines has a CASS, as required by Federal regulations.[26] The CASS is a risk management system that comprises a continuous cycle of surveillance, investigations, analysis, and corrective action. CASS provides a structured process of collecting and evaluating information to identify factors that could lead to an accident.

[24] American Airlines had an FAA-approved MEL, which contained a list of equipment and instruments allowed be inoperative on a specific aircraft for continuing flight beyond a terminal point. A review of the company's MEL procedures revealed that ATSV failures could be deferred by maintenance personnel, the logbook entry completed, the start switch placarded, and then the manual start could be attempted. At the time of the accident, six MEL items in the airplane logbook were open, including the left engine ATSV.

[25] Neither Boeing nor American Airlines considered the failure of the ATSV a safety-related failure.

[26] In accordance with 14 CFR 121.373, each certificate holder must establish and maintain a system for the continuing analysis and surveillance of the performance and effectiveness of its inspection program and the program covering other maintenance, preventative maintenance and alterations, and for the correction of any deficiency in those programs, regardless of whether those programs are carried out by the certificate holder or by another person.

American Airlines' CASS is designed to ensure that all personnel, including all maintenance providers, comply with company manuals and all applicable regulations and statutes through a system of audits and investigations of operational events. The CASS includes a continuous process of surveillance and the collection, and analysis of information, including that discovered during scheduled audits, to evaluate whether all maintenance and alterations are, in fact, performed in accordance with American Airlines manuals and to ensure that maintenance records are adequate, correct, and complete and generated in accordance with the manuals. Collecting data on unexpected operational events, including but not limited to aborted takeoffs, delays due to unscheduled maintenance, or any other maintenance- or operational-related event leading to an unsafe condition, is also part of the CASS.

American Airlines' CASS is intended to ensure that all elements of the company's maintenance program are effectively accomplishing maintenance actions. The CASS focuses on analysis and correction of that portion of the maintenance program that allowed a discrepancy or failure to occur. The CASS includes surveillance and analysis of operational data such as increased frequency of unscheduled parts replacement or increased need for unscheduled maintenance, changes in operational capability or reliability, or trends of individual item failure rates. Further, the CASS includes the real-time collection of event data and analysis for use in developing improvements to the maintenance program that allowed the event to occur.

The CASS is responsible for maintaining a surveillance program of base repair/overhaul activities to ensure that all maintenance, preventative maintenance, alterations, and inspections are performed in accordance with American Airlines' maintenance program and for continuously analyzing and evaluating the level of performance and effectiveness of all elements of American Airlines' Continuous Airworthiness Maintenance Program. Mechanical performance monitoring is conducted daily. Daily conferences provide communication and controls necessary to manage the maintenance and inspection programs. Maintenance and engineering conference calls are conducted every day to review and monitor maintenance performance on the previous day and to initiate corrective action for certain types of issues, including deferred maintenance items, recurring problems, and other significant events. It also reviews the status of any events that might affect the current day's operation. Safety-related failures are emphasized.

1.6.6 ATSV-Air Filter Maintenance and Inspection Procedures

1.6.6.1 American Airlines' Maintenance and Inspection Procedures

The American Airlines maintenance program required ATSV-air filter elements to be cleaned at every C check. The ATSV-air filter cleaning procedure in effect at the time of the accident, which was in accordance with the procedures on American Airlines Maintenance Work Card 7751, dated March 16, 2006, required opening the air filter, cleaning the filter element with solvent, drying it with compressed air, reassembling the air filter, and reinstalling it on the airplane. The procedure also stated that the screen fitting was to be removed and the metal fitting checked for flatness and general condition. A review of American Airlines' maintenance manuals revealed that no detailed visual inspections of the filter element itself nor specific time-in-service inspections or replacements of the ATSV-air filters were required and that the filters were not tracked.[27]

After the accident, American Airlines revised Maintenance Work Card 7751, (revision dated May 28, 2008), to add visual inspection criteria. The revised card calls for the inspection of the ATSV-air filter for breaks, tears, cracks, or other structural degradation. The card also stated that the key inspection points included the ends of the ATSV-air filter screen where it is brazed to the threaded fitting and where the end cap is attached. Further, the card stated that a slight waving of the pleats is acceptable but that frayed or broken wire strands are not.

As a result of this accident, an incident at Salt Lake City International Airport (SLC), Salt Lake City, Utah (discussed in section 1.18.1), and postaccident examinations of the accident and exemplar ATSV-air filter assemblies (discussed in sections 1.18.1.1 and 1.18.1.2), American Airlines issued Engineering Change Order K3338, requiring the replacement all of its MD-80 airplanes' ATSV-air filters, which was accomplished

1.6.6.2 Manufacturer Maintenance and Inspection Procedures

The accident ATSV-air filter manufacturer, PTI Technologies, Inc, outlines cleaning and visual inspection, and replacement procedures for the ATSV-air filter in its component maintenance manual (CMM), dated May 15, 2000. The CMM cleaning procedures state that the ATSV-air filter should be cleaned using cleaning solvent and a soft bristle brush and that compressed air should be blown through the air outlets to remove debris. The CMM visual inspection procedure states that the ATSV-air filter should be examined under bright light using 5- to 7-power magnification to detect surface flaws. The CMM further states that all of the ATSV-air filter parts should be visually checked for cleanliness, cracks, corrosion, deterioration, and obvious signs of damage and that the threaded parts should be checked for crossed or damaged threads. The CMM states that, if strand damage exceeds 50 percent of one strand, the ATSV-air filter should be replaced. However, the CMM does not specify the intervals at which these cleanings, inspections, or replacements should occur.

1.6.7 MD-80 Air Turbine Starter Valve Discrepancy History

A review of American Airlines' ATSV-related maintenance troubleshooting procedures found no specific written guidance relating to a failed ATSV or ATSV-air filter. A review of the accident airplane's maintenance logbooks dated from September 1 to September 27, 2007, indicated that the ATSV-air filter had been removed and replaced on the airplane on September 17;[28] the engine-start switch had been changed on September 19; and the ATSV had

[27] When an item is tracked, its cycles and hours of service are recorded at maintenance visits. Tracking information is used to create inspection intervals and retirement lives.

[28] During postaccident interviews, the mechanic who wrote in the maintenance logbook that the ATSV-air filter had been replaced during the September 17, 2008, maintenance work stated that he actually removed it, blew air

been replaced six times from September 16 to September 27, 2007 (the same period that the reported engine start problems occurred). According to the off-duty company pilot, on the flight before the accident flight, the ATSV partially opened on the first manual start attempt, and the engine started normally on the second manual start attempt. He also stated that, although the ATSV had been replaced, its replacement had not corrected the start problem. According to American Airlines, Boeing, and PTI Technologies, Inc., no previous malfunctions related to the air filters had been reported before the accident, and none of these organizations required that the filters be tracked.

The logbook review also revealed that the ATSV operation was deferred and put on the MEL four times. The deferred status was cancelled three times after maintenance was performed (ATSV changed), an operational check was made, and the automatic start sequence was deemed satisfactory. After the accident, American Airlines revised its engine ATSV MEL procedures to require that the air supply line from the ATSV be disconnected and that any of the disconnected lines be capped, which renders the ASTV actuating part inoperable and prevents inadvertent activation on takeoff.[29]

A review of the alert items for the accident airplane from September 16 to September 27, 2007, revealed three alerts related to the left engine ATSV not opening. The first alert occurred on September 16 and included the maintenance discrepancy and the action taken. The second alert occurred on September 17 and included the maintenance discrepancy, the action taken, and Technical Services' comments in the form of an action to be taken (ATBT), recommending that maintenance personnel troubleshoot the wiring. The ATSV maintenance operation was deferred and the ATSV put on the MEL until the airplane arrived at the next maintenance base, at which time, the ATSV was replaced. However, because the air filter in the replacement ATSV would not allow air to pass through to the line, and because no air filters were in stock, the ATSV remained on the MEL. On September 18, maintenance personnel reported that the reported maintenance discrepancy "could not be duplicated" and removed the ATSV from the MEL. The third alert occurred on September 27 and included the maintenance discrepancy, the action taken, and an ATBT recommending that maintenance personnel troubleshoot the wiring.

A review of American Airlines' maintenance writeups for reported engine start problems in its MD-80 fleet from September 16 to September 28, 2007, revealed 27 additional engine start-related maintenance items. Of the 27 items, 18 were deferred and put on the MEL. All of the ATSV-related maintenance writeups indicated that the issue was resolved. It was noted for each of the 27 cases that, once the start problem was resolved, no repeat discrepancies occurred within the next few days. None of the corrective actions noted in the maintenance writeups indicated replacing the ATSV-air filter.

through it, and then reinstalled it on the airplane. He stated that he did not correct the logbook entry. Other maintenance personnel indicated that they also used this "blowing" technique to check the ATSV-air filter.

[29] Capping the supply lines does not cut off the pneumatic supply to the ATSV butterfly valve; therefore, the engine can still be started manually using the specialized wrench.

1.7 Meteorological Information

Weather observations at STL are made by an automated surface observing system, which records continuous information on wind speed and direction, cloud cover, temperature, precipitation, and visibility (in statute miles) and transmits an official report each hour. The 1251 report indicated the following: wind variable at 4 knots, visibility 10 miles, few clouds at 800 feet agl and scattered clouds at 2,500 feet agl, and temperature 28° Celsius (C). The 1351 report indicated the following: wind 310° at 13 knots with 21-knot gusts, visibility 10 miles, few clouds at 1,000 feet agl, and temperature 29° C.

1.8 Aids to Navigation

No problems with any navigational aids were reported.

1.9 Communications

No technical communications difficulties between the pilots and any of the air traffic controllers who handled the accident flight were reported.

1.10 Airport Information

STL is located about 10 miles northwest of downtown St. Louis at an elevation of about 618 feet. The airport has four precision instrument runways, 12L/30R, 12R/30L, 11-29, and 06-24. The airport has 24-hour ATCT service.

STL has an FAA-approved airport emergency plan and maintains a 14 CFR Part 139 Index D[30] ARFF facility, which is operated by the City of St. Louis, on the airfield. A minimum of 20 ARFF personnel, including 3 fire captains, are on duty at all times. At the time of the accident, the STL ARFF facility maintained 14 vehicles, 10 of which carried water and aqueous film-forming foam (AFFF) and 7 of which carried dry chemical agent.

The primary means of alarm notification at the STL ATCT is a direct, two-way, phone linkup between the ATCT and the three on-airport ARFF stations. Alarms sound in all three locations when an alarm is activated in any of the stations. STL also has five “crash boxes” monitored in five locations throughout the Airport Authority offices that automatically activate when the ATCT-to-ARFF hotline is picked up. The ARFF facility provides services for the airport 24 hours a day, 7 days a week.

[30] Part 139 establishes minimum standards for ARFF equipment based on the number, frequency, and size of passenger-carrying aircraft that use the airport. Index D refers to ARFF requirements for airports used by air carrier aircraft at least 159 feet but less than 200 feet long.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The accident airplane was equipped with an L-3 Communications FA2100-1020 CVR, which records 2 hours of digital audio information. The CVR contains a 2-channel recording of the last 2 hours of operation and a separate 4-channel recording of the last 30 minutes of operation. The 2-hour portion of the recording consists of a cockpit area microphone (CAM) channel and a channel that combines the captain and first officer audio panel information. The 30-minute portion of the recording consists of captain, first officer, and second officer audio panels and CAM. The CVR was sent to the NTSB's laboratory in Washington, D.C. for readout and evaluation. The exterior of the CVR had not sustained any heat or structural damage, and the tape was played back normally and without difficulty.

For the 30-minute recording, the CAM audio panel provided fair quality audio information, and the combined captain and first officer panel provided good quality audio information.[31] For the 2-hour recording, the CAM audio panel provided fair quality and the captain, first officer, and second officer audio panels provided good quality audio information. A transcript was prepared of the last 1 hour 28 minutes and 17 seconds of the 2-hour 21-second digital recording. (The transcript is included in appendix B.)

1.11.2 Flight Data Recorder

The accident airplane was equipped with a solid-state L3 Communications Fairchild model FA2100 flight data recorder (FDR). The FDR was sent to the NTSB's laboratory for readout and evaluation. The FDR was in good condition, and the data were extracted normally. Fifty-five parameters were recorded by the FDR. After the FDR was powered and recording data for the accident flight, it twice lost power and stopped recording. For the FDR to be powered when the airplane is airborne, 115 volts of electrical power must be provided; one of the fuel levers must be in the ON position; and the FDR circuit breaker must not be pulled. Power was lost during parts of the accident flight.

1.12 Wreckage and Impact Information

The recovered ATSV-air filter assembly components were removed and sent to the PTI facility, in Oxford, California, for teardown and examination under NTSB supervision. The filter element of the ATSV-air filter assembly was found fractured along a line from the lower air filter fitting to just above the fitting braze joint. About 70 percent of the filter element material was missing. The remaining material was found adhered to the inner wall of the housing and

[31] The NTSB rates the quality of CVR recordings according to a five-category scale: excellent, good, fair, poor, and unusable. See appendix B for a description of these ratings.

appeared to be reddish-brown. Some mesh material was still attached to the end cap, and this mesh, as well as the cap edges appeared to be worn and rounded off.[32] An incorrect housing was found installed on the assembly.[33] The end cap was found intact but separated from the filter element and in an inverted orientation, partially covering the air outlet within the ATSV-air filter housing.

The ATS was found in place between the AGB and the ATSV. The AGB housing was melted through 360° of its circumference. The ATS blade tips were worn down by about ¼ inch and exhibited material deformation in the direction opposite of rotation. The turbine bearing could be rotated with mild hand effort and was very rough. The input spline bearing could be easily rotated by hand, but the shaft rotation did not cause the gears to rotate, consistent with a loss of continuity within the gear train. The ATSV and ATS were removed and shipped to Honeywell's facility in Tempe, Arizona, for detailed examinations under NTSB supervision.

The ATSV flow body and its housing and butterfly plate were found intact and in place between the ATS and the starter pneumatic line. The piston/diaphragm and its housing were melted off. The solenoid and ball valve assembly housing were melted. When the ATSV was removed, the butterfly valve was observed in the closed position.

The Honeywell examinations revealed that the solenoid, a small segment of the ATS exhaust screen, and the manual override button were at the bottom of a puddle of resolidified metallic material, resting on the inner surface of the forward lower cowl door. The butterfly valve shaft, which was verified to be in the closed position, could not be turned by hand. Once the melted metallic material was removed from the shaft, the butterfly valve could be rotated with a wrench using about 15 to 30 inch-pounds of torque. The solenoid valve assembly was separated from the solenoid housing. The solenoid housing mounting flange was found bent. The manual override button sleeve in the ball valve housing exhibited score marks consistent with contact against the manual override pin. The turbine blades, exducer hub, and shroud exhibited rotational scoring. The turbine blades were worn down to the same height as the exducer blades on the trailing edge and tapered further inward moving forward along the blade chord.

The manual override button and ball valve housing were sent to the American Airlines facility in Tulsa, Oklahoma, for additional examinations. The examinations revealed that the override button was buckled in an S-shape on the end of the pin closest to the ball valve and that the pin end was deformed with a concave spherical indentation pattern, consistent with a compression-type overload. The manual override button sleeve in the ball valve housing was scored from contact with the ridge of the manual override button, consistent with the application of significant force on the button.

[32] After a January 23, 2008, in-flight uncommanded ATSV opening and fire warning event at SLC, PTI sent the recovered portion of the accident ATSV-AF assembly to the NTSB for additional examinations. For more information, see section 1.18.1.1.

[33] According to PTI, the incorrect housing should not have affected the functionality of the assembly.

The left engine-driven hydraulic pump was removed from the engine for examination, and no internal mechanical damage was found. Two seals were found to be brittle, consistent with thermal damage. The rectangular-shaped rear cover was distorted. The maximum distortion was at the lower half of the cover and near the centerline of the bottom edge. Two major cracks and multiple thin "spider cracks" originated from this area of distortion. The two major cracks continued past the parting line and joined at one corner of the housing. When about 20 psi of air was applied, the housing emitted streams of fluid through the two fracture locations. A "coked" deposit, consistent with overheated hydraulic fluid, was observed on the rear housing cover interior and on the bottom of the housing interior. The fire sleeves that surrounded the three hydraulic hoses were present; however, they exhibited severe thermal damage, and significant portions of one of the sleeves were missing. The hydraulic pump and hose assembly contained a small amount of heavy soot. A hydraulic test unit was connected to the case-drain and pressure hoses, and low-pressure fluid was introduced to the system, which revealed three leaks in the hoses.

The PTU, PTU shutoff valve, right engine-driven hydraulic pump, left hydraulic reservoir assembly, and auxiliary hydraulic pump were removed and examined at the American Airlines maintenance facility in Tulsa, Oklahoma. All internal and external leakage test requirements were met. The units were bench tested, and no problems were found.

1.13 Medical and Pathological Information

No postaccident tests for the presence of alcohol and drugs in the flight crewmembers were conducted. American Airlines reported that, at the time of the event, the company believed that the criteria for an accident had not been met, and that, therefore, testing was not required.

1.14 Fire

The left engine nacelle cowling was destroyed by fire. The pylon skin and engine mounts and a small area of fuselage skin around the pylon intersection exhibited thermal damage.[34] The external engine components, including the AGB, hydraulic pump, ATS, and ATSV, exhibited fire damage. The internal engine components were not damaged. No indications of case rupture or uncontainment were found. Multiple fluid leaks were found in the fuel and hydraulic lines. The segment of the ATSV wiring harness from the cockpit overhead panel to the left engine area was tested for continuity and short errors, and no fault was found.

[34] The airplane was returned to service after the accident after American Airlines removed and replaced the left engine, pylon, cowls, engine pylon apron, engine mounts, cone bolts, and inspected the structural area for fire damage in accordance with its maintenance procedures and structural repair manuals.

1.15 Survival Aspects

1.15.1 Cockpit and Cabin Crew Communications

About 1316, the flight attendants received the four-chime emergency notification from the cockpit, and they all picked up their interphones. The captain provided the flight attendants with the emergency information. Specifically, the captain told the flight attendants that they would be landing at STL in about 5 to 10 minutes, that an evacuation would probably not be necessary, that the signal for an evacuation would be the “Easy Victor” command, and that the nature of the emergency was a fire indication for the left engine. The captain then announced over the PA system that the Left Engine Fire indication had illuminated and that the flight was returning to STL. He advised the passengers to keep their seatbelts on and to remain calm.

The No. 2 flight attendant stated that, after the briefing, she heard “two pops” and a “swooshing sound” but that she looked out the small tailcone window and saw that everything appeared normal; therefore, she did not report the sounds to the captain. At 1328:54, the off-duty company pilot made another announcement to the passengers, stating, “please pay attention to the flight attendants….do not be alarmed.” He subsequently told the flight attendants that a ground evacuation was not planned but to be ready if one became necessary.

After the airplane landed, the off-duty company pilot told the flight attendants to be seated. About 30 seconds later, he announced to the passengers that ARFF trucks were waiting outside of the airplane but that their presence was precautionary and instructed the passengers to remain seated. At 1340:40 (about 8 minutes after landing), the captain told the passengers that ARFF personnel had secured the airplane, that everything was good on the outside, and that they were going to be towed off the runway. Subsequently, the flight attendants instructed the passengers to remain seated with their seatbelts fastened and to keep their items stowed. About 1341:27, ARFF personnel told the captain through the cockpit window that they would be coming on board. Shortly after, the captain told the No. 1 flight attendant to disarm the door to allow ARFF personnel to come aboard. At 1343:28, the captain announced that ARFF personnel would be coming on board to “check things out.”

ARFF personnel visually scanned the interior and, about 1346, reported, “everything was good.” ARFF personnel then exited the airplane and moved the airstairs truck away from the door. For about 10 minutes after ARFF personnel exited the airplane, the flight crew waited for the tug to arrive to tow the airplane to the gate. Before the tug arrived, ARFF personnel noticed that fuel was dumping from the left engine and, therefore, recommended that the passengers be deplaned. (See section 1.15.2 for more details.) At 1410:05, the captain announced that the passengers would be deplaning. The flight attendants stated that they stayed at their door positions in case the emergency slides had to be deployed.

All of the passengers deplaned without incident while the airplane was on the runway. According to the flight attendants, there was no sense of urgency to get the passengers off the airplane. The flight attendants stated that the deplaning was orderly and “quicker than normal.”

After the passengers deplaned, the flight attendants exited through the L1 door. The flight attendants stated that, overall, communications with the cockpit were "good" and that they received enough information from the captain.

The American Airlines flight attendant manual (FAM) contains guidance regarding cabin and cockpit communications during an emergency. The FAM states that flight attendants are responsible for continuously providing the captain with updates in an emergency situation. The manual further states that the No. 1 flight attendant is responsible for coordinating with the cockpit crew and adds that crew communication is of the utmost importance to ensure the safety of both the passengers and the crew.

AC 120-48, "Communication and Coordination Between Flight Crewmembers and Flight Attendants," dated July 13, 1998, provides guidance on how to handle and avoid common problems that occur in coordination among flight crewmembers and flight attendants. The AC states that the most common problem with communications during emergencies involves the flight crewmembers not informing the flight attendants of the nature of the emergency, the time available to prepare the cabin, and the necessary special instructions (for example, to use only one side of the aircraft in the evacuation). The AC also states, "The quality and timing of the information given to the flight attendants is extremely important in an emergency… Communications from the flight crew should be clear, precise, and instructional."

The AC states that the timing and quality of the cabin-to-cockpit communications are also critical and that flight attendants should convey specific information to the flight crew in a timely manner. The AC further states that one of the most common problems with cabin-to-cockpit communications is the failure of the flight attendants to convey important safety-related information to the flight crewmembers. The AC added, "flight attendants should be aware that it is always important they report unusual noises and abnormal situations to flight crewmembers as soon as possible and be specific in their report."

1.15.2 Emergency Response and ARFF Personnel and Cockpit Communications

According to the STL Operations and Communication Center radio log, the STL ARFF facility received the initial emergency notification alarm about 1317. Seventeen ARFF personnel in 10 vehicles responded to the accident. As a result of the captain's request for a change in landing runway, the ARFF vehicles had to move from their original standby positions, for runway 30R, to standby positions for runway 30L. According to the STL police department's law enforcement offense/incident report, the vehicles reached the standby locations for runway 30L about 1320.

The report stated that, about 1332, the airplane landed uneventfully with the "left engine still slightly on fire and hydraulic issues with main landing gear doors hanging open." ARFF vehicles followed the airplane down the runway and were then positioned around the airplane. About 3 minutes later, the captain established contact with ARFF personnel through the ground controller, and he was informed that there was "still a little bit of fire" in the engine and that

ARFF personnel were applying extinguishing agent. ARFF personnel used hand lines to discharge water and the rooftop turret to discharge AFFF into the engine. ARFF personnel also used a thermal imaging camera on the outside of the airplane to look for any remaining hot spots. This revealed that everything looked normal except for a 'little hot area' toward the top of the engine.

According to the CVR transcript, ARFF personnel were communicating with the flight crew through an open cockpit window and via ATC while the extinguishing operations were being conducted. AC 150/5210-7D "Aircraft Rescue and Fire Fighting Communications," recommends that ARFF personnel and flight crewmembers communicate through a designated emergency radio, or "discrete," frequency.[35] During postaccident interviews, the incident commander (IC) indicated that he chose not to use a discrete frequency because ARFF personnel were able to communicate with the pilots through the window and via ATC. The AC also states that ATC should provide the pilot with the IC's call sign. The CVR did not record ATC providing the captain with the IC's call sign or a discrete frequency.

After applying AFFF to the left engine and completing the thermal scanning, three ARFF personnel used the airstairs truck to enter the airplane through the L1 door[36] to conduct a primary search, ensure that the fire had not penetrated or breached the interior of the airplane, and check on the welfare of the passengers. After ARFF personnel visually scanned the interior and determined that no fire was in the cabin, they exited through the L1 door and moved the airstairs truck. About 6 minutes later, ARFF personnel told the STL ground controller that the fire was out and that the inside was good. For about the next 10 minutes, the airplane waited on the runway to be towed.

At 1357:42, the CVR recorded the Left Engine Fire warning bell and aural alert and then the first officer stating, "I just moved that thing [pneumatic crossfeed valve] and it just…it went back in when I pulled it." Shortly thereafter, the CVR recorded someone outside of the airplane informing the pilots that the left engine was "dumping gas." Maintenance personnel then instructed the pilots to "pull the left engine shutoff valve" and stated, "you're dumping fuel." Two trucks then applied AFFF to the back third of the fuselage and engine. The IC decided to deplane the passengers, which ARFF personnel relayed to the pilots through the cockpit window. During postaccident interviews, the IC stated that ARFF personnel could decide to deplane an airplane depending on the emergency conditions and type of incident.

About 1401, the CVR recorded the captain stating that ARFF personnel "want to take everybody off." About 3 minutes later, the captain contacted ATC to ask why ARFF personnel

[35] AC 150/5210-7D was issued as a result of Safety Recommendation A-98-41, which asked the FAA to "establish a designated radio frequency at all airports certified under title 14 CFR Part 139 that allows direct communication between airport rescue and firefighting (ARFF) personnel and flight crewmembers in the event of an emergency and take appropriate measures to ensure that air traffic control personnel, ARFF personnel, and pilots are aware of its designation."

[36] During postaccident interviews, the No. 1 flight attendant stated that she was concerned when the ARFF truck parked in front of the L1 door because the truck blocked the door, leaving only the overwing exits through which to evacuate. According to the IC, he used the L1 door instead of the tailcone door to access the airplane because of the hazards associated with the fire in the left engine.

wanted to deplane the passengers. He also stated that he felt that it would be safer to keep the passengers on the airplane. ATC relayed the query to ARFF personnel, who responded that the IC wanted to return the airstairs truck to the airplane and deplane the passengers because heat and smoke were still coming out of the left engine. The flight crew waited for the airstairs truck to return to the L1 door, and the passengers began deplaning about 1410. The passengers deplaned without incident and were transported to the airport terminal by bus. The IC stated that most of communications between the flight crew and ARFF personnel occurred face-to-face through the open cockpit window and that he felt that communications were "good."

1.16 Tests and Research

1.16.1 High-Temperature Exposure Fuel Fitting Tests

In September 2008, the NTSB conducted tests to examine the susceptibility of the fuel manifold fittings on JT-8D 200 series engines to leaking when exposed to high temperatures like those of an ATS exhaust during an uncommanded valve opening during high engine power conditions. The fuel fittings are stainless steel and assembled using a rubber packing to create a liquid-tight seal that, if compromised, could cause a leak on the inside of the fuel fitting. The rubber packing material specification qualifies it to maintain its integrity when exposed to a temperature of up to 100º C (212º F).

Tests were conducted using a laboratory oven, an oil burner, and a forced air combustion heater. The metal fuel fittings from the accident engine were cleaned with an ultrasonic part cleaner, returned to serviceable condition, and used in the tests. Both new and used rubber packings and nylon packing retainers were used in the tests. The packing and packing retainers were assembled inside the test fittings in accordance with the P&W JT-8D maintenance manual's fitting assembly procedure, which consisted of lubricating a packing and retainer, assembling the fitting, and tightening the fitting to a torque of 35 inch-pounds. After assembly, the fitting was secured with safety wire. Before each test began, 300-psi static pressure was applied to the assembled fittings to establish that they were airtight.

Two oven tests were conducted at the NTSB's laboratory. In the first test, just the rubber packing was exposed to a 600º F environment for 3, 9, and 21 minutes. After 3 minutes of exposure, the rubber packing was still flexible, and the surface of the packing exhibited check marks and fine lines. After 9 minutes of exposure, the packing was hard and brittle, and the check marks had become more pronounced. Gently squeezing the packing caused it to fracture in the middle. After 21 minutes of exposure, the two packing pieces remained hard and brittle with no perceptible change in appearance. Weight measurements indicated that the packing had lost 5.94 percent of its mass. In the second oven test, a fitting with packing and packing retainer was exposed to a 600º F environment for 2 hours, after which, the fitting showed evidence of a leak. Disassembly revealed that the packing retainer had melted and that the packing was fractured. The fractured packing was found to be hard and brittle.

The oil burner tests were conducted at the FAA Technical Center in Atlantic City, New Jersey. For the tests, fuel was circulated through the fitting at a flow rate of about 0.3 gallons per minute at a pressure of about 20 psi while the oil burner ran for 2 minutes to reach a steady state. The fuel fitting was then exposed to 2,000º F for 5 minutes, the burner was shut off, fuel recirculation was stopped, and a static pressure of 300 psi was applied.[37]

The first oil burner test was conducted using a packing and packing retainer that had 11,115 total service hours. After 5 minutes of exposure, the fitting showed evidence of a leak, which became more pronounced when the fuel recirculation was stopped and 300-psi static pressure was applied. Disassembly of the fitting revealed that the outer perimeter of the packing exhibited a tendency to crumble. The packing remained somewhat pliable, and the packing retainer was partially melted and had separated at one section of its circumference. The second oil burner test was conducted using new packing and packing retainer. After 5 minutes of exposure, the fuel fitting was on fire. Disassembly of the fitting revealed characteristics similar to but less severe than those observed on the fitting used in the first oil burner test. The packing retainer was discolored and exhibited minor indications of melting, but it had not separated.

Three forced air combustion heater tests were conducted at the FAA Technical Center using a kerosene-fueled heater. The tests were conducted using the same recirculation and static pressure scheme used in the oil burner tests. For each of these tests, the heater was warmed up for 2 minutes until it reached a steady state, and then the fuel fitting was placed in front of the heater at a 600º F location.

The first forced air combustion heater test was conducted with used packing. The fuel fitting was placed in front of the heater for 5 minutes 30 seconds, and then the fitting was moved away from the heater, the fuel recirculation was stopped, and 300-psi static pressure was applied. No leaks were found. After 5 more minutes of exposure, no leaks were found. Disassembly of the fuel fitting revealed that, although the packing was still flexible, it exhibited a tendency to crumble and exhibited a ragged edge and some minor striations along its outer circumference. The packing retainer did not exhibit evidence of melting or other damage. The second forced air combustion heater test was conducted using a new packing and retainer. The fuel fitting was placed in front of the heater for 10 minutes and was maintained at 300-psi static pressure. After 10 minutes of exposure, no leaks were found. Disassembly revealed that the packing had a pronounced ragged edge and exhibited a slightly ragged edge on its inner circumference. The packing retainer was severely melted, deformed, and brown. The third forced air combustion heater test was conducted using new packing and packing retainer. In this test, the fitting was tightened to a torque of 15 inch-pounds, which was half of the manufacturer’s specification. The fuel fitting was placed in front of the heater for 10 minutes. No leaks were found. Disassembly revealed that the packing exhibited ragged inner and outer circumferences, and it was flexible. The inner circumference was more ragged than in the previous combustion heater test. The packing retainer was severely melted and deformed. Portions of the retainer were found charred, brittle, and black.

[37] The heating conditions and placement of the test fitting used in the testing were the same as those used in the certification tests. The certification tests also used a mechanism for inducing a vibration into the test fitting; however, the mechanism was not used during the NTSB’s tests.

1.17 Organizational and Management Information

American Airlines is a Part 121 airline that offers passenger and cargo service and, at the time of the accident, operated about 4,000 flights daily to more than 250 cities in over 40 countries. The company's corporate office is in Fort Worth, Texas, adjacent to Dallas/Fort Worth International Airport (DFW). At the time of the accident, American Airlines operated a fleet of more than 600 airplanes, consisting of Airbus 300s; Boeing 737s, 757s, 767s, 777s; and McDonnell Douglas MD-80s. American Airlines has 10 crew bases located throughout the United States.

1.17.1 Flight Crewmember Training

1.17.1.1 General Information

According to American Airlines, after pilots complete initial training, they receive recurrent training and checking under the Advanced Qualification Program (AQP), which is a voluntary alternative to the traditional pilot training and checking regulatory requirements under 14 CFR Parts 121 and 135. According the FAA, the line operational evaluation (LOE) is the primary means of proficiency evaluation under an AQP to verify that an individual's job knowledge and technical and crew resource management (CRM) skills meet AQP qualification standards.

During ground school, American Airlines pilots were required to read the ground evacuation procedures in the quick reference handbook (QRH)[38] and then to discuss the procedures in the classroom and practice them in a flight-training device. The training focused on covering the procedures step-by-step to ensure that the pilots understood each step as they performed the action. The ground evacuation procedures were also reviewed during recurrent training. The American Airlines MD-80 program manager estimated that 90 percent or more of the pilots practiced an emergency evacuation during recurrent training. American Airlines provided flight attendants with 7 weeks of training.

1.17.1.2 Human Factors and Safety Training

All American Airlines pilots and flight attendants attend human factors and safety training during initial and recurrent training to meet Federal CRM training requirements. During human factors and safety training, crew communication, coordination, teamwork, and American Airlines incidents are reviewed. The two accident pilots and three flight attendants received this training at their last recurrent training session.

[38] The QRH is carried in the cockpit and contains information also found in the FOM, including abnormal and emergency checklists.

Pilots and flight attendants attend human factors and safety training separately, the pilots during a course that is 2 hours 45 minutes long, and the flight attendants during a course that is 1 hour long.

Both pilot and flight attendant trainees are organized into small groups to encourage participation and discussion. The training includes a review of videotaped reenactments of American Airlines incidents. According to documents from the April 2007 flight attendant recurrent training program,[39] among the events discussed were the following: American Airlines flight 1740, in which an MD-80 was forced to make an emergency landing after the landing gear failed to extend, and American Airlines flight 908, in which a 777 aborted takeoff because of an engine fire. After reviewing the details of the two events, the instructor is told to state, "When a fire erupts on the exterior of the aircraft and the fuselage is intact, statistics show that it will most likely be extinguished before becoming life threatening to the occupants."

In 2007, an ARFF training film from the DFW Department of Public Safety was incorporated into recurrent training for pilots and flight attendants. The video shows an American Airlines representative interviewing a DFW ARFF training specialist about evacuation decision-making and flight crew communications with ARFF personnel. The American Airlines representative states that the flight crew must determine if and when an evacuation should begin and that flight attendants have the authority to begin an evacuation if faced with life-threatening circumstances. The flight attendants are also instructed to attempt at all times to communicate with the cockpit before deciding to begin an evacuation and to give the pilots time to assess the situation and ARFF personnel time to do their jobs. Pilots are instructed to establish communication with an air traffic controller, airport operations personnel, or ARFF personnel. The DFW ARFF training specialist also states that ARFF personnel do not initiate communications with the flight crew because they know that the crew is busy and do not want to interfere with the emergency procedures. He also stated that ARFF personnel do everything they can to contain a fire without having to evacuate passengers and that this is often safer and quicker than evacuation. In addition to this guidance on evacuation decision-making, instructors provide trainees with statistics from a NTSB's Safety Study, "Emergency Evacuations of Commercial Airplanes."[40] The statistics cited were that only about 6 percent of passengers are injured during evacuations and that most injuries are minor.

Pilots also receive additional instruction that focuses on pilot-related human factors issues. For example, the module effective at the time that the captain last attended recurrent training (January 2007) addressed leadership styles, decision-making, professionalism, flight operational quality assurance, and partnership for safety. The module effective when the first officer last attended recurrent training (May 2007) addressed flight operational quality assurance, checklist usage, emergency landing procedures, evacuation issues, teamwork, and the use of all resources in an emergency situation.

[39] The flight attendant recurrent human factors and safety training module indicated that the events and information reviewed in flight attendant recurrent training were also covered in the pilot recurrent human factors and safety training.

[40] National Transportation Safety Board, *Emergency Evacuation of Commercial Airplanes*, Safety Study NTSB/SS-00/01 (Washington, DC: NTSB, 2000).

1.17.2 Emergency and Abnormal Procedures

The American Airlines DC-9 Aircraft Operating Manual (AOM) contains emergency and abnormal condition procedures. According to AC 25-1581-1 "Aircraft Flight Manuals," an emergency requires immediate flight crew action to protect the airplane and occupants from serious harm. The AC states that an abnormal condition requires flight crew action resulting from system or component failure to maintain an acceptable level of airworthiness for continued safe flight and landing but does not indicate that the action must be taken immediately. During the flight, the flight crew encountered one emergency, the left engine fire, and several abnormal conditions, including, but not limited to, the left engine open ATSV, partial electrical and power failure, and hydraulic pressure loss.

The order of accomplishment for emergency procedures listed in the AOM is as follows:

> 1. The pilot—monitoring…will read from the QRH. Both challenge and response should be read aloud.
>
> 2. Upon completion of the checklist, the pilot-monitoring…will announce, 'checklist complete.'
>
> 3. After completing a procedure in the QRH, ensure that all other procedures and checklists are completed as appropriate for the phase of flight.

The AOM contains several checklists that should have been applied to address the situations on the accident flight, including, but not limited to, the L or R Engine Start Valve Open checklist, the Engine Fire/Damage/Separation checklist, Left or Right Hydraulic Pressure Low and the Hydraulic Quantity Low or Decreasing checklist, the One Engine Landing checklist, and the Emergency Landing Gear Extension checklist, all of which are discussed below. The AOM and 14 CFR 121.557(a) also state, in part, the following:

> In an emergency situation that requires immediate decision and action, the pilot in command may take any action he considers necessary under the circumstances. In such a case, he may deviate from prescribed operations, procedures and methods…to the extent required in the interest of safety.

1.17.2.1 L or R Engine Start Valve Open Checklist

The L or R Engine Start Valve Open light checklist stated, in part, that, if an ATSV-Open light illuminated in flight, the Engine Failure/In-flight Shutdown procedure was to be accomplished. The flight crew did not perform the L or R Engine Start Valve Open checklist or the Engine Failure/In-flight Shutdown procedure. The flight crew performed the Engine Fire/Damage/Separation checklist, which is discussed in the following section, after the Left Engine Fire Warning light illuminated about 1 minute after the ATSV-Open light illuminated.

At the time of the accident, an uncommanded open ATSV was considered an abnormal condition that the flight crew was expected to respond to once they recognized the problem; however, it was not considered an emergency situation that required immediate attention. After the accident, American Airlines issued DC-9 Operating Manual Bulletin No. DC-9-24, dated August 15, 2008, which amended the L or R Start Valve Open checklist by making it an emergency procedure and adding the following three steps: disconnect the autothrottle, move the affected engine throttle to idle, and close the pneumatic crossfeed valve lever of the affected engine. American Airlines has also received approval from the FAA to modify its MD-80 airplanes such that an in-flight ATSV open condition activates the Master Caution light, which is an amber annunciator light located directly in front of each pilot to alert them to the presence of an abnormal condition.[41] The modification is designed so that the illumination of the ATSV-Open light triggers the Master Caution light when the throttle angle exceeds 25° but prevents it from triggering the Master Caution light during normal engine starts.

1.17.2.2 Engine Fire/Damage/Separation Checklist

The first two steps of the emergency Engine Fire/Damage/Separation checklist are to turn off the autothrottle and to place the throttle to idle. The checklist states that, if the Engine Fire light remains illuminated after these two steps are taken, which it did in the accident airplane, the fuel lever should be moved to the OFF position, and the engine fire handle should be pulled.[42] The checklist stated that, if the Engine Fire light still remains illuminated, the engine fire handle agent should be discharged and, if it remains illuminated for an additional 30 seconds, the remaining fire bottle should be discharged. In the event that an immediate landing is planned, the checklist states to take the following steps: start the APU; turn the fuel crossfeed on; and set the hydraulic system, as required.[43] The checklist further states that the captain should then brief the flight attendants on the situation. The checklist states that the One Engine Landing and the Emergency Landing checklists should then be accomplished and that the Ground Evacuation checklist should be accomplished, if required.

After the first officer accomplished the first two items of the checklist, he was interrupted by an ATC call. After the first officer communicated with ATC, the captain transferred control of the airplane to the first officer so that he could brief the flight attendants. After the captain briefed the flight attendants, he resumed control of the airplane and the first officer resumed the checklist and continued performing the items up to the point at which the fire bottles were discharged.

[41] According to the American Airlines DC-9 AOM, the Master Caution light illuminates to indicate a condition that requires corrective action.

[42] During postaccident interviews, the first officer stated that he had trouble pulling the fire handle during the flight and that it was harder to pull in the airplane than in the simulator. After the accident, American Airlines modified its simulators to require more pull force for the fire handle so that it better replicated the force required in the airplane.

[43] During postaccident interviews, American Airlines personnel stated that its pilots were trained to check the hydraulic pressure and quantity indications and the position of the hydraulic switches before responding to the hydraulics item on the Engine Fire/Damage/Separation checklist.

An American Airlines captain and check airman stated that, if there was a fire indication in the cockpit, he expected that the checklist would be completed 95 percent of the time without stopping. He added that, if there was an engine fire, it would make sense that "you would at least close the fuel control lever, pull the fire handle, and shoot a bottle at a minimum." American Airlines manuals contained no guidance on when it was acceptable to interrupt the Engine Fire/Damage/Separation checklist or, if it was necessary to interrupt the checklist, which minimum items should be accomplished.

According to the check airman, it was not specifically written that the captain should ensure that everything possible was done to extinguish an engine fire by completing the checklist before handing control of the airplane to the first officer and proceeding to brief the flight attendants. However, he stated that he considered this part of the company's prioritization training and basic aviation and added that they were trained in the simulator to put out the fire before moving to lower priority tasks. He stated that, if a pilot had not prioritized properly and attempted to brief the flight attendants before completing critical items on a checklist, the checkairman or simulator proficiency pilot would correct the trainee. During postaccident interviews, the captain and first officer stated that they did not think that it was stated anywhere that a certain number of steps must be performed before moving on to another task, and the first officer stated, "whether they should finish the engine fire damage checklist before talking to flight attendants probably depended on the situation."

1.17.2.3 Hydraulic Pressure- and Quantity-Related Checklists

The first checklist item on both the Left or Right Hydraulic Pressure Low and the Hydraulic Quantity Low or Decreasing checklists states to turn off the transfer hydraulic pump switch, which allows the right hydraulic system to maintain hydraulic pressure in that system, if possible. No evidence was found that the either flight crewmember addressed the hydraulic system, which was required to be set, as required, as a part of the Engine Fire/Damage/Separation checklist. The CVR recorded the off-duty company pilot stating that hydraulic system problems existed, but the CVR did not record either pilot performing either abnormal hydraulic system checklist.

1.17.2.4 One Engine Landing Checklist and Go-Around Procedures

The One Engine Landing checklist included, in part, the following procedures for a go-around with one engine:

- call for go-around engine pressure ratio (that is, thrust provided by remaining engine),
- press TO/GA [takeoff/go-around] button,[44]
- retract flaps to 11°,

[44] Pressing the TO/GA [takeoff/go-around] button automatically advances engine power to go-around power and prompts the flight director to provide go-around guidance.

- maintain airspeed at a minimum of Vref [that is, approach and landing reference speed] plus 5 knots,
- retract landing gear, and
- disarm spoilers.

A review of the CVR transcript and FDR data revealed no evidence that the flight crew accomplished any of the one-engine go-around procedures except for increasing the airspeed.

1.17.2.5 Emergency Landing Gear Extension Checklist

The Emergency Landing Gear Extension checklist included the following steps:

- put the gear handle in the down position,
- pull the emergency gear extension lever full up, and
- check to see if the three gear lights are green.

The checklist further states that, if the right hydraulic system cannot be pressurized, the gear doors will remain open and the Gear Door Open light will be illuminated and that moderate braking should be used to avoid unnecessary damage to the main gear doors. The checklist then states to install the gear safety pins after landing and before taxiing. Lastly, the checklist contains the following caution:

> Do not stow emergency gear extension lever until door malfunction has been corrected or until main gear door hydraulic bypass handle has been pulled.

The flight crew extended the nose landing gear during the go-around by conducting the first three steps of the Emergency Gear Extension checklist items; however, the flight crew did not conduct the checklist items for an unpressurized right hydraulic system.

1.17.3 Emergency Evacuation Guidance

The American Airlines Flight Operations Manual (FOM) contains the following general guidance on emergency ground evacuations:

> A. In an emergency evacuation, it is likely that certain passengers and crewmembers will suffer injury. The Captain should consider the relative risks of remaining aboard the aircraft against the risks of evacuation.

B. Although indications of fire must be regarded with the utmost seriousness, in some cases such as a fire warning light, torching, or external smoke, the Captain should seek further information or confirmation from other sources such as the tower, other aircraft, or emergency response crews…

C. If an irregularity or emergency develops during ground operations and it is not feasible to return or continue to the terminal / gate area, the Captain should consider the use of emergency exits and evacuation slides to deplane passengers and crew only if their safety is in question. Otherwise internal or remote stairs or an eventual return to the terminal / gate should be used for deplaning.

The American Airlines FOM contains the following guidance to flight attendants regarding initiating evacuations:

> When an aircraft has come to a stop in an obvious life-threatening situation (fire, black smoke in the cabin, crash), Flight Attendants are authorized to initiate an evacuation without awaiting instructions from the cockpit. Flight Attendants will attempt to communicate with the cockpit if at all possible. If contact with the cockpit is not possible, or time is of critical importance, Flight Attendants will make an independent decision and operate all usable exits.

In February 1997, American Airlines issued Flight Operations Technical Information Bulletin No. 97-02, "Emergency Evacuations," which was distributed to all cockpit crewmembers. The bulletin stated, "it is not feasible…to establish a rigid set of rules regarding evacuation since there are many situational variables that can occur" and that the captain "alone must evaluate the specific condition and make the appropriate decision." The bulletin provided the following guidelines for pilots to follow when deciding whether or not to initiate an evacuation:

1. The decision to evacuate should be deliberate and carefully considered weighing the risks against evacuating against the risks of remaining aboard.

2. The most hazardous event is fire or smoke within the pressurized area of the airplane (cabin or cargo compartment).

3. Smoke, or some flames, in the engines, APU, or wheel assembly areas will normally burn out quickly and not endanger the cabin. Request airport fire equipment, pull the fire handle, discharge fire suppression agent as appropriate, carefully monitor the area and communicate with crash vehicle crews and tower. Time and situation permitting, clear the active runway. Evacuate the passengers if the fire does not extinguish in a reasonable time or appears to be spreading.

The American Airlines FAM states that, if an emergency situation develops, flight attendants should be prepared to evacuate the aircraft. The manual also states the need to stay alert for clues, including unusual noises; impact forces; fire, sparks, or smoke; or abnormal aircraft attitude, that may signal an emergency and to begin evacuation command immediately upon a signal from the cockpit. The manual further cautions flight attendants to be aware of any additional instructions coming over the PA system from the captain, including instructions about which exits to avoid.

During postaccident interviews, an American Airlines chief pilot stated that an engine fire indication while the airplane was on the ground did not necessarily require an immediate ground evacuation. He stated that American Airlines’ policy and training on fire events was to gather as much information as possible and assess the situation before initiating an evacuation. He added that pilots should determine whether they could extinguish the fire with the on-board fire-extinguishing system and elicit information from the flight attendants and ATCT and ARFF personnel about what they see. American Airlines’ instructors stated that pilots should decide to evacuate based on the information they had in addition to any information received from ARFF and ATCT personnel and the flight attendants.

During postaccident interviews, the captain stated that he chose not to perform an emergency evacuation because the airplane was stopped under control, no hull breech had occurred, the flight attendants had not reported that any smoke or fire was present in the passenger cabin, and several ARFF vehicles with AFFF capabilities were on the runway. He added that he believed that the passengers were safer on the airplane.[45] American Airlines’ instructors stated that they agreed with the accident captain’s decision to not evacuate the airplane.

After the accident, American Airlines changed its FOM, adding the following statement:

> After an airplane has landed following a significant in-flight event, the potential also exists for a passenger or Flight Attendant initiated evacuation. If an airplane has stopped on a runway or taxiway, but an evacuation is not immediately required, consideration should be given to configuring the aircraft for a potential evacuation. Steps such as lowering the flaps, lowering the speed brakes, and shutting down the engines, should be considered to avoid the potential passenger injuries which might occur if the aircraft is not configured and the situation deteriorates or an inadvertent passenger or Flight Attendant evacuation takes place.

1.17.4 Fire Handle Retraction Guidance

The Boeing MD-80 Flight Crew Operating Manual (FCOM) stated, in part, that, if the engine fire handle were pulled, placing the respective pneumatic crossfeed valve lever to OPEN

[45] The CVR recorded the captain and flight attendants making statements about the possibility of passenger injuries during evacuations. After the decision had been made by ARFF to deplane the passengers, the CVR also recorded the first officer stating that the passengers would be safer on the airplane.

would retract the engine fire handle.[46] A review of the American Airlines FOM, AOM, and training materials did not find any information or guidance indicating that opening a pneumatic crossfeed valve would retract the respective fire handle and reverse the shutoff of fuel and hydraulic fluid. The American Airlines AOM and training did indicate that, when a fire handle was pulled, fuel was shut off and the pneumatic crossfeed valve was closed. During postaccident interviews, the American Airlines MD-80 fleet captain stated that, during training, company pilots were taught that the fire handle and the pneumatic crossfeed lever were mechanically linked and that they should be aware that opening the pneumatic crossfeed lever would retract the engine fire handle; however, no specific written guidance stated that opening the crossfeed lever could lead to the fire handle retracting.

About 25 minutes after landing, the first officer opened the left pneumatic crossfeed valve to improve the airflow in the cabin, which caused the left engine fire handle to retract and fuel to flow into the damaged engine area. Subsequently, fuel dumped onto the ground. The first officer stated that, after he realized that the left fire handle had retracted, he pulled the left engine fire handle out.

On August 5, 2008, the FAA issued Safety Alert for Operators (SAFO) 08018,[47] which discusses the fire handle characteristics of DC-9, MD-80, and MD-90 airplanes. The SAFO discusses the relationship between the fire handle and the pneumatic crossfeed valve. Further, the SAFO recommends, “Directors of Safety, Directors of Operation, Chief Pilots, and Training Managers of Boeing Models DC-9, MD-80 and MD-90 airplanes…review their training syllabus to ensure they effectively present the design and interrelationship of the systems affected by the fire handle.” The SAFO also states that operators should describe this issue in their operating manuals. The SAFO further notes that operators’ checklists should include a caution that “[t]he pneumatic crossfeed lever is mechanically connected to the fire handle. Opening the pneumatic cross-feed lever will retract the fire handle and potentially re-introduce fuel to a fire.” Lastly, the SAFO stated that flight crews should obtain proficiency in pneumatic crossfeed operation during simulator training.

After the accident, Boeing revised the Engine Fire/Severe Damage/Separation checklist in its MD-80 and -90 FCOMs to include the following caution:

> Do not open affected [pneumatic crossfeed valve] lever as this will reset ENG FIRE handle causing fuel and hydraulic fluid shutoff valves to open and fire extinguishing agent to disarm.

[46] Manufacturer’s flight crew operating manuals are not generally made available to flight crews. Instead, crews must rely on information provided by operators in their training and manuals.

[47] A SAFO is an FAA notice that provides important safety information concurrently to operators and FAA field offices in a timely manner. SAFOs frequently contain recommended actions to be accomplished by operators, but those actions are not mandatory.

1.18 Additional Information

1.18.1 Postaccident Air Turbine Starter Valve Event

According to American Airlines, about one to two ATSV-Open light illuminations were reported annually before the accident date. On January 23, 2008, the right engine ATSV-Open and Fire warning lights illuminated during climbout from SLC. No fire was found upon return to SLC. An on-ground inspection revealed damage to the ATS and engine case. The airplane had no history of ATSV problems. The filter element was found completely detached from its base. The ATSV and ATSV-air filter were replaced, and no repeat events occurred.

The NTSB investigated the SLC event because, similar to the American Airlines flight 1400 event, a fire warning and an uncommanded ATSV opening occurred during the flight. Teardown examinations of the ATSV assembly components, including the filter housing and separated filter element assembly, were conducted at the Honeywell facility in Tempe, Arizona, under NTSB supervision. The examinations revealed that metallic debris consistent with fine screen material was inside the housing and on the solenoid ball.

The ATSV-air filter element was transversely separated through the filter mesh just above the lower braze line. Both sides of the separation displayed severe mechanical damage and rubbing. Examinations using a scanning electron microscope revealed features consistent with fatigue propagation completely through the cross-sections of both fine and coarse wires. Fracture traces indicated that the fatigue initiated at the contact points with the cross wires. The housing was longitudinally sectioned, and examination of the interior surface revealed a circular burnished band where the original machined finish of the housing had been polished smooth. The band was located at the approximate installed location of the filter element end cap. The outer diameter of the end cap displayed matching burnishing. As a result of the SLC ATSV-air filter assembly examinations, further examinations were conducted on the American Airlines flight 1400 airplane's ATSV-air filter assembly and seven exemplar air filter assemblies from American Airlines. These examinations are discussed in the following two sections.

1.18.1.1 Accident ATSV-Air Filter Assembly Examinations

After the SLC incident, American Airlines sent the incident airplane's intact left engine ATSV-air filter assembly, including the filter housing, end cap, and threaded fitting, to the PTI facility in Oxnard, California, for examination under NTSB supervision. A portion of the filter mesh was found partially embedded in the internal threads of the housing. The exterior surface of the filter assembly exhibited darkening, consistent with high-temperature exposure. (See figures 5 and 6 on the following page.)

The ATSV-air filter was then sent to the NTSB's Materials Laboratory in Washington, DC, for further examination. The filter element adjacent to the braze joints at the fitting and the end cap was separated through the filter mesh. Magnified optical examinations found severe rubbing damage at the separations. The rubbing damage completely obliterated any fracture features at the separations and separation features on the portion of the mesh removed from the housing. The outer diameter edge of the end cap was rubbed and rounded. Comparisons of the accident end cap to exemplar end caps revealed that the accident cap was reduced in diameter by about 0.020 inches. The end cap's inner diameter was also rubbed and rounded, and a similar mating pattern was found on the inner diameter of the fitting.

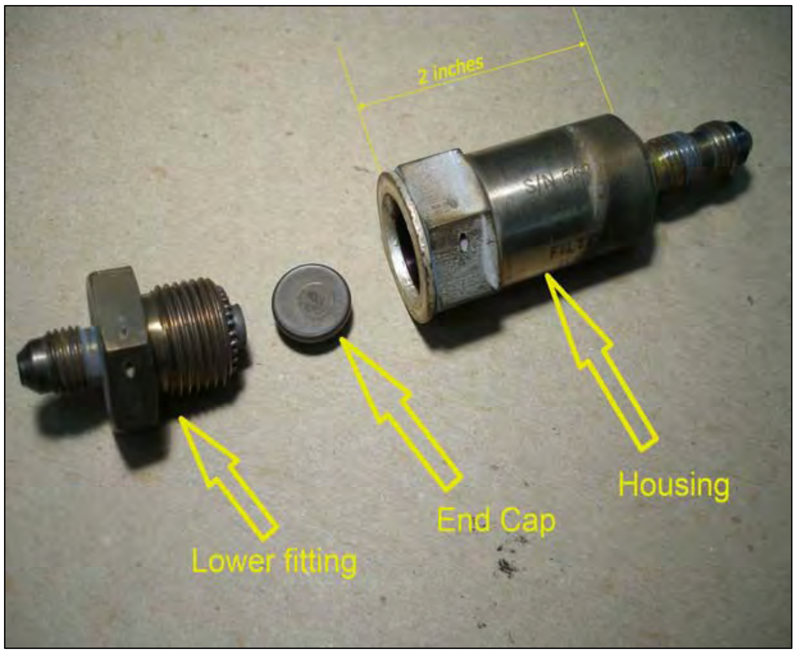

Figure 5. Photograph of the damaged ATSV-air filter housing, end cap, and lower fitting.

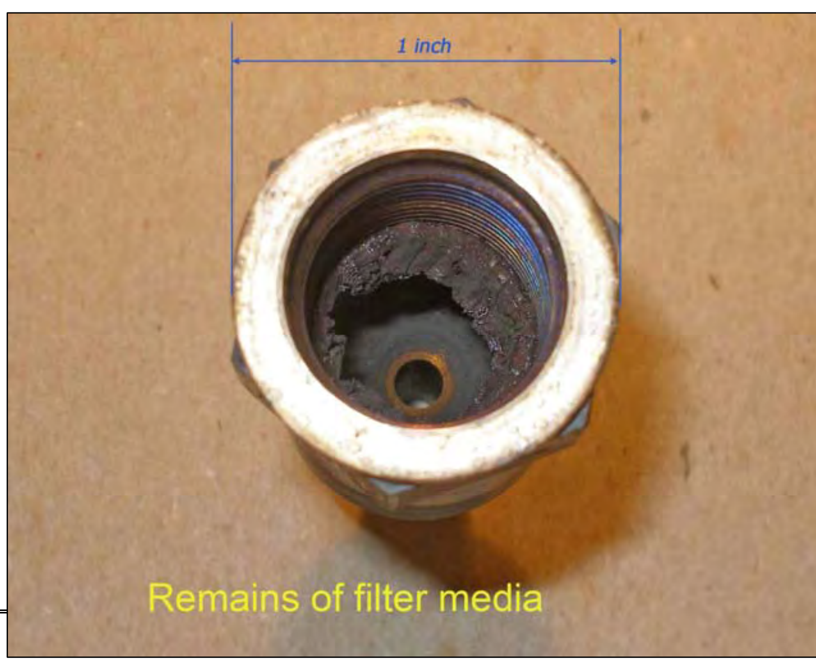

Figure 6. Photograph of the damaged ATSV-air filter housing and remaining filter material.

Investigators longitudinally sectioned the filter housing. The central region of the cylindrical interior surface was found burnished and polished smooth. The damage obliterated most of the original machined surface finish, which only remained in small bands at the upper and lower ends of the section. The damage to the interior of the housing, end cap, and filter mesh was consistent with vibratory motion of the filter mesh and end cap within the housing. The extent of the polishing of the housing was consistent with the downward progression of the end cap to the point of contact with the fitting end.

1.18.1.2 Exemplar ATSV-Air Filter Assemblies Examinations

After the SLC incident, American Airlines provided seven exemplar ATSV-air filter assemblies from in-service aircraft to the NTSB for examination. One filter was separated through the filter element and had been removed from an engine received for overhaul. The separated filter was received with the filter housing. Six of the filters were removed and were received without the housings.

Magnified optical examinations of the six intact filters revealed that three of the filters had fractured wires in the outer filter mesh material. Examinations of the fractured wires using a scanning electron microscope revealed oxidation and mechanical damage to most of the wire fracture faces, and most of the separation features were obliterated. A few wire fractures were undamaged, and these fractures contained microfeatures indicative of fatigue propagation with initiation at the contact point of the crossing wires. One of the filter's end caps exhibited polishing of the outer diameter. The end caps of two filters displayed typical machining marks with no polishing.

1.18.1.3 Additional PTI ATSV-Air Filter Tests

American Airlines provided 15 ATSV-air filters to PTI for evaluation of the filters' condition. On July 8, 2008, PTI published Test Report 81896, "American Airlines Filter Returns, P/N [Part Number] 21-10930 and P/N 21-10974," which contained the results of the tests.

According to the report, each filter was visually examined in the "as returned condition" (not cleaned). First, the filters were visually examined under normal light conditions. The filters that exhibited possible damage were then examined using a powered light source, at 45-power magnification. Lastly, PTI conducted bubble point tests per International Standard 2942 (by the International Organization for Standardization) on all of the filters to verify the fabrication integrity of a filter element by checking the absence of bubbles or to locate the largest pore of the filter element by determining the first bubble point.

The visual examinations revealed that all of the filters were dirty. Most of the filters exhibited minor dents and dings and some slight twisting or deformation of the pleats. Tears and rips in the filter mesh were visible on three of the filters. One of the filters exhibited dents consistent with impact damage, and one of the filters had a damaged mesh pack side seal. No other significant damage was observed in the remaining filters.

According to the bubble tests, the ATSV-air filters met the acceptance test requirements for new filters. However, the report concluded that five of the filters were determined to have damage related to failed mesh packs and that these filters were considered nonoperable and required replacement. The report noted that visual examination with the naked eye under normal and bright light conditions was the most efficient method to identify the failures of the filters and that bubble point tests did not provide definitive evidence of failure and would be difficult to administer in the field.

1.18.2 Multiple Emergencies Training

1.18.2.1 FAA Position

In a June 20, 2008, letter to the NTSB regarding its position on multiple emergencies training, the FAA stated that it would be impossible to train for every combination of in-flight emergencies. The FAA further stated the following:

> overloading a student with unrelated combinations of emergencies is counterproductive and generally considered negative training[48] …if the student should fail to accomplish a task or procedure satisfactorily, it is realistic to introduce an additional problem that would logically result from the unsatisfactory accomplishment of the earlier task…In general, this guideline confines the compounding of problems/emergencies to a particular aircraft system or related systems.

In addition, the FAA stated the following:

> Multiple, unrelated emergencies strung together as a training event are unrealistic training scenarios. In pursuit of realistic line-oriented training, airlines create …LOE scenarios from actual line experiences…[that] are operationally relevant, believable, and a test of the flight crew's skills and capabilities. Complex events have ongoing consequences that must be dealt with in flight and cannot be solved by simply selecting and executing an abnormal checklist. LOE scenarios require the coordinated actions of all crewmembers for successful completion…[and]

[48] "Negative transfer of training," which is commonly referred to as "negative training," describes a situation in which training leads to less effective performance in the operational environment than would have occurred if no training had been performed.

may have a number of possible and reasonable solutions. Thus, the well-designed LOE promotes the management of a complex situation.

1.18.2.2 Boeing Position

According to Boeing, the company stopped providing multiple emergencies training in the mid-1980s, in part, because of the introduction of the integrated crew advisory system (ICAS),[49] which prioritized non-normal occurrences.[50] Boeing indicated that ICAS created an environment in which the airplane could handle some emergencies. For example, the airplane could transfer electrical power automatically, and the ICAS would alert the pilots to the transfer and indicate status. Boeing stated that multiple emergencies training was subject to abuse because an instructor could increase the load on a student until they could not handle any more and that this was considered “negative training.”

1.18.2.3 American Airlines Position

At the time of the accident, the American Airlines AQP did not contain guidance on multiple emergencies training. The American Airlines MD-80 program manager/technical pilot stated that American Airlines training emphasized the importance of working together to optimally handle an emergency situation and that pilots should enlist the help of all resources available, including deadheading crewmembers, if necessary. He stated that the training emphasized the importance of maintaining situational awareness throughout the emergency as the best method of achieving a successful outcome.

After the accident, American Airlines began assessing its ability to use multiple failure scenarios in its training program and began discussions with the FAA on this issue. The FAA must approve any changes to the AQP, including adding multiple emergencies training to the program, before they can be implemented. American Airlines is working on a formal proposal to the FAA to add multiple emergencies to its training. The company has incorporated an open-ATSV event to its MD-80 pilot training.[51]

1.18.2.4 Research on Crew Performance in Emergency and Abnormal Situations

In 2000, the National Aeronautics and Space Administration (NASA) established the Emergency and Abnormal Situations (EAS) study[52] to develop guidance for procedures,

[49] The accident airplane did not have an ICAS.

[50] The ICAS logic determines the most critical problem and presents that to the pilot first.

51 The scenario involves a takeoff from LaGuardia Airport with a diversion to JFK International Airport and duplicates the events of this accident flight to the extent possible.

52 B.K. Burian, I. Barshi, and K. Dismukes, The Challenge of Aviation Emergency and Abnormal Situations. Technical Memorandum NASA/TM 2005-213462. (Washington, DC: NASA, 2005).

checklists, training, and communications to improve the performance of pilots during emergency and abnormal situations.[53] Aviation Safety Reporting System (ASRS) data examined as part of the EAS study showed that, although crews reported little difficulty handling routine emergency events resolved with checklist procedures, these events did not represent the majority of reports examined.[54] An ASRS report on an emergency situation involving an electrical failure stated:

> events took place…during a critical phase of flight…[and] occurred simultaneously with radio transmissions, configuration changes, airspeed changes, and constantly changing altitude…What we learned from this event is that running the emergency checklist may not be a classical situation where one has plenty of time for analysis and application of curative measures.

Research indicates that the presence of an emergency situation results in higher workload and requires greater effort to manage effectively because of the stress involved and the reduced opportunity for pilots to have practiced these skills compared to normal operations.[55] The EAS study report noted that, during high workload conditions, performance deficiencies, including narrowing of attention and impairment of working memory, could result from inherent limitations in cognitive processes and the effect of stress on human performance. The EAS study report also stated the following:

> When experiencing stress and high workload, crews are vulnerable to missing important cues related to their situation and are likely to experience difficulty pulling together disparate pieces of information and making sense of them. This is especially true when some of that information is incomplete, ambiguous, or contradictory…it is easy to lose one's place or jump to the wrong item or checklist when dealing with the many distractions, interruptions, and competing demands for attention that typically occur during emergency or abnormal situations.

1.18.3 Previous Related Safety Recommendations

The NTSB has had long-standing concerns about sterile cockpit adherence and cockpit discipline and has issued safety recommendations as a result of its investigations of accidents related to these issues.

53 NASA withdrew funding from the program sponsoring the EAS study before the guidance was produced.

54 B.K. Burian and I Barshi, "Emergency and Abnormal Situations: A Review of ASRS Reports," R. Jensen (Ed.) *Proceedings of the 12th International Symposium on Aviation Psychology* (Dayton, Ohio: Wright State University Press, 2003).

55 R.K. Dismukes, G.E. Young, and R.L. Sumwalt, "Cockpit Interruptions and Distractions: Effective Management Requires a Careful Balancing Act," *ASRS Directline*, Vol. 10 (1998) pp. 4-9.

1.18.3.1 Safety Recommendation A-06-7

On February 7, 2006, the NTSB issued Safety Recommendation A-06-7 as a result of its investigation of the Corporate Airlines flight 5966 accident in Kirksville, Missouri.[56] Safety Recommendation A-06-7 asked the FAA to direct principle operations inspectors (POI) of all 14 CFR Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule. Also, the NTSB noted that sterile cockpit violations are among the types of intentional noncompliance that can be detected through line operations safety audits (LOSA). On April 28, 2006, the FAA issued SAFO 06004, "Approach and Landing Accident Reduction: Sterile Cockpit, Fatigue," to emphasize the importance of sterile cockpit discipline. As a result, Safety Recommendation A-06-7 was classified "Closed—Acceptable Action" on November 9, 2006.

1.18.3.2 Safety Recommendation A-07-9

On January 23, 2007, the NTSB issued Safety Recommendation A-07-9 as a result of its investigation of the October 14, 2004, Pinnacle Airlines flight 3701 accident in Jefferson City, Missouri.[57] Safety Recommendation A-07-9 asked the FAA to require all 14 CFR Part 121 operators to incorporate into their oversight programs periodic LOSA observations and methods to address and correct findings resulting from these observations.[58] On April 13, 2007, the FAA stated that LOSA was not necessarily the only way in which an operator could accomplish oversight of the safety of its operations and that the most effective response to this recommendation is implementation of a Safety Management System (SMS) that includes safety audits as a key element. On January 22, 2008, the NTSB responded that it believed in the benefits of carriers establishing and operating an effective SMS program, especially if it included a LOSA program and classified Safety Recommendation A-07-9 "Open—Acceptable Response" pending the implementation of a LOSA program.

[56] National Transportation Safety Board, Collision with Trees and Crash Short of the Runway, Corporate Airlines Flight 5966, BAE Systems BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: NTSB, 2006).

[57] National Transportation Safety Board, Crash of Pinnacle Airlines Flight 3701, Bombardier CL600-2B19, N8396, Jefferson City, Missouri, October 14, 2004, Aircraft Accident Report NTSB/AAR-07/01 (Washington, DC: NTSB, 2007).

[58] The NTSB also issued Safety Recommendation A-07-10, which asked the FAA to require that all 14 CFR Part 121 operators establish Safety Management System programs. On April 13, 2007, the FAA stated that it had begun a rulemaking project to require Part 121 operators to establish Safety Management System programs. On January 22, 2008, the Board classified Safety Recommendation A-07-10 "Open – Acceptable Response" pending the establishment of this requirement.

2. Analysis

2.1 General

The flight crewmembers were properly certificated and qualified under Federal regulations. No evidence indicated any preexisting medical or physical condition that might have adversely affected the first officer’s performance during the accident flight. Although the captain had sleep apnea, the condition was being effectively treated, and no evidence indicated that the condition affected his performance during the accident flight. There was no evidence of flight crew fatigue.

The accident airplane was properly certificated and was equipped and dispatched in accordance with industry practices. The weight and balance of the airplane were within prescribed limits for takeoff.

ATC did not facilitate the use of a designated emergency radio frequency, and neither ARFF personnel nor the pilots requested one; no evidence indicated that this impeded ARFF efforts.

This analysis discusses the series of events that led to the uncommanded opening of the ATSV and the subsequent left engine fire, beginning with events that occurred before the accident flight. The investigation revealed that American Airlines’ maintenance personnel did not follow company cleaning procedures for the ATSV-air filter during regular maintenance checks. As a result, the damage to the air filter went undetected. The investigation also revealed that, in the weeks before the flight, the damaged ATSV-air filter had caused intermittent no-engine starts. Because no failure of an ATSV-air filter had ever been recorded, the condition was not recognized and, therefore, not properly addressed by maintenance personnel, which allowed an engine no-start to recur the morning of the accident. American Airlines’ maintenance personnel used an unapproved manual engine-start procedure, which involved using a prying device to push the ATSV manual override button. Using the prying device resulted in bending the button’s internal pin, which prevented the ball valve from sealing completely. Therefore, the ATSV opened uncommanded in flight and caused the ATS to freewheel, which led to the left engine fire that was subsequently prolonged by the flight crew’s failure to complete an emergency fire-related checklist. The analysis also discusses how American Airlines’ CASS program contributed to the accident because it did not detect that company maintenance personnel were using maintenance procedures that were not in accordance with written manuals and guidelines. Lastly, this analysis discusses additional flight crew performance issues and their possible effect on the multiple abnormal and emergency events experienced in flight and additional human factors issues.

2.2 Preflight Issues

2.2.1 Preexisting Damaged ATSV-Air Filter

According to American Airlines' maintenance procedures, at every C check, the ATSV-air filter was required to be removed, the filter element cleaned, and the metal o-ring fitting checked for flatness and general condition. No detailed visual inspections of the filter element itself nor specific time-in-service inspections or replacements of the ATSV-air filters were required. Unless a condition for removal occurred (for example, if air could not pass through the ATSV-air filter), the C check was the only time that the ATSV-air filter was removed to provide maintenance personnel an opportunity to observe noticeable damage. Maintenance records indicated that this filter cleaning procedure had been accomplished on the accident airplane's left engine ATSV-air filter during the last C check. However, the fatigue and fretting damage observed on the accident ATSV-air filter element, which had developed over a long period of time, was so extensive that it would have been clearly visible to the naked eye when the filter element was removed from its housing to perform the cleaning procedure if the procedure had actually been performed during the previous C check. In fact, given the degree of fatigue and fretting damage, it is unlikely that it was checked in accordance with American Airlines' procedures during the airplane's last few C checks, despite what the maintenance records showed.

The NTSB concludes that American Airlines' maintenance personnel did not clean the accident ATSV-air filter in accordance with its C check cleaning procedures and, therefore, missed an opportunity to identify and replace the damaged filter.

At the time of the accident, American Airlines did not have an inspection procedure for the ATSV-air filter element. After the accident, American Airlines changed the cleaning procedure so that it included an inspection procedure and a more detailed cleaning method.

2.2.2 Intermittent Engine No-Start Condition

Examinations of the accident ATSV-air filter revealed that the mesh in the filter element had disintegrated and that about 70 percent of the material was missing. The mesh adjacent to the braze joints at the fitting and end cap had separated, which allowed the end cap to become free within the housing. The flat surface of the end cap was worn in a pattern indicating that it had repeatedly contacted the inside of the housing. Depending on its location over the fitting, the end cap could block the airflow from the ATSV-air filter to the ATSV, even when the ATSV was operating normally, and prevent airflow to the ATS, causing an intermittent engine no-start condition. The mode of separation of the filter mesh in the accident filter element could not be verified because of severe postseparation fretting damage. However, fatigue was detected in the wires of other filter elements.

The NTSB concludes that the filter element of the ATSV-air filter disintegrated, allowing the end cap to become free, which blocked the air flow and caused the engine no-start condition.

2.2.3 Use of Unapproved Manual Engine-Start Procedure

Since the cause of the engine no-start condition was incorrectly diagnosed, the left engine ATSV had been replaced six times during the 12-day period before the accident to address these engine no-start events. Because of the intermittent nature of the failure, maintenance personnel found that replacing the ATSV appeared to allow the engine start system to work properly in all but one case; therefore, they cleared the logbook discrepancy and took the ATSV off of MEL status for the times that the ATSV replacement appeared to work. In the case that the ATSV replacement did not work, it remained on the MEL because the ATSV-air filter would not allow air to pass through and no filters were in stock. Neither Boeing, American Airlines, nor PTI had previously encountered a failure within the ATSV-air filter and, therefore, no procedures on how to address such a failure existed.

The NTSB concludes that American Airlines' maintenance personnel's troubleshooting efforts for the engine no-start condition incorrectly focused on the ATSV and engine start system wiring because of the intermittent nature of the condition, the history of ATSV electrical circuit problems, and the lack of a history of ATSV-filter failures for which no troubleshooting guidance existed.

According to the Boeing AMM, when using the ATSV manual override button to perform a manual engine start, the button should be pushed using only thumb or finger pressure. Using a prying device to push the manual override button could put too much force on the internal pin, causing it to buckle. Boeing addressed this problem in December 1996 by issuing AOL 9-2549 to inform operators that using a levering tool to depress the manual override button could deform the internal pin. Further, Boeing revised the manual engine-start procedure contained in its AMM to include a caution to only use finger pressure to push the manual override button to avoid damaging the ATSV.

American Airlines' manual engine-start procedures are more conservative than Boeing's because they do not allow the use of the manual override button procedure when performing a manual engine start. American Airlines' only approved manual engine-start procedure requires that a special wrench be used to turn the wrenching flats on the ATSV butterfly valve. However, as described previously, some American Airlines maintenance personnel sometimes used the (unapproved) override button procedure when attempting manual engine starts because it was quicker, more practical, and easier.

A review of the company's Request for Services forms, which could have been used by American Airlines maintenance personnel to request that procedures for performing a manual engine start be modified to allow use of the override button, found no evidence that any maintenance personnel had requested this change. As noted, the internal pin of the accident airplane's ATSV manual override button was found bent, indicating that the manual override button had been depressed with a prying device at some point before the accident flight because finger pressure alone could not have bent the pin. The ATSV on the accident airplane had been replaced the day before the accident, and it is possible that the airplane flew several flights, uneventfully, with the pin in the bent condition.

Therefore, the NTSB concludes that American Airlines' maintenance personnel repeatedly used an unapproved maintenance procedure, which included using a prying device to push the ATSV manual override button, to manually start the accident engine, which resulted in bending the internal pin in the override button.

After the accident, American Airlines changed its MEL procedures, requiring that the air supply line for a deferred ATSV now be disconnected and capped to prevent actuation of the manual override button and inadvertent activation of the ATSV. The MEL procedure change did not add or approve the use of the override button for a manual start. As mentioned, American Airlines is also awaiting FAA approval to install ATSVs that have a modified internal pin in the ATSV override button that makes using a prying device ineffective.

2.3 Uncommanded ATSV Opening and Subsequent Left Engine Fire

2.3.1 Uncommanded Air Turbine Starter Valve Opening

A bent manual override pin can become stuck and fail to retract fully, preventing the ball valve from sealing completely. According to Honeywell, if the ball valve is slightly unseated, air can leak around the ball. During high-power or takeoff conditions, the air supply pressure to the ATSV would be sufficient to open the butterfly valve, causing the ATSV to open uncommanded during takeoff and the ATS to freewheel. Damage to the ATS indicated that it freewheeled past its allowable 2-minute limit (the ATS will freewheel until it fails, the air pressure supply is stopped, or the ATSV is closed) and then sustained a catastrophic internal failure. After the valve opens, the ATSV-Open light illuminates on the cockpit annunciator panel, providing the pilot with a visual cue; no audible warning occurs for this event. More details about the ATSV-Open light can be found in section 2.4.1.

The NTSB concludes that the internal pin in the left engine ATSV override button was bent, which resulted in the uncommanded opening of the ATSV during high-power engine conditions at the beginning of the takeoff roll and caused the ATS to freewheel until it sustained a catastrophic internal failure.

2.3.2 Left Engine Fire

The engine core, including the compressor, combustor, and turbines, operated normally throughout the event. No evidence of uncontainment or combustor burnthrough was found. No preexisting conditions were found that would have interfered with the engine's normal operation. The fire damage was confined to the nacelle cavity. The fire damage observed in the cavity, including heavy black soot, indicated that a significant fire occurred.

2.3.2.1 Ignition Source

For a fire to occur in the engine nacelle cavity, an ignition source and a combustible fluid source must have been present. Several electrical ignition sources are contained within the nacelle, including electrical and ignitor box wiring and the ATS. However, these were inspected, and no evidence of arcing was found.

The uncommanded opening of the ATSV and the subsequent ATS freewheeling and failure could be an ignition source. During high-power engine conditions, such as those that exist during takeoff and initial climb, the open ATSV would allow a high-velocity airstream of about 600° F to flow into the engine nacelle area. Once the turbine bearing has failed, the exhaust airstream could momentarily reach temperatures of about 2,000° F if the oil from the ATS gearbox is ignited. Additionally, small particles of incandescent metal, which would be more than 2,000° F, would be generated and ejected from the exhaust duct when the turbine contacts the shroud.

Therefore, the NTSB concludes that the open ATSV and resulting failed ATS allowed a hotter than typical airstream and/or incandescent particles to flow into the engine nacelle area and likely provided the ignition source for the in-flight fire.

2.3.2.2 Combustible Fluid Source

As noted, the freewheeling ATS allowed hot engine bleed air to flow into the engine area for more than 2 minutes. This hot air flow could serve as an ignition source in the presence of an exposed, combustible fluid; however, this event does not sufficiently explain why a fire started in the nacelle cavity. Components and equipment located in the area exposed to the hot exhaust of an open ATSV are required to be fire resistant and, therefore, capable of withstanding the temperatures present during an ATSV-open event and of preventing combustible fluid sources in the engine from being readily available to the ignition source. Accordingly, an open ATSV condition, even during high-power phases of flight, should not degrade and compromise fluid lines, fittings, or components containing combustible fluids located in this area of the engine nacelle. Historically, prolonged ATS freewheeling and contained ATS failures have been rare and, when they have occurred, they have typically caused only minor heat damage to parts in the area adjacent to the ATS exhaust duct.

Investigators considered several possible sources for the combustible fluid including: a preexisting latent failure condition of a nacelle component; the degradation of an engine component; a small hole in the fuel or hydraulic lines; a hydraulic fluid leak; and a stainless steel fuel fitting exposed to hot exhaust from the ATS. Details of the examination of each of these sources can be found in appendix C. However, none of these were proved conclusively to be a source of the combustible fluid.

The NTSB concludes that a combustible fluid, such as oil, hydraulic fluid, or fuel, was available in the engine; however, fire damage precluded the determination of the specific source of the combustible fluid.

2.4 Flight Crew Performance

As noted, during the flight, the pilots encountered an uncommanded opening of the ATSV followed by indications of an engine fire. During the brief flight, the pilots also encountered several other abnormal events, including electrical and hydraulic system anomalies and the nose landing gear's failure to extend. The investigation revealed that the flight crew did not perform several of the appropriate checklists and interrupted an emergency fire-related checklist. This section discusses in detail the pilots' responses to these anomalies and the possible reasons for them.

According to CVR evidence, about 74 seconds after the takeoff roll began and while the airplane was climbing through about 1,500 feet mean sea level, the first officer detected the illumination of the ATSV-Open light for the left engine. About 1 minute later (1313:55), the Left Engine Fire aural warning sounded, and the Left Engine Fire warning light illuminated. A review of the CVR transcript revealed no evidence that the flight crew performed any of the L or R Start Valve Open checklist items during the 53-second period from the detection of the ATSV-Open light to the onset of the Left Engine Fire warning.[59]

This section details the pilots' actions in response to both abnormal and emergency alerts and some of the possible reasons for and the effects of these actions on the events that occurred both in flight and after landing. Section 2.5 considers additional human factor issues that were identified during the investigation.

2.4.1 Detection of and Response to the Left Engine ATSV-Open Light

The proper operation of the ATSV-Open light system could not be completely verified during postaccident inspections because the wiring harness within the nacelle sustained too much fire damage to confirm electrical signal continuity. The time that the ATSV-Open light illuminated could not be determined through aircraft inspection or CVR or FDR information.

During the Before Takeoff checklist, the pilots checked the status of the annunciator panel, and they made no comments about the illumination of the ATSV-Open light at that time.

[59] In postlanding statements recorded by the CVR and during postaccident interviews, the pilots indicated that they thought that only a few seconds elapsed between the illumination of the ATSV-Open light and the Engine Fire warning.

No direct evidence exists to determine exactly when the light illuminated during the 74-second period between the application of takeoff power and the first officer's detection of the ATSV-Open light at 1313:02. Therefore, the NTSB evaluated the pilots' likely allocation of attention during discrete events in this period to determine when the ATSV-Open light might have illuminated. For example, at 1311:48, the captain called for the autothrottles to be engaged. To engage the autothrottle, the first officer would have reached toward the digital flight guidance system (DFGS), which is located centrally below the annunciator panel, providing him an opportunity to detect the light. As the takeoff roll continued, the captain's visual attention would have been directed primarily toward the flight instruments and the runway environment, and the first officer would have been monitoring vertical speed, raising the gear, and making radio communications; therefore, they likely would not have noticed illumination of the ATSV-Open light during this period.

At 1312:34, the captain called, "heading select," which would have again required the first officer to interact with the DFGS. From about 1312:37 to 1312:59, the first officer was engaged in normal ATC communications. At 1313:02, 2 seconds after resetting the altitude in the DFGS, the first officer detected the annunciator. Although the first officer had two opportunities to look at the DFGS after applying power to the left engine, he did not comment on the ATSV-Open light; therefore, it is unlikely that the light was illuminated at these times. Although it is possible that the illumination of the light coincided with its detection, it is also possible that the light illuminated at some time between 1312:34 and 1313:02 and was not detected.

The ATSV-Open light is static in appearance and illuminates as amber words against a black background on a large annunciator panel. These characteristics can make it hard to detect the light during daytime conditions. Although the light remains illuminated after onset, a pilot must notice its appearance. Further, because the light does not flash, its initial illumination is the only means to capture a pilot's attention, and research has shown that the reliable and timely detection of abrupt onset events in the periphery is difficult because it depends on factors difficult to control, such as where a pilot's visual attention is focused.[60] In addition, competing visual demands, especially during high-workload phases of flight, can prevent a pilot from actively scanning the annunciator panel. As a result, a light can go undetected for a varying amount of time.[61]

Regardless, once the light was detected, the pilots did not initiate the L or R Start Valve Open checklist. As PIC, the captain had the primary responsibility to address the abnormal condition and call for the associated checklist in a timely manner, and the first officer shared this responsibility. However, at the time of the accident, American Airlines guidance and training indicated that an open ATSV was an abnormal event that did not require immediate action. Further, when the first officer noticed the light, the pilots were involved in ATC communications

[60] R.A. Rensink, J.K. O'Regan, and J.J. Clark, "To See or Not to See: The Need for Attention to Perceive Changes in Scenes," *Psychological Science*, Vol. 8 (1997), pp. 368-373.

[61] In postaccident interviews, the American Airlines MD-80 Fleet Training Manager stated that the ATSV-Open light could be hard to see and that he had observed pilots miss the presence of the annunciator in the simulator.

and configuration changes during a high-workload period. In addition, time is needed to assess a situation when an abnormal light illuminates.

The NTSB concludes that the pilots might not have immediately detected the ATSV-Open light illumination because of its location, static appearance, and color and that, once they detected the light, the pilots did not immediately respond to it because an open ATSV was considered an abnormal situation that did not require immediate action and they were involved in ATC communications and airplane configuration changes.

In August 2008, American Airlines initiated action to modify its MD-80 airplanes so that the onset of the ATSV-Open light would trigger the Master Caution light,[62] which is located near the pilots' normal field of vision and, therefore, provides a more robust signal to quickly alert the pilots that a problem exists. A caution light would capture the pilots' attention and lead the pilots to scan the annunciator panel to determine the specific problem, something they would otherwise be less likely to do during a high-workload period. However, the NTSB recognizes that unintended consequences, such as high-speed rejected takeoffs, could result from coupling the ATSV-Open light to the Master Caution system because, if the light came on late in the takeoff, it might give the pilots only seconds to determine if an aborted takeoff should occur and might lead them to abort unnecessarily. According to American Airlines, this risk would be mitigated by training its pilots to reject a takeoff only if the annunciator illuminates before the takeoff decision speed (V_1) is reached and, for later onsets, to initiate corrective action only after an operationally safe altitude is reached, which for this accident was about 1,200 feet (about 580 feet agl). (The first officer detected the ATSV-Open light when the airplane was at an altitude of about 1,500 feet, or about 880 feet agl.) Although these efforts would appear to provide American Airlines' pilots with a more reliable way to rapidly detect the onset of the ATSV-Open light, there is not sufficient evidence to determine that the rest of the MD-80 fleet should be modified. For example, an open ATSV does not necessarily result in an engine fire. Because of this, Boeing considers the current alerting method for an open-ATSV condition to be adequate.

The NTSB concludes that coupling the ATSV-Open light with the Master Caution system might increase pilots' ability to detect the presence of an abnormal ATSV condition; however, unintended consequences, such as aborted takeoffs, may occur and, therefore, more study is needed to determine whether the FAA should mandate the modification of the ATSV-Open light in the MD-80 fleet. Therefore, the NTSB recommends that the FAA evaluate the history of uncommanded ATSV-open events in the MD-80 fleet and the effectiveness of coupling the ATSV-Open light to the Master Caution system to determine whether all MD-80 airplanes need to be modified to couple the ATSV-Open light to the Master Caution system. Once the evaluation is completed, the FAA should require any necessary modifications.

[62] Other lights, including the hydraulic temperature high or the hydraulic pressure low lights, are also coupled to the Master Caution system.

2.4.2 Response to Left Engine Fire Warning and Subsequent Events

About 1313:55, about 1 minute after the first officer detected the ATSV-Open light, the Engine Fire aural warning sounded, and the Left Engine Fire warning light illuminated. After the Left Engine Fire warnings activated, the first officer contacted ATC to report the emergency and the flight's immediate return to STL. When the first officer asked the captain about task allocation, the captain told him to "run the checklist" and stated that he, the captain, would fly the airplane. The captain did not indicate who should handle radio communications, even though, as PIC, it was his responsibility to allocate tasks. About 3 seconds later, before starting the checklist, the first officer engaged in communications with ATC. During emergency conditions, task allocation should change to better manage workload and effectively resolve problems. The American Airlines AOM stated that, during an emergency, the captain should designate a flying pilot, who should not perform other duties that could detract from airplane control. However, the guidance did not explicitly address whether the flying pilot or the pilot monitoring should be responsible for radio communications during emergency situations. This ambiguity might have contributed to the misallocation of tasks during the accident flight, specifically, the first officer's handling of radio communications while conducting the checklist.

About 1314:50 (about 54 seconds after the fire warning sounded), the CVR recorded the first officer calling out, "autothrottle off," which is the first item on the Engine Fire/Damage/Separation checklist. The first officer then called for the left engine throttle to be placed in the idle position, which is the second item on the checklist. Shortly after the captain moved the throttle, ATC contacted the flight crew, and the first officer interrupted performance of the checklist for about the next 38 seconds to respond to several ATC queries. Subsequently, without asking the first officer the status of the Engine Fire/Damage/Separation checklist, the captain transferred control of the airplane to the first officer because he wanted to brief the flight attendants, even though according to the checklist, this task was to be completed after all critical items, including shutting off the fuel supply to the engine and stabilizing any possible in-flight fire, had been accomplished.

The sustained interruption of the checklist occasioned by the ATC communications provided an opportunity for the captain to proceed to a noncritical task and for both pilots to fail to recognize that the critical items on the checklist had not been completed. Research has shown that interruptions can distract pilots and impede their completion of tasks because it becomes more difficult for them to maintain an awareness of what steps remain to be performed.[63] The NTSB notes that the circumstances did not warrant further interrupting the checklist to brief the flight attendants because the event occurred during the initial climb, which meant that the cabin was in its takeoff configuration with passengers and flight attendants in their seats and carry-on baggage and carts stowed. As a result, the time needed to prepare for an evacuation would have been minimal.

[63] K. Dismukes, "Concurrent Task Management and Prospective Memory: Pilot Error as a Model for the Vulnerability of Expert," *Proceedings of the Human Factors and Ergonomics Society 50th Annual Meeting* (2006) pp. 901-913.

After the captain briefed the flight attendants, the pilots made remarks about the valve indications, and the first officer continued to handle communications with ATC. CVR evidence clearly shows that handling the radio communications affected the first officer's ability to complete the Engine Fire/Damage/Separation checklist. The first officer could have taken steps to ameliorate the situation. For example, he could have told ATC to stand by so that he could complete the critical items on the checklist, or he could have handed off communications to the captain. However, as PIC, the captain should have recognized that handling the radio communications was making it difficult for the first officer to run the checklist and that he, the captain, could handle ATC communications without interfering with airplane control.[64]

More than 2 minutes after the captain interrupted the Engine Fire/Damage/Separation checklist, the CVR recorded the first officer resuming its performance as the captain took back control of the airplane. Before the third item could be acknowledged by the captain, the aural fire warning again activated about 1317:02. About 1317:16, as a result of the electrical anomalies caused by the fire, the captain detected a reverser-unlocked annunciator, the cockpit door opened, and the power transfer occurred, all of which distracted the pilots from the checklist.

The increased time allocated to running the Engine Fire/Damage/Separation checklist as a result of interruptions also increased the pilots' workload as the situation deteriorated. During the final interruption, electrical problems resulting from the engine fire caused some instrumentation loss, the illumination of multiple annunicators, and the aforementioned malfunctioning of the cockpit door, all of which increased the pilots' workload. Coping with partial instrumentation increased the captain's flying workload, and the multiple annunciators[65] increased both pilots' troubleshooting workload by creating confusion about the actual state of the airplane and forcing the pilots to constantly reassess the situation. Responding to the malfunctioning cockpit door also increased the pilots' workload and distracted them during their efforts to configure the airplane for landing.[66]

As noted, the workload associated with ATC communications was also relatively high during this portion of the flight. After the accident, the captain described the workload during the event "[as] busy as he could handle at the time." The first officer stated that it was an "extremely compressed period of time and they had a lot to do." The pilots could have used various methods to manage the increasing workload but primarily used task shedding. For example, as noted previously, the pilots did not complete several checklists, most likely because they were focused on flying the airplane and communicating with ATC and because of the workload and stress associated with addressing the emergency situation. However, the NTSB notes that, after the go-

[64] During normal operations, pilots have been observed trading assigned duties, such as radio communications, to prevent the pilot not flying from being interrupted during high-priority tasks and to manage workload. For example, see the 2001 report by D.L. Damos and B.G. Tabchnick, "Cockpit Task Prioritization: Jump Seat Observations," published by Damos Research Associates, Los Angeles.

[65] The captain estimated that two-thirds of the annunciators were illuminated and, therefore, he considered the information useless. The off-duty pilot also stated that most of the annunciator lights were on when he entered the cockpit. Postaccident evaluations using an American Airlines' simulator suggested that about one-third of the annunciators were illuminated.

[66] Although the open cockpit door should have been a low priority task, since September 11, 2001, pilots have been acutely aware of the importance of securing the cockpit, and this likely influenced the pilots' behavior.

around, the captain did request that the off-duty pilot come to the cockpit, which was a good decision because it reduced the captain's and copilot's workload. The off-duty pilot helped with flight attendant and passenger communications and troubleshooting the nose landing gear situation. After the accident, the captain stated that he felt that they had completed the items needed to safely land the airplane.

The NTSB concludes that the pilots failed to properly allocate tasks, including checklist execution and radio communications, and they did not effectively manage their workload; this adversely affected their ability to conduct essential cockpit tasks, such as completing appropriate checklists. The NTSB further concludes that no preexisting indicators in the pilots' training or performance histories were found that could explain their poor performance during the accident flight. The NTSB recommends that the FAA require POIs to review their operators' pilot guidance and training on task allocation and workload management during emergency situations to verify that they state that, to the extent practicable, the pilot running the checklists should not engage in nonessential operational tasks, such as radio communications.

About 1317:26, the CVR recorded the first officer stating, "I can't even shut it off," referring to the difficulty he was experiencing moving the fuel lever to the OFF position, which was the third item on the checklist. About 1317:36, the first officer read the next item on the checklist, which directed the nonflying pilot to pull the engine fire handle on the captain's command. The CVR did not record the captain confirming that the first officer had pulled the fire handle; however, about 1317:52, the first officer advised the captain that both fire agents had been discharged, which is the next item on the checklist and could only have been accomplished if the fire handle had been pulled. Even though the checklist had not been completed, the first officer then announced that he was going to set the landing speed settings. CVR evidence indicated that the first officer was subsequently distracted as he tried several times to shut the cockpit door, which kept opening as a result of electrical problems, and responded to several ATC transmissions.

The NTSB is concerned about how the pilots managed and prioritized tasks during this phase of the flight and is especially concerned about the flight crew's interruption of the emergency Engine Fire/Damage/Separation checklist. During the 2 minutes that elapsed from the time that the first officer initially started the checklist to the time he resumed it, the first officer engaged in radio communications for about 63 seconds, and the captain engaged in the flight attendant briefing for about 31 seconds. About 80 percent of the pilots' delay in performing the third item on the checklist, which would have shut down the fuel supply to the engine and alleviated the fire, was caused by their performance of tasks unrelated to shutting off fuel to the engine and stabilizing the fire. To minimize the severity of the fire, the pilots should have continued conducting, without interruption, the Engine Fire/Damage/Separation checklist up to, at a minimum, completing the following critical items: shutting off the fuel to the affected engine, pulling the associated engine fire handle, and discharging the fire agent. By delaying the performance of these critical items, the pilots exposed the passengers, cabin crew, and airplane to unnecessary risks. American Airlines stated that its pilots were trained in the simulator to complete the checklist to at least the point where fire agent was discharged before deviating from the checklist. Pilots are expected to know the possible consequences of interrupting or deviating from an emergency or abnormal checklist, especially if a fire is involved. Further, the CVR did not record the pilots completing the Engine/Fire/Damage/Separation checklist. Specifically, they did not start the APU, turn the fuel crossfeed on, or set the hydraulic system.

About 1319:59, the flight crew attempted to extend the landing gear; however, the gear indicator lights did not provide valid information about gear status. Neither pilot detected the absence of the normal increase in cockpit noise associated with the extension of the nose landing gear[67] or the loss of hydraulic pressure on the right side, which they might have detected if they had taken time to distribute their tasks and to become more deliberate and focused. Noticing these conditions might have helped them to detect the nose landing gear problem earlier. However, the NTSB recognizes that the detection of this anomaly would have been more difficult because of the errant cockpit indications caused by the fire-induced electrical problems.

As events continued, rushing through and skipping tasks continued to cause problems for the pilots. The first officer asked ATC to verify whether the landing gear had extended. ATC responded that the main gear appeared to be down but that the nose gear did not appear to be down. If the pilots had continued performing the Engine Fire/Damage/Separation checklist, they would have reached the item to set the hydraulic systems, which would have provided them with an opportunity to notice the hydraulic anomalies that were being caused by the engine fire. If the pilots had detected the hydraulic anomalies, the pilots should have completed the checklist and then initiated the Left or Right Hydraulic Pressure Low or Hydraulic Quantity Low or Decreasing checklist. The first step on both checklists was to turn off the hydraulic transfer pump switch, which would have allowed the right hydraulic system to pressurize and enabled the nose gear to fully extend. The CVR did not record the flight crew performing either checklist during the flight. According to American Airlines, pilots were trained to check hydraulic pressure and quantity indications before responding to the hydraulic system-related item on the Engine Fire/Damage/Separation checklist.

The NTSB concludes that the pilots' interruption of the emergency Engine Fire/Damage/Separation checklist at a critical point prolonged the fire and led to additional problems, including the loss of hydraulic pressure, which caused the nose landing gear to fail to extend.

2.4.3 Decision to Go Around

After ATC verified that the nose landing gear had not extended, the captain decided to execute a go-around. During postaccident interviews, the captain stated that, by the time he was aware that the nose landing gear had not extended, the airplane was too low and close to the airport to manually extend the nose landing gear and that, even though fire indications were still alerting in the cockpit, he no longer trusted the annunciators because of the airplane's electrical anomalies. The captain also stated that he did not want to attempt a landing without the nose gear

[67] As demonstrated in other DC-9 airplane wheels-up landing accidents, pilots can fail to detect the absence of increased cockpit noise in high-workload conditions. For example, see National Transportation Safety Board, *Wheels-Up Landing, Continental Airlines Flight 1943, Douglas DC-9, N10556, Houston, Texas, February 19, 1996,* Aircraft Accident Report NTSB/AAR-97/01 (Washington, DC: NTSB, 2007).

extended without briefing the flight attendants and passengers and that he felt that it was safer to execute a go-around, extend the gear, and then land the airplane.

The NTSB concludes that, given the airplane's altitude and the lack of time to prepare for a nose landing gear up landing, the captain's decision to go around was a reasonable choice.

The CVR did not record the pilots performing any of the items on the One Engine Landing Go-Around checklist as required by American Airlines procedures and training. Further, FDR data did not indicate that any of these actions were taken. However, the NTSB recognizes that multiple failures were occurring, which imposed a strain on the pilots' performance.

2.4.4 Decision to Not Evacuate

During the flight, the captain briefed the flight attendants that they would not evacuate passengers from the airplane after landing unless it became necessary. After landing, ATC informed the pilots that ARFF trucks were approaching the airplane and asked them if they needed anything. The first officer responded that the left engine needed to be checked because a fire indication was still illuminated. Shortly thereafter, ARFF personnel indicated that there was still "a little bit of fire" in the left engine. ATC then informed the pilots that ARFF personnel were applying fire-extinguishing agent to the engine, which the captain confirmed about 30 seconds later by talking to ARFF personnel through the cockpit window. The captain did not call for an evacuation.

There was no fire in the cabin, the hull was not breeched, and the circumstances did not meet American Airlines' criteria for an immediate evacuation. Further, neither the flight attendants nor ARFF personnel recommended an emergency evacuation to the captain, which they are allowed to do if they deem it necessary. In addition, ARFF personnel's response was timely and sizable, they described the fire as "small," and they were making efforts to extinguish the residual left engine fire. All of these factors likely reinforced the captain's decision to not conduct an evacuation. During postaccident interviews, the captain stated that ARFF personnel gave him the sense that they had the situation under control. Further, both pilots stated that, because ARFF personnel were actively applying fire-extinguishing agent to the residual fire, they concluded that it was safer for the passengers to remain on the airplane. About 1337, ARFF personnel reported that the fire was extinguished.

The NTSB concludes that the captain's decision not to conduct an emergency evacuation after the airplane landed was in accordance with company guidance and was appropriate because the fire was not severe and ARFF personnel were actively responding to the residual fire.

2.4.5 Retraction of the Fire Handle

While waiting for the tug to tow the airplane to the terminal, the first officer opened the left pneumatic crossfeed valve to provide air to the cabin. Shortly thereafter, ARFF personnel informed the pilots that fuel had spilled out of the engine area onto the ground, and the first officer pulled the left engine shutoff valve. Subsequently, the IC recommended to the captain that the passengers be deplaned as a safety precaution, and the captain complied. All of the passengers deplaned without injuries.

The NTSB concludes that the IC's decision to deplane the passengers after fuel spilled out of the engine area was prudent.

According to the Boeing MD-80 FCOM, opening the pneumatic crossfeed valve on the MD-82 airplane causes the associated engine fire handle to retract. In this case, opening the pneumatic crossfeed valve caused the left engine fire handle to retract and fuel to be reintroduced to the left engine area. Although the American Airlines AOM indicated that the fire handle was mechanically linked to the pneumatic crossfeed lever and pilots are told during training that pulling the fire handle will mechanically shut off the pneumatic crossfeed valve, American Airlines' manuals and training did not indicate that opening the crossfeed valve causes the fire handle to retract, reversing the shutoff of fuel.

The NTSB concludes that the first officer did not have a clear understanding of the relationship between the pneumatic crossfeed handle and the engine fire handle, most likely because of inadequate company guidance and training on the issue; this resulted in the first officer inadvertently reintroducing fuel to the left engine, creating potential unnecessary risk of fire. As a result of this accident, the FAA issued SAFO 08018, which explained the fire handle characteristics of DC-9, MD-80, and MD-90 series airplanes and the relationship of the engine fire handle and the pneumatic crossfeed valve. The SAFO recommended that operators review their training and operating manuals to ensure that the design and interrelationship of the systems affected by the fire handle are adequately explained. It further recommended that they add a caution to their checklists stating that opening the crossfeed handle will retract the fire handle and potentially reintroduce fuel to a fire. The NTSB commends the FAA for issuing SAFO 08018; however, the actions recommended in a SAFO are not mandatory, and more permanent action is warranted to prevent the recurrence of a potential unnecessary risk of fire. Therefore, the NTSB recommends that the FAA require MD-80 series airplane operators to incorporate information about the relationship between the pneumatic crossfeed valve and the engine fire handle into their training programs and written guidance.

2.5 Additional Human Factors-Related Issues

2.5.1 Multiple Abnormal and Emergency Situations Training

The pilots might not have been faced with multiple problems if they had completed the emergency fire-related checklist, adequately allocated tasks, such as radio communications, and managed their workload. If the pilots had completed the emergency fire-related checklist in a timely manner, they could have precluded the electrical anomalies, including the problems with the cockpit door opening, and the hydraulic problems, including the failure of the nose landing gear to extend.

The pilots ultimately had to manage and prioritize cascading failures after interrupting the Left Engine Fire checklist, increasing their workload to beyond what would normally be required to manage a single-system problem. American Airlines training was conducted under an AQP that did not include multiple emergencies training; however, it did incorporate training on an emergency event that produced associated abnormal conditions. After the accident, the company began working on a formal proposal to the FAA to add multiple emergencies to its training program.

Research demonstrates that emergency situations increase workload and require additional effort to manage effectively because of the stress involved and the lack of opportunity for pilots to practice these skills compared to those used in normal operations.[68] NASA's EAS study report noted that, during high-workload conditions, performance deficiencies, including narrowing of attention and impairment of short-term memory, could result from inherent limitations in cognitive processes and the effect of stress on human performance. The EAS study report further noted that pilots may jump to the wrong item or checklist when dealing with the many distractions, interruptions, and competing demands for attention that typically occur during emergency or abnormal situations and that realistic interruptions and distractions needed to be incorporated into training.

Industry has not universally accepted the need for multiple emergencies training. Boeing and the FAA have both indicated that such training could be "negative" because it might overload a student. They further argue that training to student failure or saturation should be avoided, especially if the multiple system failures faced by the student seem artificial. However, the NTSB notes that, if the system failures are layered in such a way that they would be linked normally to inaction or collateral damage, such training may not be problematic. Additionally, using LOEs derived from actual events involving multiple emergencies may not be negative training.

The NTSB acknowledges the concerns raised by Boeing and the FAA and recognizes that operators have a limited amount of time to allocate to this type of training. However, the initial

[68] R.K. Dismukes, G.E. Young, and R.L. Sumwalt, "Cockpit Interruptions and Distractions: Effective Management Requires a Careful Balancing Act," *ASRS Directline*, Vol. 10 (1998) pp 4-9.

efforts of the EAS study, the circumstances of this accident, and other accidents and incidents suggest that pilots could benefit from the chance to develop the skills and decision-making abilities needed during multiple systems failures, competing task demands, and increased workloads and from knowing the possible consequences of interrupting or deviating from an emergency checklist and not taking timely corrective action during single or multiple emergency situations.

The NTSB concludes that improved pilot training methods for responding to multiple systems failures, competing task demands, and increased workload would help pilots develop the skills and decision-making abilities needed during both single and multiple abnormal and emergency situations. Therefore, the NTSB recommends that the FAA establish best practices for conducting both single and multiple emergency and abnormal situations training. The NTSB further recommends that, once the best practices for both single and multiple emergency and abnormal situations training asked for in Safety Recommendation A-09-24 have been established, the FAA require that these best practices be incorporated into all operators' approved training programs.

2.5.2 Nonpertinent Discussion and Cockpit Tone

CVR transcripts show that the pilots engaged in several nonpertinent discussions during taxi and after landing, indicating that a casual atmosphere existed in the cockpit. At 1307:48, after receiving clearance to taxi, the captain stated to the first officer, "when you're ready…checklist." Although he did not call for the checklist by name (that is, he used nonstandard phraseology), the captain's statement implied that he wanted the first officer to begin the Before Takeoff checklist. The first officer did not reply to the captain's statement. At 1307:59, the first officer made a nonpertinent remark. The captain did not challenge the nonpertinent conversation, rather he and the first officer continued the nonpertinent discussion until 1308:14. About 20 seconds later, the first officer began the Before Takeoff checklist.

The pilots interrupted running the Before Takeoff checklist for about 38 seconds to engage in another nonpertinent conversation. Again, the captain engaged in and did not challenge the nonpertinent discussion. At 1311:01, the first officer contacted ATC without instruction from the captain while the airplane was still taxiing and before he had completed the Before Takeoff checklist, suggesting self-induced pressure or rushing on behalf of the pilots. Although calling ATC to announce that the airplane is ready for takeoff before arriving at the hold short line is not unusual, it is not good practice to do so before the Before Takeoff checklist items have been completed. The first officer resumed the Before Takeoff checklist at 1311:20 and completed it about 12 seconds later.

The NTSB is concerned that the pilots engaged in nonpertinent conversations during airport surface navigation, which was not consistent with company guidance or Federal regulations that require a sterile cockpit during critical phases of flight to prevent redirection or degradation of pilot attention. The reasons why both pilots failed to ensure that standards were maintained and that procedures were properly performed cannot be determined definitely. It is possible that the captain did not demand adherence to the procedures because he had less experience in the MD-80 than the first officer did (850 hours versus 3,000 hours, respectively) and because he was having difficulty transitioning back to being PIC, a role that he had resumed only 5 months and 100 flight hours before the accident after about 3 years as a first officer on the 777. Although the accident first officer should have known not to engage in nonpertinent conversation, the captain had the ultimate responsibility to challenge or correct the first officer, demand a more professional tone in the cockpit, and stop the nonpertinent conversation during the accident flight.

CVR evidence also indicates that, after landing, the pilots' attention was directed away from a situation involving active ARFF fire suppression activities and, therefore, their actions were not in accordance with the degree of professionalism and focus demanded. For example, while the pilots were attempting to establish communications with ARFF personnel, the off-duty company pilot made a nonpertinent comment and the pilots laughed in response. They were interrupted by ARFF personnel stating on the radio that there was still residual fire in the left engine. The flight crew then resumed operationally relevant discussion for about 1 minute 41 seconds. Then, for about the next 1 minute 22 seconds, the pilots discussed the in-flight events, which were not relevant to ARFF activities.

Although the situation on the ground did not deteriorate, the NTSB is concerned that the pilots allowed their attention to be diverted away from monitoring ARFF's progress during an unresolved situation. The presence of ARFF personnel might have played a role in the pilots' belief that it was an appropriate time to discuss the flight and decompress after the stressful emergency situation. However, as PIC and per company procedures, the captain was responsible for the passenger and crew safety until they disembarked from the airplane. The pilots should have been remaining vigilant to situational changes and soliciting all relevant and available information until they were notified that the fire had been extinguished. Although the sterile cockpit rule does not technically apply to postlanding events, because of the uncertainty of the situation in this case, the NTSB considers the postlanding events before the fire was extinguished to be a critical phase of this flight.

The NTSB has addressed issues related to nonpertinent conversation and cockpit discipline during several previous accident investigations. For example, in its report on the August 26, 2007, accident in which Comair flight 5191 crashed during takeoff,[69] the NTSB concluded that the "flight crew's noncompliance with standard operating procedures…most likely created an atmosphere in the cockpit that enabled the crew's errors." In addition, the NTSB determined that a contributing factor to the accident was the flight crew's nonpertinent conversation during the taxi, which resulted in a loss of positional awareness. The report also discussed previous accidents in which cockpit discipline was reduced and attention to task-related activities was diverted. The report also cited industry data showing that pilots who intentionally deviated from standard operating procedures were three times more likely to

[69] National Transportation Safety Board, *Attempted Takeoff From Wrong Runway, Comair Flight 5191, Bombardier CL-600-2B19, N431CA, Lexington, Kentucky, August 27, 2006,* Aircraft Accident Report NTSB/AAR-07/05 (Washington, DC: NTSB, 2007).

commit other types of errors, mismanage errors, and find themselves in undesired situations compared with pilots who did not intentionally deviate from procedures.[70]

In addition, the NTSB has previously issued safety recommendations regarding cockpit discipline and sterile cockpit adherence. On February 7, 2006, as a result of the Corporate Airlines flight 5966 accident, the NTSB issued Safety Recommendation A-06-7, which asked the FAA to direct the POIs of all 14 CFR Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule. On April 28, 2006, the FAA issued SAFO 06004 to emphasize the importance of sterile cockpit discipline. As a result, the NTSB classified Safety Recommendation A-06-7 "Closed—Acceptable Action." On January 23, 2007, as a result of its investigation of the Pinnacle Airlines flight 3701 accident, the NTSB issued Safety Recommendation A-07-9, which asked the FAA to require all 14 CFR Part 121 operators to incorporate into their oversight programs periodic LOSA observations and methods to address and correct findings resulting from these observations. On January 22, 2008, the NTSB classified Safety Recommendation A-07-9 "Open—Acceptable Response" pending the implementation of a LOSA program.

The NTSB concludes that the casual atmosphere in the cockpit before takeoff affected and set a precedent for the pilots' responses to the situations in flight and after landing, eroded the margins of safety provided by the SOPs and checklists, and increased the risk to passengers and crew.

2.5.3 Emergency Evacuation Preparedness

After landing, the airplane was not configured to facilitate an evacuation. If evacuation had become necessary, the aft galley and tailcone exits would not have been usable because of the engine fire, and, at different times during the event, the L1 evacuation slide was not available because the airstairs were either parked in front of the door or the slide was disarmed. To maintain readiness during unusual events that do not require an immediate evacuation, pilots and flight attendants should continually assess the situation for changes by actively exchanging information about conditions inside and outside of the airplane. For example, pilots should solicit information from available resources, including flight attendants and ATC, and ARFF personnel, and flight attendants should determine the usability of emergency exits and provide this information to the flight crew. Exchanging this type of information can help a crew maintain readiness to evacuate if necessary.

After the accident, American Airlines revised its procedures to ensure that, when an airplane is stopped away from the gate after a significant in-flight event, pilots establish a configuration and mindset that would allow them to rapidly perform an evacuation and to maintain those conditions until the situation has been resolved. Pilots are instructed to configure

[70] The data came from the LOSA Collaborative, which is a network of researchers, safety professionals, pilots, and airline representatives collaborating to provide, among other things, oversight and implementation of LOSA and a forum of information exchange regarding LOSA.

the airplane up to the point of commanding an evacuation. The NTSB commends American Airlines' change of its operational procedures to address this safety issue.

The NTSB concludes operational procedures requiring that an airplane be configured for an evacuation when it is stopped away from the gate after a significant event would help expedite an emergency evacuation if one became necessary. Therefore, the NTSB recommends that the FAA require that operators provide pilots with guidance requiring that pilots and flight attendants actively monitor exit availability and configure the airplane and cabin for an evacuation when the airplane is stopped away from the gate after a significant event to help expedite an emergency evacuation if one becomes necessary.

2.5.4 Flight and Cabin Crew Communication Issues

CVR evidence and postaccident statements indicate that the flight attendants did not detect smoke or fumes in flight. However, during the flight, the two flight attendants seated in the aft cabin did discuss hearing some popping noises that they thought could be associated with the left engine, but they did not convey this information to the cockpit or the lead flight attendant. At the time that the noises were heard, the pilots were shutting down the left engine and using the fire-extinguishing agent, and, therefore, it is unlikely that this information would have changed the outcome because the information was consistent with the known situation. Regardless, the NTSB is concerned that the information was not conveyed to the cockpit, as required by proper CRM procedures and company guidance that all crewmembers provide pertinent information to the captain to help in decision-making.

Further, after landing, the pilots did not actively seek information from the flight attendants because they believed that the flight attendants would pass any significant information to them.[71] However, long after the fuel spill, during the debriefing on the ground, a flight attendant stated that she had smelled fuel earlier, but she did not pass this information to the cockpit when it happened, which was, again, inconsistent with the pilots' expectations and with company guidance and proper CRM.

The NTSB has had longstanding concerns about the need for effective communications between pilots and flight attendants and has issued numerous safety recommendations and reports on this subject.[72] For example, the NTSB's report on the December 20, 1995, Tower Air accident at JFK International Airport in which the airplane departed the runway during an attempted takeoff highlighted communication problems between the cockpit and cabin.[73] The report noted that the flight attendants did not relay to the cockpit pertinent information, including

[71] The captain stated during postaccident interviews that, if there had been smoke or fumes in the cabin during or after the flight, he knew that the flight attendants would not have hesitated to tell him.

[72] For more information about these recommendations, see NTSB/SS-00/01.

[73] National Transportation Safety Board, *Runway Departure During Attempted Takeoff, Tower Airlines Flight 41, Boeing 747-136, N605FF, JFK International Airport, New York, December 20, 1995,* Aircraft Accident Report NTSB/AAR-96-04 (Washington, DC: NTSB, 1996).

that an engine had separated, significant floor intrusion had occurred above the nose gear, a flight attendant had been seriously injured, and the PA system in the aft cabin had failed.

The issue of communication has also been examined by the research community[74] and by industry training. However, this accident shows that this issue needs to be addressed further. AC 120-48, "Communication and Coordination Between Flight Crewmembers and Flight Attendants," which provides guidance on how to handle and avoid common problems that occur in coordination among flight crewmembers and flight attendants, is the most recent AC focused on best practices for cockpit and cabin communications during normal and emergency situations; yet, it was issued more than 20 years ago and has not been updated; therefore, it does not reflect current industry knowledge based on research and lessons learned from relevant accidents and incidents.[75] The AC also does not address the communication and coordination issues associated with the environment of increased security in which flight crews now work as a result of the events on September 11, 2001.

The NTSB concludes that, during the emergency situation, the flight attendants did not relay potentially pertinent information to the captain in accordance with company guidance and training. The NTSB recommends that the FAA revise AC 120-48 to update guidance and training provided to flight and cabin crews regarding communications during emergency and unusual situations to reflect current industry knowledge based on research and lessons learned from relevant accidents and incidents over the last 20 years.

2.6 Additional Maintenance Issues

2.6.1 Air Turbine Starter Valve-Air Filters

As a result of this investigation and a subsequent uncommanded ATSV-open event in Salt Lake City, Utah, American Airlines sent seven serviceable[76] ATSV-air filters to the NTSB for evaluation. Three of the seven ATSV-air filters revealed evidence of the onset of fatigue in the filter elements' outer mesh. In addition, American Airlines sent 15 serviceable ATSV-air filters to PTI for bubble testing and visual inspections, which were performed in accordance with the PTI CMM. The testing and inspections revealed that five of the filters had damaged mesh and required replacement. The NTSB also determined that the early-stage fatigue fractures within the outer mesh were too small to be seen by the naked eye or when using the 5- to 7-power magnification recommended in the PTI CMM. In fact, a 40-power magnification was required to identify some early-stage fatigue areas in the outer mesh. In addition, PTI found that

[74] See, for example, R.D. Chute's and E.L. Wiener's "Cockpit-Cabin Communication: Shall We Tell the Pilots?" in *The International Journal of Aviation Psychology*, Vol. 6(3) (1996) pp. 211-231.

[75] The NTSB notes that AC 120-51E, "Crew Resource Management Training," briefly addresses the importance of effective flight crew and flight attendant communications and states that "communications and coordination problems between cockpit crewmembers and flight attendants continue to challenge air carriers and the FAA." AC 120-48 is referenced in AC 120-51E as related reference material.

[76] A serviceable component is one that came from an airplane that was in operation.

the approved bubble test method did not adequately detect early-stage fatigue cracks in the filter. The NTSB notes that inspection guidelines do not require an inspection of the inner mesh; however, this is understandable given that it is hidden from view and cannot be adequately inspected for evidence of fatigue. The NTSB is concerned that ATSV-air filters cannot be adequately inspected, which may lead to future problems.

The NTSB concludes that the Boeing and PTI inspection criteria for the ATSV-air filter are inadequate to detect early-stage fatigue fractures of the outer mesh of the filter element and that, because of the ATSV-air filter design, the inner mesh of the filter element cannot be inspected for evidence of fatigue. Based on the investigation findings, American Airlines replaced the ATSV-air filters on its entire fleet of MD-82 aircraft. However, because the ATSV-air filter cannot be adequately inspected for fatigue damage, further action is warranted. Therefore, the NTSB recommends that the FAA require Boeing to establish an appropriate replacement interval for ATSV-air filters installed on all MD-80 series aircraft.

2.6.2 Continuing Analysis and Surveillance System Program Deficiencies

A number of deficiencies in the performance and effectiveness of American Airlines' maintenance program contributed to the accident. Although the American Airlines CASS program is intended to provide a structured process to identify and correct factors that could lead to an accident, the investigation revealed that the program did not prevent recurring engine no-start failures from leading to an accident.

First, American Airlines' CASS program should have ensured that the inspection and maintenance program related to the accident airplane's engine start system was effective when followed. During the 12-day period preceding the accident, however, the left engine ATSV was deferred and/or replaced a total of six times without permanently resolving the engine no-start condition on the accident airplane. Over that time, technical services personnel, who are assigned to review and act on alert items reported by line maintenance personnel, issued three ATBTs in response to the alerts, indicating that they were aware of the repeated engine start failures and subsequent ATSV changes, but these actions failed to address the overall system issue. Instead of forbidding additional ATSV replacements until maintenance personnel could adequately troubleshoot the problem, determine its cause, and correct the problem, personnel continued to allow the airplane to be dispatched with deferrals against the left engine start system. The NTSB is concerned that the company's maintenance alert system did not recognize the recurring failed engine starts, ATSV replacements, and MEL deferments as a possible serious problem that needed to be addressed systemically and that these unresolved maintenance problems were not adequately addressed through daily conference calls with maintenance and engineering staff conducted as part of American Airlines' CASS program.

In addition, a CASS program is supposed to ensure that an operator is following its inspection and maintenance manuals and procedures, but the investigation found that American Airlines maintenance personnel were not complying with a number of maintenance program requirements including the requirement to use approved manual engine-start procedures and appropriate tools, to perform ATSV-air filter cleaning procedures during C checks, and to correctly document the work accomplished on the accident airplane.

As a result, the NTSB concludes that American Airlines' maintenance personnel were using maintenance procedures that were not in accordance with written manuals and guidelines and that its CASS program did not adequately detect and correct these performance deficiencies before they contributed to an accident. Although these findings alone do not suggest that American Airlines' CASS program is wholly inadequate, the NTSB is concerned that maintenance personnel could be using other unapproved procedures and/or that other recurring problems with American Airline's airplanes could occur without detection and that this could affect safety. Therefore, the NTSB recommends that American Airlines evaluate its CASS program to determine why it failed to (1) identify deficiencies in its maintenance program associated with the MD-80 engine no-start failure and (2) discover the lack of compliance with company procedures. American Airlines should then make necessary modifications to the program to correct these shortcomings.

3. Conclusions

3.1 Findings

1. The flight crewmembers were properly certificated and qualified under Federal regulations. No evidence indicated any preexisting medical or physical condition that might have adversely affected the first officer's performance during the accident flight. Although the captain had sleep apnea, the condition was being effectively treated, and no evidence indicated that the condition affected his performance during the accident flight. There was no evidence of flight crew fatigue.

2. The accident airplane was properly certificated and was equipped and dispatched in accordance with industry practices. The weight and balance of the airplane were within prescribed limits for takeoff.

3. Air traffic control did not facilitate the use of a designated emergency radio frequency, and neither aircraft rescue and firefighting (ARFF) personnel nor the pilots requested one; no evidence indicated that this impeded ARFF efforts.

4. American Airlines' maintenance personnel did not clean the accident air turbine starter valve-air filter in accordance with its C check cleaning procedures and, therefore, missed an opportunity to identify and replace the damaged filter.

5. The filter element of the air turbine starter valve-air filter disintegrated, allowing the end cap to become free, which blocked the air flow and caused the engine no-start condition.

6. American Airlines' maintenance personnel's troubleshooting efforts for the engine no-start condition incorrectly focused on the air turbine starter valve (ATSV) and engine start system wiring because of the intermittent nature of the condition, the history of ATSV electrical circuit problems, and the lack of a history of ATSV-air filter failures for which no troubleshooting guidance existed.

7. American Airlines' maintenance personnel repeatedly used an unapproved maintenance procedure, which included using a prying device to push the air turbine starter valve manual override button, to manually start the accident engine, which resulted in bending the internal pin in the override button.

8. The internal pin in the left engine air turbine starter valve (ATSV) override button was bent, which resulted in the uncommanded opening of the ATSV during high-power engine conditions at the beginning of the takeoff roll and caused the air turbine starter to freewheel until it sustained a catastrophic internal failure.

9. The open air turbine starter valve and resulting failed air turbine starter allowed a hotter than typical airstream and/or incandescent particles to flow into the engine nacelle area and likely provided the ignition source for the in-flight fire.

10. A combustible fluid, such as oil, hydraulic fluid, or fuel, was available in the engine; however, fire damage precluded the determination of the specific source of the combustible fluid.

11. The pilots might not have immediately detected the air turbine starter valve (ATSV)-Open light illumination because of its location, static appearance, and color, and, once they detected the light, the pilots did not immediately respond to it because an open ATSV was considered an abnormal situation that did not require immediate action and they were involved in air traffic control communications and airplane configuration changes.

12. Coupling the air turbine starter valve (ATSV)-Open light with the Master Caution system might increase pilots' ability to detect the presence of an abnormal ATSV condition; however, unintended consequences, such as aborted takeoffs, may occur and more work needs to be done to determine whether the Federal Aviation Administration should mandate the modification of the ATSV-Open light in the MD-80 fleet.

13. The pilots failed to properly allocate tasks, including checklist execution and radio communications, and they did not effectively manage their workload; this adversely affected their ability to conduct essential cockpit tasks, such as completing appropriate checklists.

14. No preexisting indicators in the pilots' training or performance histories were found that could explain their poor performance during the accident flight.

15. The pilots' interruption of the emergency Engine Fire/Damage/Separation checklist at a critical point prolonged the fire and led to additional problems, including the loss of hydraulic pressure, which caused the nose landing gear to fail to extend.

16. Given the airplane's altitude and the lack of time to prepare for a nose landing gear up landing, the captain's decision to go around was a reasonable choice.

17. The captain's decision not to conduct an emergency evacuation after the airplane landed was in accordance with company guidance and was appropriate because the fire was not severe and aircraft rescue and firefighting personnel were actively responding to the residual fire.

18. The incident commander's decision to deplane the passengers after fuel spilled out of the engine area was prudent.

19. The first officer did not have a clear understanding of the relationship between the pneumatic crossfeed handle and the engine fire handle, most likely because of inadequate company

guidance and training on the issue; this resulted in the first officer inadvertently reintroducing fuel to the left engine, creating potential unnecessary risk of fire.

20. Improved pilot training methods for responding to multiple systems failures, competing task demands, and increased workload would help pilots develop the skills and decision-making abilities needed during both single and multiple abnormal and emergency situations.

21. The casual atmosphere in the cockpit before takeoff affected and set a precedent for the pilots' responses to the situations in flight and after landing, eroded the margins of safety provided by the standard operating procedures and checklists, and increased the risk to passengers and crew.

22. Operational procedures requiring that an airplane be configured for an evacuation when it is stopped away from the gate after a significant event would help expedite an emergency evacuation if one became necessary.

23. During the emergency situation, the flight attendants did not relay potentially pertinent information to the captain in accordance with company guidance and training.

24. Boeing and PTI inspection criteria for the air turbine starter valve (ATSV)-air filter are inadequate to detect early-stage fatigue fractures of the outer mesh of the filter element, and, because of the ATSV-air filter design, the inner mesh of the filter element cannot be inspected for evidence of fatigue.

25. American Airlines' maintenance personnel were using maintenance procedures that were not in accordance with written manuals and guidelines, and its Continuing Analysis and Surveillance System program did not adequately detect and correct these performance deficiencies before they contributed to an accident.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was American Airlines' maintenance personnel's use of an inappropriate manual engine-start procedure, which led to the uncommanded opening of the left engine air turbine starter valve, and a subsequent left engine fire, which was prolonged by the flight crew's interruption of an emergency checklist to perform nonessential tasks. Contributing to the accident were deficiencies in American Airlines' Continuing Analysis and Surveillance System program.

4. Safety Recommendations

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations.

To the Federal Aviation Administration:

> Evaluate the history of uncommanded air turbine starter valve (ATSV) open events in the MD-80 fleet and the effectiveness of coupling the ATSV-Open light to the Master Caution system to determine whether all MD-80 airplanes need to be modified to couple the ATSV-Open light to the Master Caution system. Once the evaluation is completed, require any necessary modifications. (A-09-21)

> Require principal operations inspectors to review their operators' pilot guidance and training on task allocation and workload management during emergency situations to verify that they state that, to the extent practicable, the pilot running the checklists should not engage in nonessential operational tasks, such as radio communications. (A-09-22)

> Require MD-80 series airplane operators to incorporate information about the relationship between the pneumatic crossfeed valve and the engine fire handle into their training programs and written guidance. (A-09-23)

> Establish best practices for conducting both single and multiple emergency and abnormal situations training. (A-09-24)

> Once the best practices for both single and multiple emergency and abnormal situations training asked for in Safety Recommendation A-09-24 have been established, require that these best practices be incorporated into all operators' approved training programs. (A-09-25)

> Require that operators provide pilots with guidance requiring that pilots and flight attendants actively monitor exit availability and configure the airplane and cabin for an evacuation when the airplane is stopped away from the gate after a significant event to help expedite an emergency evacuation if one becomes necessary. (A-09-26)

> Revise Advisory Circular 120-48, "Communication and Coordination Between Flight Crewmembers and Flight Attendants," to update guidance and training provided to flight and cabin crews regarding communications during emergency and unusual situations to reflect current industry knowledge based on research

and lessons learned from relevant accidents and incidents over the last 20 years. (A-09-27)

Require Boeing to establish an appropriate replacement interval for air turbine starter valve-air filters installed on all MD-80 series aircraft. (A-09-28)

To American Airlines:

Evaluate your Continuing Analysis and Surveillance System program to determine why it failed to (1) identify deficiencies in its maintenance program associated with the MD-80 engine no-start failure and (2) discover the lack of compliance with company procedures. Then, make necessary modifications to the program to correct these shortcomings. (A-09-29)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

MARK V. ROSENKER
Acting Chairman

KATHRYN O'LEARY HIGGINS
Member

DEBORAH A. P. HERSMAN
Member

ROBERT L. SUMWALT
Member

Adopted: April 7, 2009

Member Sumwalt filed the following concurring statement on April 13, 2009, and was joined by Acting Chairman Rosenker.

Board Member Statement

Member Sumwalt, Concurring

Unfortunately, I, once again, find myself compelled to comment on the casual attitude of a flight crew. The fact is, time and time again, Safety Board investigations have revealed casual crew attitudes. Of significance is that in several cases, I believe that casual attitude either directly caused the accident or exacerbated factors leading to the accident.

Granted, in the case of American Airlines flight 1400, the flight landed safely and no one was injured. Passengers applauded when the aircraft landed, and upon deplaning, passengers heavily complimented the crew's performance. But, as the report points out, the processes used to get to that landing (and after landing, for that matter) were fraught with crew-precipitated problems.

As an airline pilot for nearly two-and-a-half decades, I recognize the difficulties this crew must have experienced in controlling the aircraft. Among others, they were dealing with an engine out; multiple caution and warning lights in the cockpit; the primary stabilizer trim was not working, leading to heavy control forces; no normal operation of rudder which was exacerbated by the engine-out condition; intermittently failing Primary Flight Displays and Navigation Displays; a nose gear that would not extend; and, a host of other problems associated with dual hydraulic and partial electrical system failures. On go-around, the captain had difficulty maintaining airspeed and climbing due to single engine performance with the two main landing gear extended. On landing, they could extend flaps to only eight degrees due to insufficient hydraulic pressure, and the actual flap position was unknown to the crew due to inaccurate gauges. They faced controllability issues on landing due to a combination of asymmetric thrust, no nose wheel steering and manual rudder operation. To compound all of this was high task loading, stress, and distractions associated with the cockpit door opening and dealing with multiple abnormalities.

The Board affirmed the captain's good decision to request the deadheading captain to come to the cockpit. And as a professional aviator, I also applaud his decision to land on the longest available runway.

One of the party submissions stated that the crew did not have "any formal flight crew training that addresses multiple system failures this complex." Perhaps that is true, but I note that the crew *was* trained and practiced engine fires at least annually. The crew *was* trained and practiced dealing with abnormal and emergency situations and, the crew *was* trained in workload prioritization and task allocation.

I ask rhetorically: What is the best way to prepare yourself to deal with events that are unfamiliar to you – events where there are no established procedures? Based on my flying experience and aviation safety background, I firmly believe the answer is rigorous adherence to standard operating procedures (SOPs) and cockpit discipline on each and every flight. When you do this, you are preparing yourself for the unexpected.

Section 2.5.2 of the American 1400 report pertains to non-pertinent cockpit conversations and cockpit tone, and through this concurring statement, I would like to expound upon that discussion.

In reviewing the cockpit voice recorder transcript, there were several things that pointed to a casual crew attitude. For example, after starting engines, the captain stated, "I'm ambivalent right now. I got six months to go." Although perhaps an offhanded comment, when combined with other behavior in the cockpit discussed below, I can't help wondering if this comment was, in fact, a true indicator of how the captain approached his job on the day of the accident.

The taxi checklist was conducted in a non-standard manner. For example, the captain simply stated, "…checklist and all that stuff when you're ready…" rather than calling for the checklist by name. The first officer did not reply to the captain's statement, but instead, engaged in a personal conversation for a minute or so before initiating the checklist. Also telling was the way the checklist was conducted by the first officer. A flight deck checklist is to be accomplished crisply, using the precise checklist challenge and response. In this case, the first officer recited the checklist by adding unnecessary verbiage such as "how about" followed by the actual printed checklist item. Examples include, "*how about* flight instruments and bugs," "*how about* flaps and slats," "*bout* anti-skid," "*and the* APU," "*alright* crossfeeds," "*and the* packs," "*all right, how about* PA." Additionally, the first officer interrupted the checklist by engaging in non-pertinent remarks. The captain engaged in and did not challenge non-pertinent remarks, although in direct violation of FAA and company requirements to maintain a sterile cockpit.

Taken in isolation, these individual deviations may seem insignificant. When viewed in totality, however, these remarks and deviations from SOPs before, during and after the emergency, paint a picture of a flight crew who may not have been mentally prepared to properly deal with the abnormal and emergency situations. The crew faced a critical emergency less than two minutes after takeoff and I believe that because of their relaxed and casual attitude, the situation caught them off-guard. Quite simply, they weren't mentally in the ball game when the engine fire first manifested itself and this contributed to their critical delays in initiating and completing the appropriate checklists.

Why does a professional aviator insist on strict adherence to procedures, including checklist usage and sterile cockpit compliance? It is not for the flights where everything goes right. Instead, it is for those flights when things go to hell and you need something to fall back on. You fall back on procedures, SOPs and discipline that have been practiced repeatedly over time. You insist on doing things this way so that when faced with an unfamiliar situation, you are mentally prepared to deal with it because you can fall back on procedures and discipline that *are* familiar to you.

So, how does the industry improve hallmarks of professionalism such as discipline and compliance? I believe the answer is through management and peer pressure, as well as through individual accountability and responsibility. Management and pilot associations must take a firm stance that sterile cockpit discipline, precise checklist usage and strict adherence to SOPs will be followed; to do anything less is unacceptable.

Attitudes change over time, but often these changes occur because of management, peer and societal pressures, along with knowing there will be consequences of not following the group norms. Examples of attitudinal changes that have evolved over time include contemporary societal views of smoking, drinking and driving, and seat belt usage. Those views have evolved because of laws, peer pressures and an awareness of consequences of non-conformity. In the case of improving pilot professionalism, the laws (regulations and company policies) are present. What is lacking are sufficient peer pressures, consequences, and in some cases, individual accountability and responsibility.

I urge management and pilot associations to tow a heavy line on insisting on compliance. And I urge that individual pilots insist on this, as well. By addressing these issues through management and pilot association pressures, along with individual accountability and responsibility, needed changes will occur. To do anything less is simply unacceptable.

5. Appendixes

Appendix A

Investigation and Public Hearing

Investigation

The National Transportation Safety Board was initially notified about this accident on September 28, 2007. An investigator traveled to the accident scene.

The following investigative groups were formed: Operations and Human Performance, Maintenance Records, Aircraft Systems, Aircraft Powerplants, and Survival Factors. Specialists were assigned to conduct the readout of the flight data recorder and to transcribe the cockpit voice recorder at the NTSB's laboratory in Washington, D.C.

Parties to the investigation were the Federal Aviation Administration; American Airlines; the Boeing Company; Pratt & Whitney; Lambert-St. Louis International Airport; the Allied Pilots Association; Transportation Workers Union; the Association of Professional Flight Attendants; Honeywell; and PTI Technologies, Inc.

Public Hearing

No public hearing was held for this accident.

Appendix B

Cockpit Voice Recorder Transcript

The following is the transcript of the L-3 Communications FA2100-1020 cockpit voice recorder, serial number 121794, installed on a McDonnell Douglas DC-9-82 that executed emergency landing at Lambert-St. Louis International Airport, St. Louis, Missouri, on September 28, 2007.

LEGEND

APR	Radio transmission from the St. Louis approach controller
CAM	Cockpit area microphone voice or sound source
C-2	Radio transmission from Car 2
C-19	Radio transmission from Car 19
DEP	Radio transmission from the St. Louis departure controller
GND	Radio transmission from the St. Louis ground controller
HOT	Flight crew audio panel voice or sound source
INT	Flight crew interphone voice or sound source
MET	Radio transmission from metering controller
OPS	Radio transmission from Operations
RDO	Radio transmissions from N454AA
STL-CC	Radio transmission from the St. Louis Communications Center
TRK-42	Radio transmission from Truck 42

TRK-53	Radio transmission from Truck 53
TRK-100	Radio transmission from Truck 100
TRK-107	Radio transmission from Truck 107
TRK-167	Radio transmission from Truck 167
SWP-145	Radio transmission from Sweeper 145
TWR	Radio transmission from the St. Louis airport tower controller
V-61	Radio transmission from Vehicle 61
-1	Voice identified as the captain/PIC/pilot
-2	Voice identified as the first officer/SIC/co-pilot
-3	Voice identified as the ground crewman #1
-4	Voice identified as the dead head passenger acting as FO on previous flight
-5	Voice identified as the flight attendant #1
-6	Voice identified as the flight attendant #2
-7	Voice identified as the flight attendant #3
-A	Voice identified as air rescue fire personnel (ARFF)
-F	Voice identified as an FAA official
-J	Voice identified as the jump seat pilot
-M	Voice identified as ground/maintenance personnel
-?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word

( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in central daylight time (CDT).

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1228:25.6 Beginning of Recording			
1300:28.9 Beginning of Transcript			
1229:55.8 CAM	[The captain and FO review the guidance for Engine Start Valve Manual Operation Procedure in the QRH].		
1238:55.3 CAM	[A ground crewman notifies the captain that they are set up to perform a manual start procedure on the left engine. The captain and FO review the manual engine start procedure].		
1240:57.3 CAM	[The captain and FO perform the before starting engines checklist and takeoff briefing].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1245:35.8 INT	[The captain initiates left engine start by holding the switch in the *start* position while instructing the ground crew to open the start valve].		
1246:34.1 INT	[The captain informs ground crew that he sees no indication of start valve opening].		
1249:52.8 INT	[A ground crewman notifies the captain that they are having difficulty manually opening the start valve and had opened the lower cowling for the left engine. The FO suggested that the Captain should release the start switch].		
1251:31.1 INT	[A ground crewman notifies the captain that maintenance wanted him to shut off the air supply to enable replacement of the start valve, since they could not open the start valve manually. The ground crewman notifies the captain that both maintenance personnel had returned to their line office and that the ground crew were re-connecting the external air supply].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1255:04.6 CAM	[The jump seat rider verifies that the start valve had been replaced the day before yesterday, and that this had not solved the start problem. Also, while the aircraft was in Chicago the day before, the start valve opened only partially on the first manual start attempt. But the engine started normally on the second manual start attempt,].		
1300:28.9 INT-3	'kay cockpit we're cleared ta- if we go ahead and uh we're gonna start this thing up and when you uh get to twenty percent open it run the fuel to it and let me know when to kill the air.		
1300:40.2 INT-1	okay ah you want us to go ahead and try to start now huh?		
1300:43.7 INT-3	correct, we're gonna wind it up and uh go ahead and do just like a regular light-off and let me know ah when to kill the air.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1300:51.4 INT-1	okay all right I'm uh I got a start valve open light right now.		
1300:56.1 INT-3	okay you got rpm?		
1300:59.0 INT-1	uh yes we do.		
1301:00.5 INT-3	okay go for a regular light-off and let me know when about thirty five percent.		
1301:05.0 INT-1	all right.		
1301:06.2 CAM-2	* * * * * * *.		
1301:08.6 INT-1	does that mean they've already got the valve open or uh what?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1301:10.8 INT-3	yes the valve's open we're spinnin' the engine.		
1301:12.7 INT-1	okay.		
1301:14.7 INT-1	I mean ah di- did I open it with the switch or did they open it?		
1301:17.3 INT-3	we're opening this ourselves.		
1301:19.8 INT-1	all right thanks.		
1301:21.5 CAM-J	that's ah all we would get twenty one twenty two percent.		
1301:24.1 CAM-1	'kay give it to 'em.		
1301:26.1 INT-1	okay we just put fuel in.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1301:28.2 INT-3	okay.		
1301:31.6 INT-1	there's thirty-five percent right there.		
1301:33.6 INT-3	okay, we got it.		
1301:37.1 INT	[sound of noise transient similar to electrical power source switching]		
1301:37.6 CAM	[sound similar to cockpit window being closed]		
1301:41.4 INT-1	okay looks like we're good to go uh. it's the let's get clearance to push then.		
1301:46.4 INT-3	all right uh I'll give it back over the ramp.		
1301:50.4 CAM-1	all right.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1301:50.4 CAM-2	* I guess it's gonna be * won't be (an event).		
1301:53.4 CAM-J	glad I can help you guys. see?		
1301:54.9 CAM-2	[sound of chuckle].		
1301:58.5 CAM-1	thanks a lot @.		
1301:59.2 CAM-J	you bet.		
1302:00.4 CAM-2	ah * a nice family man.		
1302:02.7 CAM-1	yeah.		
1302:05.4 CAM-1	I'm ambivalent right now. I got six months to go and.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1302:07.9 CAM-2	do you really?		
1302:08.7 CAM-1	(yeah).		
1302:09.1 CAM-2	@ #. how many how many years you got?		
1302:13.9 CAM-1	it's not quite eighteen for me by the time I get done but I did I did active duty for twenty years.		
1302:19.0 CAM-2	did you okay. Air Force or?		
1302:21.5 CAM-1	yeah Air Force tankers.		
1302:23.0 CAM-2	ooh where were did you fly'em out of?		
1302:26.1 CAM-1	mostly out of mid-west uh Grissom.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1302:28.9 CAM-2	okay.		
1302:29.1 CAM-1	Wright Patt.		
1302:29.8 CAM-2	eh well you refueled us guys up at uh up at Battle Creek.		
1302:33.4 CAM-1	oh yeah I'm sure we did. * had the airborne command post * * *.		
1302:37.2 CAM-2	okay.		
1302:40.2 CAM-2	* (this that) * * *. as soon as you're ready to shove off, I'll tell 'em.		
1302:46.7 INT-4	cockpit do you copy?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1302:48.4 INT-1	I hear ya.		
1302:49.4 INT-4	ah yes the ground area is clear uh you can give 'em a call any time you're ready.		
1302:52.4 INT-?	I ah.		
1302:54.4 INT-1	okay thanks.		
1302:59.1 CAM-2	you got a nice little pay check coming in * * * see well now you're already getting your military retirement.		
		1303:06.8 RDO-2	hey uh.
1303:07.9 PA-1	okay folks we got the left engine started and we'll be underway ah in just a second.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
		1303:11.8 RAMP	tremendous fourteen hundred uh why don't you uh if you're set then switch to metering on twenty seven fifty five ask 'em for uh ask 'em for tail west spot number uh, spot number twelve we'll see you later.
		1303:26.2 RDO-2	tail west twelve *.
		1303:29.2 RDO-2	hey meter American fourteen hundred ready to go off Charlie sixteen for a tail west spot twelve.
1303:32.8 INT-1	brakes are released uh cleared to push tail west spot twelve.		
		1303:33.0 GND	American fourteen hundred * * * * push as requested advise * *.
1303:36.2 INT-4	copy clearance push tail west spot twelve.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1303:37.4 RDO-2	* * thanks.
1303:39.2 CAM-2	you know what? spot twelve, cleared to do 'er.		
1303:41.1 CAM-1	'kay.		
1303:45.6 CAM-1	got a new ATIS already?		
1303:46.9 CAM-2	yeah, * * *.		
1303:49.8 CAM-1	'kay we're supposed to do what a forty or forty five?		
1303:52.0 CAM-2	forty yeah * * twenty *.		
1303:54.4 CAM-1	ah we can make the turn.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1303:55.6 CAM-1	I gotta guess ah if there's no more delays I can get down to Orlando and *.		
1303:59.3 CAM-2	it was ah, earlier flight time you guys were were like fifteen hundred coming off so from Orlando.		
1304:06.1 CAM-?	[low level mostly unintelligible speech consistent with the flight attendant safety briefing together with Morse code identifier sounds].		
1304:07.4 CAM-2	* * * * (right)?		
1304:10.7 CAM-2	pickup time and make a *.		
1304:13.4 CAM-2	put thirty twenty in there please *.		
1304:14.6 CAM-1	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1304:21.3 CAM-2	back on.		
1304:29.1 CAM-1	(we were) right here man.		
1304:30.6 CAM-2	yeah.		
1304:33.5 CAM-1	yeah this whole * * do that little dance on the inside.		
1304:38.4 CAM-1	yeah you remember that?		
1304:39.8 CAM-2	* * remember comin' down during the F-one hundred. did you ever do that?		
1304:43.5 CAM-1	not in the one hundred but I did it * * did on the inside in the eighty a couple of times before I got pushed off the seat.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1304:49.7 CAM-2	did the F-one hundred for # five years after that then did the seven three for a couple then jumped back to, jumped into.		
1304:59.5 CAM-1	(did you ever get displaced)?		
1305:00.9 CAM-2	no I, no I uhm I left before when they announced the airplane was going to come out I I jumped ship so, real quick and then I was up their and then then lines started getting # and # but you know what # with that * * * * (gettin close).		
1305:17.0 CAM-1	maybe we'll get four right into Chicago or something.		
1305:19.7 CAM-2	yeah I can * (three zero) * * * okay see ah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1305:28.7 CAM-1	if you see anything prior V one, let me know I'll probably decide when we get within twenty knots of V one I think we're flying, unless it's catastrophic and ah.		
1305:36.7 INT-4	ah cockpit, brakes parked.		
1305:40.9 INT-1	uh, brakes are parked that was a nice push-out uh you can ah release if you want and ah disconnect and we'll see you up front.		
1305:46.3 INT-4	all right, area being cleared disconnecting interphone have a good day.		
1305:49.9 INT-1	okay thank you.		
1305:56.3 CAM-1	anyway if uh unless we're on fire we'll go to Chicago. if we're on fire we'll come back and land here.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1306:01.9 CAM-2	all righty.		
1306:22.1 CAM-2	oh there there's an old crew in here.		
1306:24.7 CAM-1	okay start light.		
1306:27.0 CAM-2	yeah these boys are doing * thirty-five minute turns here.		
1306:33.6 CAM-1	yeah, fifteen minute down change. * probably wasn't even fifteen minutes.		
1306:38.5 CAM-1	we get the log book back?		
1306:40.1 CAM-2	yeah yeah they didn't even take it ah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1306:43.1 CAM-1	okay we're going to have them defer it or something if it's working.		
1306:46.9 CAM-2	uuhm I don't know what the # they just did.		
1306:49.4 CAM-1	well they said they manually opened it for us.		
1306:51.2 CAM-2	yeah.		
1306:59.7 CAM-1	let's try not to screw anything up too much before I you know *.		
1307:05.9 CAM-2	* * there's forty percent.		
1307:06.9 CAM-1	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1307:07.5 INT	[sound of electrical transient similar to electrical power source switching]		
		1307:08.6 RDO-2	hey meter American uh fourteen hundred we are ready to taxi.
		1307:12.8 MET	American fourteen hundred monitor ground point niner.
1307:15.3 CAM-1	good day.		
		1307:15.3 RDO-1	day.
1307:15.7 CAM-2	all right and I'm on number one now.		
1307:17.7 CAM-1	number one and what'd they say?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1307:19.0 CAM-2	just monitor this it's 'cause they're so busy here they (you know) they have to over control everything.		
1307:27.1 CAM-1	the metering thing is * * just a joke but.		
1307:30.7 CAM-?	hint hint we're gonna go out this.		
1307:32.5 CAM-?	yeah you.		
		1307:33.0 GND	American fourteen hundred St. Louis ground taxi runway three zero left.
		1307:35.7 RDO-2	down to thirty left American fourteen hundred.
1307:38.0 CAM-2	right.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1307:38.1 CAM-1	I thinkin' I wanna go left and.		
1307:39.6 CAM-2	yeah, swing off of Delta and * *.		
1307:42.4 CAM-1	if you go down Charlie, Southwest will run you over.		
1307:46.1 CAM-1	clear left.		
1307:46.6 CAM-2	right side clear.		
1307:48.3 CAM-1	flaps when you're ready ah checklist and all that stuff when you're ready watch your feet.		
1307:59.7 CAM-2	yeah we have to get to Chicago * * * *. my wife's coming in from Orange county from.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1308:02.7 CAM-2	* * *.		
1308:04.8 CAM-1	is that right?		
1308:05.6 CAM-1	you takin' her to Orlando?		
1308:07.0 CAM-2	no, she's working ah tonight she's working ah she works contract for ah flight attendant for McDonalds corporation at the base there so she was with us for twenty years twenty-two years and uh she's coming in from Orange County we're gonna fly home in the morning to Grand Rapids * * # I got a hotel at the * Holiday Inn Select * * * * * *.		
1308:09.5 CAM-1	oh.		
1308:14.9 CAM-1	oh yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1308:34.0 CAM-2	we'll let's see, we talked about the weight * * * and we did have a headwind variable four but * * *.		
1308:39.3 CAM-2	* * *.		
1308:40.1 CAM-1	* * *.		
1308:41.1 CAM-2	yeah you're good. yup.		
1308:44.0 CAM-1	*.		
1308:44.3 CAM	[several low level unintelligible comments between pilots]		
1308:44.8 CAM-2	* woulda turned around.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1308:46.7 CAM-1	hey @.		
1308:50.6 CAM-2	how about flight instruments and bugs?		
1308:52.5 CAM-1	okay we're set for uh standard uh runway ah thirty left at uh St. Louis *.		
1308:58.3 CAM-2	* * how about flaps and slats?		
1309:00.6 CAM-1	okay T-P-S said eight I got eight I got eight got eight and takeoff.		
1309:06.2 CAM-2	all righty verified eight stab trim with eight flaps five four.		
1309:10.1 CAM-1	set.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1309:10.6 CAM-2	'bout anti-skid?		
1309:12.0 CAM-1	is (armed).		
1309:12.9 CAM-2	A-B-S?		
1309:14.6 CAM-1	takeoff and armed.		
1309:15.3 CAM-2	spoiler lever?		
1309:16.8 CAM-1	armed.		
1309:17.3 CAM-2	and the APU?		
1309:19.6 CAM-1	comin' down.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1309:20.6 CAM-2	alright crossfeeds?		
1309:21.6 CAM-1	closed.		
1309:22.6 CAM-2	anti-ice?		
1309:24.1 CAM-1	windshield * * *.		
1309:24.7 CAM-2	and * the packs?		
1309:26.0 CAM-1	and uhm auto and pressure on [sound similar to single chime] * * *.		
1309:31.4 CAM-2	briefing.		
1309:32.5 CAM-1	* * * we're pretty much done there.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1309:36.1 PA-1	and folks we'll be down to the departure end of the runway in about a minute or so uh like the flight attendants prepare for takeoff now.		
1309:59.1 CAM-1	okay got two engines running just gotta make sure we have both of 'em started. [sound of chuckle].		
1310:05.4 CAM-1	okay. * *.		
1310:07.3 CAM-2	I'm sure it's been attempted before.		
1310:09.3 CAM-1	oh yeah.		
1310:10.7 CAM-1	I almost forgot the other day I think.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1310:14.0 CAM-2	I know I almost did it in the simulator, but we we uh * Chicago long time ago in the F-one hundred one of these things we we're ah going off of three two left * * ten they're like yeah cleared to hold no okay you know we were sittin' in line and we're like okay we'll get ready to start ah well you guys go to the other side you got a you know little bit a * in trail so we cut across the * * * side hey you guys are cleared to make a loop back around and we're like, cleared for takeoff like * * (instruments). * * * * * * they knock you out of your routine * *.		
1310:45.6 CAM-1	yeah I know.		
1310:46.9 CAM-2	* * now you're ready to go and I'm like well # * * * *. well there's tower so * * we're * we're ready to go.		
		1311:01.0 RDO-2	American fourteen hundred we'll be ready to go at the end.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1311:05.4 TWR	American fourteen hundred St. Louis tower runway three zero left turn right heading three four five cleared for takeoff with the transponder.
		1311:12.2 RDO-2	all righty uh transponder's on up to uh make it a left uh right turn to three forty-five cleared take off thirty left American ah fourteen hundred.
1311:20.9 CAM-2	all right how 'bout PA?		
1311:21.4 CAM	[sound of hi-lo chime]		
1311:23.3 CAM-1	* * .		
1311:23.9 CAM-2	annunciator lights?		
1311:25.4 CAM-1	they're checked.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1311:26.2 CAM-2	engine ignition?		
1311:28.2 CAM-1	continuous.		
1311:28.8 CAM-2	transponder?		
1311:29.8 CAM-1	TARA.		
1311:30.7 CAM-2	nose wheel lights?		
1311:31.8 CAM-1	they're on bright.		
1311:32.4 CAM-2	complete for the takeoff checklist then.		
1311:35.0 CAM	[sound of multiple snaps similar to seat adjustments].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1311:36.6 CAM-1	line 'er up * * * roll.		
1311:48.3 CAM	'kay auto-throttles on.		
1311:49.4 CAM	[sounds similar to aircraft accelerating on takeoff roll].		
1312:03.7 CAM-2	there's eighty knots.		
1312:21.0 CAM-2	V one.		
1312:22.1 CAM-2	rotate.		
1312:25.2 CAM-2	V two.		
1312:28.1 CAM-1	positive rate, gear up.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1312:29.0 CAM-2	*.		
1312:29.8 CAM	[sound of click similar to landing gear handle being moved].		
1312:34.3 CAM-1	heading select.		
1312:35.3 CAM	[sound similar to nose gear door closing].		
		1312:37.8 TWR	American fourteen hundred three four five contact departure good day.
		1312:42.4 RDO-2	good day.
		1312:49.0 RDO-2	and departure American three forty er fourteen hundred actually we're out of uh one point five for five thousand.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1312:53.9 DEP	American fourteen hundred St. Louis radar contact climb maintain one five thousand.
		1312:57.7 RDO-2	one five fifteen American fourteen hundred.
1312:59.5 CAM-1	there's five thousand set and armed half rate.		
1312:59.9 CAM-2	fifteen er.		
1313:02.2 CAM-2	ah that # uh start valve light thing is * on.		
1313:05.6 CAM-1	# I didn't see that before.		
1313:07.4 CAM-2	well * I didn't either.		
1313:11.1 CAM-1	does that mean the start valve is open?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1313:13.2 CAM-2	ahm.		
1313:14.5 CAM-1	could very well mean that.		
		1313:15.1 DEP	American fourteen hundred turn right heading zero five zero don't join the departure vector for traffic.
		1313:19.5 RDO-2	okay we'll make a right turn zero five zero and uh not join American uh fourteen hundred.
1313:29.0 CAM-1	and half rate, flaps up, climb power.		
1313:32.0 CAM-2	oh.		
1313:33.4 CAM-2	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1313:33.6 CAM-1	one five thousand.		
1313:36.6 CAM-2	* * * * we'll look at it.		
1313:55.0 CAM	[sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine.		
1313:58.9 CAM-2	fire light oh my gosh.		
1314:02.5 CAM-1	alright we have to go back and land.		
1314:03.6 CAM-2	* *.		
1314:05.6 CAM-?	* * *.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1314:10.7 CAM-1	declare an emergency.		
		1314:12.4 RDO-2	hey uh St. Louis American ah fourteen hundred.
		1314:14.7 DEP	yes sir.
		1314:15.7 RDO-2	yeah we're gonna have to uh declare an emergency swing back around there and land at St. Louis.
		1314:22.3 DEP	five seven Charlie roger American fourteen hundred roger just maintain ah (whatever altitude) you need at or below five thousand be fine need to uh do some work first or come right back?
1314:29.2 CAM-1	* * * * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1314:29.8 RDO-2	ah no we're gonna come right back around uh we've just got a uh left engine fire indication.
		1314:34.6 DEP	five seven Charlie thank you the altimeter's three zero one nine American fourteen hundred turn right heading one two zero.
1314:37.2 CAM-2	you gonna fly or are you ah you run * *.		
1314:40.0 CAM-1	run the checklist I'll fly it.		
1314:41.3 CAM-2	you betcha.		
		1314:43.0 DEP	American fourteen hundred turn right to a heading of ah one two zero.
		1314:46.0 RDO-1	* one-twenty American uh five hundred.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1314:47.8 CAM-2	one thousand.		
1314:48.4 CAM-1	*.		
1314:49.8 CAM-2	engine failure * * * fire one * * damage separation let's see auto-throttles pilot flying off.		
1314:59.3 CAM-1	off.		
1314:59.8 CAM-2	okay left throttle pilot flying idle. * *.		
		1315:04.3 DEP	American fourteen hundred I can get you right back in for two four if you need to.
1315:05.1 CAM-1	idle.		
		1315:08.1 RDO-2	uum yeah they're * two four would work.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1315:10.6 CAM-2	wanna do that?		
		1315:11.1 DEP	American fourteen hundred roger the airport's at uh three o'clock and six miles maintain two thousand five hundred.
		1315:16.4 RDO-2	we're going up two thousand five hundred we do have the field in sight fourteen hundred.
1315:17.7 CAM-1	I gotta tell the flight attendants.		
		1315:19.9 DEP	* roger what's the nature of the emergency? do you need the uh the uh equipment's standing by it's going to be a short notice for 'em.
		1315:24.7 RDO-2	yeah you're gonna have to roll the trucks for us ah I got a left indication of a left engine fire.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1315:29.5 DEP	left engine fire you wannoo ah you wanna do thirty right or do you wanna ah do two four?
1315:33.8 CAM-1	let's do thirty right.		
		1315:34.8 RDO-2	let's do uh if it's good better for the uh ARFF guys let's do thirty right.
		1315:38.6 DEP	American fourteen hundred maintain two thousand five hundred heading one four zero.
		1315:41.9 RDO-2	'kay one-forty down to two thousand five hundred.
1315:44.2 CAM-2	I can I can fly for you wanna talk to those * *.		
1315:44.3 CAM-1	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1315:45.9 CAM-1	yeah just fly the airplane.		
1315:46.8 CAM	[sound of hi-lo chime].		
1315:47.8 CAM-2	all righty.		
		1315:48.5 RDO-?	[sound similar to an electronic transient].
1315:49.8 CAM	[sound of two hi-lo chimes]		
1315:50.7 CAM-?	* * * *.		
1315:53.9 INT-5	this is @ on C.		
1315:54.4 INT-?	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1315:55.4 INT-1	hey this is @ uh I got ah fire indication on the left engine we're going back to land at St. Louis we're gonna to be on the ground in uh probably less than ten minutes uh.		
1316:02.5 INT-5	all right.		
1316:03.1 INT-1	okay I don't think we'll have to evacuate but uh if we do you know what the signal is it'll be uhm easy victor easy victor three times.		
1316:10.1 INT-6	okay.		
1316:10.3 INT-1	'kay.		
1316:11.1 INT-1	all right uh can you prepare the cabin? we're gonna be on the ground in probably uh five minutes or less.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1316:14.3 CAM	twenty-five hundred [electronic voice].		
1316:15.2 INT-5	okay.		
1316:15.5 INT-6	thanks.		
1316:15.7 INT-1	okay? thanks.		
1316:16.9 CAM-1	* * * make sure it's the loop that's uh that's *.		
1316:20.6 CAM-2	yeah well uh * * * *.		
1316:22.7 CAM-2	the light? now it's back on. * * one more time.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1316:23.7 DEP	American fourteen hundred they're building a hole for you on final right now so maintain two thousand five hundred and uh one forty heading. contact approach on one two four point two five twenty four twenty five they'll get you right in.
1316:26.3 CAM	[sound similar to mechanical click].		
1316:34.4 INT-6	* * * seats we do need for you to remain in your seats with your seatbelts fastened we will be landing in five minutes.		
		1316:35.3 RDO-1	twenty four twenty-five American uh fourteen hundred.
1316:40.9 CAM-2	that valve goes in and out.		
1316:44.0 CAM-1	got it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1316:44.5 CAM-2	got it? cool all right ah be right there.		
1316:46.9 CAM-2	the valve is.		
1316:47.7 CAM	[sound similar to two mechanical clunks].		
		1316:48.2 RDO-1	and arrival American uh twenty oh fourteen hundred ah we're with you.
1316:48.3 CAM-?	* * * *.		
1316:59.0 CAM-2	okay it says ah fuel lever.		
1317:01.3 CAM-1	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1317:01.7 CAM	[sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine.		
1317:01.8 CAM-2	fire light.		
1317:02.6 CAM-1	okay yeah *.		
1317:04.0 INT-5	I'm gonna go tell these pilots up here what we just heard okay, I'm just gonna tell the pilots up here what I heard..		
1317:04.3 CAM-2	it says ah fuel lever at (Captain's) command, off.		
1317:07.4 INT-6	what are you gonna say?		
1317:08.7 CAM	confirm that's the left.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1317:10.9 INT-6	she's got the door open up there.		
1317:11.3 CAM-1	well now it went out.		
1317:12.6 CAM-1	this thing is fallin' apart.		
1317:12.9 INT-5	oh, okay.		
1317:15.3 CAM-1	gotta a verser unlocked light got a.		
		1317:16.7 RDO-?	[sound similar to knock].
1317:16.7 CAM	[sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine [sound similar to fire warning bell] fire left engine.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1317:19.3 CAM-2	I just got power transfer too.		
1317:19.3 CAM-1	now you lost what?		
		1317:20.4 RDO-?	[sound similar to electrical transient].
1317:21.6 CAM-2	do you want me to kill this one?		
		1317:23.2 RDO-?	[sound similar to electrical transient].
1317:23.7 CAM-1	yes.		
1317:25.8 CAM-2	oh # I can't even shut it off.		
1317:30.1 CAM-?	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1317:32.4 CAM-2	ahh fire handle.		
1317:36.3 CAM-2	captain says to pull.		
1317:37.1 CAM	[sound similar to fire warning bell] fire left engine.		
		1317:38.5 APR	American fourteen if you're on turn right heading two five zero.
1317:42.1 CAM-?	* * *.		
		1317:43.0 RDO-1	two five zero American fourteen hundred.
1317:44.5 CAM-?	* * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1317:44.6 APR	American fourteen hundred the airport one o'clock one zero miles when you get established on the heading just advise when you have it in sight.
		1317:50.6 RDO-1	American fourteen hundred.
1317:51.7 CAM-2	all right it blew agent two.		
1317:56.8 CAM-2	I'm gonna get you some bugs.		
1317:59.7 CAM-2	all I gotta worry 'bout is puttin' gear and the flaps that all right?		
1318:04.3 CAM-1	say again.		
1318:04.9 CAM-2	gear and the flaps I'll get you some speeds we're gonna be heavy weight but big deal.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1318:10.4 CAM-1	all right.		
1318:12.2 CAM-2	here do whatever you need to do with that and I'll uh.		
		1318:13.7 APR	American fourteen hundred I'm sorry you say airport in sight?
1318:17.1 CAM-?	* *.		
		1318:17.1 RDO-1	negative I didn't say that.
		1318:18.4 APR	all right American fourteen hundred roger fly heading two five zero.
1318:18.7 CAM-2	straight out there.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1318:19.3 CAM	[sound similar to the cockpit door being operated].		
1318:21.7 CAM-2	* * * * we've lost all # power * *.		
		1318:21.8 RDO-2	two five zero fourteen hundred.
1318:27.0 CAM-2	this # will not discharge.		
1318:29.8 CAM-2	[sound similar to the cockpit door being operating multiple times] it's not gonna shut.		
1318:30.0 CAM-1	* * *.		
1318:30.3 CAM-2	(valves * * eleven).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1318:34.7 CAM-2	it's that we've lost all power to them [sound similar to the cockpit door being operated] just hold it shut for me [sound similar to the cockpit door being operated].		
1318:37.2 INT-5	yeah.		
1318:38.3 INT-6	what uhm why is the door keep opening up there?		
1318:40.0 CAM-2	come on. I'm not gonna # with the door [sound similar to mechanical bang] #.		
1318:42.0 INT-5	I don't know I didn't know it was.		
1318:44.8 INT-6	do you hear like popping stuff over here on by that engine?		
1318:48.2 CAM-2	can you op- close the door and I'll I'll latch it?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1318:48.6 INT-5	no.		
1318:49.0 INT-6	I hear like pops and I don't know if it's the toilet or what it is.		
1318:53.0 CAM-2	[sound similar to the cockpit door being operated] * # everything here. [sound similar to the cockpit door being operated] all right * * # with that.		
1318:55.7 INT-5	* * * * * * * * *. ahm you're not gonna use your door I don't believe.		
1318:59.0 CAM-1	okay so that's.		
1318:59.9 CAM-?	all right.		
1319:02.2 INT-6	why? I didn't hear you.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1319:03.4 INT-5	I don't know I don't know.		
1319:05.3 INT-6	okay.		
1319:05.5 CAM-1	I'm not going to # with this thing any more.		
1319:06.4 INT-5	ah okay it could be it could be what they are talking about.		
1319:07.4 CAM-2	*.		
1319:07.6 CAM-1	* fired both of the both bottles just give me thirty flaps speed.		
1319:12.8 CAM-1	er a no, twenty-eight flap speed.		
1319:12.9 INT-6	yeah, it could be.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1319:13.1 CAM-2	we're gonna shoot a two thirty-seven.		
1319:14.0 INT-5	yeah.		
1319:16.2 INT-6	okay.		
1319:17.4 CAM-2	and uh eighty six.		
1319:18.8 INT-6	'kay.		
1319:22.0 CAM-1	just give me the bottom bug.		
		1319:22.4 APR	American fourteen hundred uh cleared visual approach runway three zero right.
1319:23.3 CAM-2	uuh.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1319:24.2 CAM	[low level background sound].		
		1319:26.9 RDO-2	cleared visual thirty right American uh fourteen hundred.
1319:29.1 CAM-1	where is?		
		1319:29.5 APR	American fourteen hundred if you can give me fuel and souls.
1319:29.6 CAM-2	# was that?		
		1319:32.3 RDO-2	uuh we got ah one thirty seven on board four er five crewmember and uhm.
		1319:38.3 RDO-2	twenty-one and three on the fuel.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1319:41.8 APR	I'm sorry I missed the fuel say again.
		1319:43.8 RDO-2	uuh it's about three hours.
		1319:45.4 APR	thanks.
1319:46.8 CAM-?	I'm kidding.		
1319:47.0 CAM-2	uh your flaps twenty eight should be one thirty eight.		
1319:49.9 CAM-1	one thirty-eight set just gimme ah.		
1319:53.2 CAM-2	three thirty-seven.		
1319:53.3 CAM-1	localizer, localizer pretty * * ah?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1319:56.6 CAM-2	yup.		
1319:58.2 CAM-1	eh let's put the gear down.		
1320:00.5 CAM	[sound similar to landing gear handle being operated].		
1320:01.0 CAM-2	got the runway?		
1320:01.8 CAM-1	yup I got it yeah.		
		1320:09.9 APR	American fourteen hundred contact tower one two zero point zero five.
1320:12.2 CAM	[sound similar to spoiler handle being armed].		
		1320:13.1 RDO-2	two zero zero five.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1320:14.0 CAM-2	I got about five * *.		
1320:16.2 CAM-?	'kay.		
		1320:18.7 RDO-2	hey tower American five hundred 'bout five out on the visual for thirty left with emergency.
1320:26.6 CAM-?	zero zero five.		
		1320:30.5 RDO-2	tower, American five hundred, five out on the visual thirty uh, right with emergency.
		1320:34.8 TWR	American fourteen hundred St. Louis tower runway three zero right, cleared to land. wind three one zero at one three.
		1320:39.8 RDO-2	cleared to land thirty right American five hundred.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1320:42.0 RDO-2	fourteen hundred.
1320:43.5 CAM-2	okay I'm gonna run through some of this other # hydraulic pumps those are all high and on.		
1320:49.0 CAM-2	uhhh altimeters I ain't worrying about it flight instruments bugs.		
		1320:50.6 TWR	American fourteen hundred I'm assuming you want to be followed down the runway?
1320:53.2 CAM-2	yeah I guess.		
		1320:53.7 RDO-2	yeah we're gonna stop straight ahead on the runway.
1320:55.3 CAM-2	one thirty-eight for the final bug speed.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1320:55.5 TWR	okay.
1320:57.1 CAM-1	yup flaps twenty-eight.		
1320:59.5 CAM-2	twenty-eight yeah okay no smoking seatbelt sign. but you already set 'em down correct?		
1321:00.6 CAM-?	* *.		
1321:03.2 CAM-1	give me flaps twenty-three we got the gear down right?		
1321:06.0 CAM-2	yep.		
1321:07.3 CAM-2	your just not going to get anything 'cause you've lost uh, everything here but.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1321:11.6 CAM-1	okay.		
1321:12.0 CAM-2	I ain't got time to # around figure out why.		
1321:14.0 CAM-1	yeah I don't either.		
1321:15.4 CAM-1	I tried to start the APU but it's not starting as far as I can tell.		
1321:17.9 CAM-2	oh # * not showing ah shouldn't we get this?		
1321:21.3 CAM-1	yeah.		
		1321:24.1 RDO-2	hey tower American fourteen hundred?
1321:24.3 CAM-1	yeah.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1321:30.7 CAM-2	I don't get # gear either. we're gonna have to manually drop these #.		
		1321:31.7 TWR	American fourteen hundred go ahead.
		1321:36.1 RDO-2	hey tower American fourteen hundred?
		1321:39.9 RDO-1	tower American fourteen hundred you see any indication we have our wheels down?
1321:46.0 CAM-?	(they're not there) * *.		
		1321:47.1 TWR	American fourteen hundred uh. the mains appear to be down but I can't I don't there is no nose gear I don't believe there's a nose gear.
		1321:57.2 RDO-2	all right we're gonna have to go around then.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1321:57.5 RDO-1	okay.
		1321:58.9 RDO-1	we're goin' around I wanna make a right hand pattern.
1322:01.5 CAM-2	#.		
		1322:03.1 TWR	American fourteen hundred okay just uh fly runway heading and climb and maintain three thousand and there is no nose gear. ah * appear to be down but no nose gear.
1322:08.7 INT-5	what'd you need hon?		
1322:09.8 INT-6	you could see the ground.		
1322:11.0 INT-5	yes honey we're almost there.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1322:12.0 RDO-1	oh uh we'll go straight ahead three and uh we're gonna take a block three to four for fourteen hundred.
1322:12.4 INT-6	do you suppose we had to dump fuel?		
1322:15.4 INT-5	uuhm that could be.		
1322:17.4 INT-6	ah 'cause I bet we went around a little bit to dump fuel we were probably too heavy to land.		
1322:18.6 CAM-2	#.		
1322:20.1 CAM-1	# all right uh.		
1322:22.2 INT-5	oh I didn't even think of that that's a good point.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1322:22.9 TWR	yeah thank you.
1322:24.3 INT-6	yeah.		
1322:25.4 INT-6	okay I just wondered if you could see the ground.		
1322:26.1 CAM-2	let me uhm get the book out.		
1322:26.1 CAM-1	okay.		
1322:28.0 INT-5	yeah uh we're uhmm getting pretty close.		
1322:28.7 CAM-1	call up. call up @ real quick tell her to send @ up here.		
1322:31.1 INT-6	all right.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1322:32.7 INT-5	*.		
1322:35.0 CAM-2	uuh, # * * * *. @.		
1322:39.4 CAM-7	yes.		
1322:39.9 CAM-2	can you send @ up here real quick?		
1322:44.5 CAM-7	what.		
1322:45.0 CAM-2	can you get @ ah other captain up here real quick?		
1322:47.6 CAM-7	yes.		
1322:50.2 CAM-2	you gotta be # kidding me.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1322:52.0 TWR	American fourteen hundred uuhm say your request.
1322:52.9 CAM-7	he's comin'.		
		1322:55.3 RDO-2	eh yeah we're gonna figure what the heck uhh try to get this nose gear down here.
		1322:59.2 TWR	American fourteen hundred roger just for your information there was quite a bit of black uhm I guess soot or whatever on that left engine so I * * the fire was real.
1322:59.5 CAM-2	is he here?		
1323:01.4 INT-6	yeah.		
1323:01.8 INT-5	she just had the captain go up there to help.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1323:05.1 INT-6	oh she did?		
1323:06.0 CAM	[sound of several clicks and bangs].		
1323:06.4 INT-5	the the retiree she just had him up there.		
1323:07.6 CAM-2	*can hit the latch okay can't get the # nose gear down now.		
		1323:08.6 RDO-2	okay.
		1323:09.4 TWR	fourteen hundred ah, do you prefer to make uh you just go straight out because of the engine? do you wanna make some turns? do you wanna climb? what do you want to do?
1323:10.0 INT-6	not good.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1323:10.7 CAM	[sound of mechanical clicks and bangs].		
1323:11.3 INT-5	just just keep me informed.		
1323:11.7 CAM-J	# okay I (I can't latch these) doors.		
1323:13.5 CAM-1	I got an A-C cross-tie.		
1323:13.6 INT-6	(eh no kidding).		
1323:14.4 CAM	[sound of mechanical clicks and bangs].		
1323:17.0 INT-5	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1323:17.7 RDO-1	well, we're gonna have to make a uh, turn to the right here just to keep us in the area and uh, we may have to come back to two four and uh, we're gonna have to let you know.
1323:18.4 INT-6	* * * *.		
1323:23.6 INT-5	yeah.		
1323:23.8 INT-6	I'm I'm getting nervous (when he when he).		
1323:25.2 CAM-?	* * * * * * [multiple voices].		
1323:25.7 INT-5	I am too.		
1323:26.2 CAM-J	we can't get the nose gear down?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1323:26.4 INT-6	when he says the doors that means the ones to not use right?		
		1323:26.6 TWR	American fourteen hundred go ahead and make a right turn heading zero six zero and climb and maintain three thousand.
1323:29.6 CAM-J	okay?		
		1323:32.0 RDO-2	all right right zero six zero and uh it's gonna be extremely slow climb here.
1323:33.0 CAM-1	and I'm ah not climbin'.		
1323:33.2 INT-5	yeah.		
		1323:35.7 TWR	American fourteen hundred roger.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1323:37.7 CAM-2	I'll get your flaps up (a little).		
1323:39.3 CAM-J	'kay well let's see.		
1323:40.7 CAM-1	* * * M-C-T (as well and then) * *.		
1323:41.9 CAM-J	'kay.		
1323:43.5 CAM-2	yeah it's all dead * * * # everything (in) this side.		
1323:47.2 CAM-J	all right.		
1323:48.1 CAM-1	so we're gonna lose the other engine if we're not careful.		
1323:49.2 CAM-J	* its override.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1323:51.0 CAM-2	yup.		
1323:51.9 CAM-J	for whatever that's worth.		
1323:54.2 CAM-J	ahhh yeah that's good too.		
1323:58.0 CAM-J	alright we're-.		
1323:58.3 CAM-2	alright.		
1323:58.5 CAM-1	we're gonna have to.		
1324:00.1 CAM-2	you wanna let's see there's no let me ch- check the # gear thing here.		
1324:04.3 CAM-1	there's no way to get the nose gear down right?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1324:05.8 CAM-2	I don't think so.		
1324:07.0 CAM-1	we're just have to go back and land 'cause I do- I I can't maintain airspeed.		
1324:10.5 CAM-J	yeah.		
1324:11.6 CAM-1	* now		
1324:12.1 CAM-2	you can get the flaps up all the way if you want.		
1324:14.1 CAM-1	okay, gimme half.		
1324:15.7 CAM-1	just leave the slats out.		
1324:16.2 CAM-2	leave the slats out.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1324:17.4 CAM-2	while we're on four wer- give me about one forty-five or so * *.		
1324:21.5 CAM-1	I don't want to burn up this engine too.		
1324:23.6 CAM-1	(tell) * we gotta come back and land now.		
1324:26.8 CAM-2	which one do you wanna take uuh?		
1324:28.7 CAM-1	the longest runway.		
1324:30.8 CAM-2	you know eleven is probably the badest the best the new one there?		
1324:30.9 CAM-J	that's two zero left.		
1324:34.6 CAM-J	three zero left is eleven thousand feet.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1324:36.4 CAM-2	yeah.		
1324:37.0 CAM-J	that's extra two thousand feet.		
1324:38.2 CAM-1	okay.		
1324:39.1 CAM-1	okay.		
1324:39.2 CAM-J	we're gonna land with the nose gear up?		
1324:41.1 CAM-2	thirty left all right.		
1324:44.7 CAM-J	all right well you it would you got the gear handle down (but it).		
1324:47.6 CAM-2	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1324:48.0 CAM-J	and the mains are down?		
1324:48.6 CAM-?	the mains are down.		
1324:49.0 CAM-2	mains are down they're stayin'.		
1324:49.1 CAM-?	yeah.		
1324:50.8 CAM-?	yeah.		
1324:51.4 CAM-1	and I can't hardly turn (us).		
1324:53.8 CAM-2	yeah it.		
1324:59.2 CAM-2	you're ah you know I'm gonna (tell me) * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1325:01.1 CAM-1	yeah.		
		1325:01.2 RDO-1	hey uh St. Louis American fourteen hundred we're gonna have to give you a block between two and four here.
		1325:06.3 TWR	block between two and four right to sixty for American fourteen hundred please.
		1325:09.7 RDO-1	okay and we're gonna have to have thirty left.
		1325:12.0 TWR	American fourteen hundred plan runway three zero left.
1325:13.5 CAM-J	alright (you want) me talk to @?		
		1325:15.0 RDO-1	thanks.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1325:15.6 CAM-2	* * *.		
1325:15.9 CAM-1	what are the winds.		
		1325:17.4 RDO-1	and uh winds still calm?
		1325:19.4 TWR	winds are c- well actually winds are three three zero at one three.
		1325:23.5 RDO-1	okay and uh, you keep us coming around for thirty left.
1325:24.4 CAM-J	are you gonna wanna evacuate or no?		
1325:26.4 CAM-1	* not unless we have to.		
1325:28.3 CAM-J	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1325:29.7 TWR	American fourteen hundred turn right heading zero niner zero.
		1325:32.5 RDO-2	right zero nine zero fourteen hundred.
1325:34.7 INT-J	[sound of multiple clicks] @ [sound of multiple clicks], @, can you hear me? are you on the interphone? [sound of multiple clicks]		
1325:35.7 CAM-J	@ hey @ pick up the intercom.		
1325:36.3 CAM-2	gear handle * *.		
1325:39.2 CAM-1	I don't know if it works.		
1325:50.1 CAM-2	(okay five) I'm gonna do the I'm go in and do the (landing) gear thing here for you just take a look at that.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1325:54.4 CAM-1	I can't I can't get this sucker to climb.		
1326:00.0 CAM-J	you've lost the all ah hydraulic pressure on the right side.		
1326:02.9 CAM-?	* *.		
1326:03.7 CAM-2	how the # did that happen?		
1326:05.9 CAM-1	I don't know.		
1326:12.4 CAM-1	* * * *.		
1326:13.8 CAM-2	all right.		
		1326:14.7 TWR	fourteen hundred fly heading one one zero vector downwind runway three zero left.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1326:19.9 RDO-1	ah yes sir one one zero fourteen hundred.
1326:21.9 CAM-?	ahh.		
1326:25.1 CAM-2	emergency gear extension accomplish.		
		1326:25.2 TWR	American fourteen hundred what's your heading now sir?
		1326:27.7 RDO-1	we're turning to a heading of one one zero right now.
1326:30.2 CAM-?	* * * *.		
		1326:30.5 TWR	all right thank you.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1326:32.2 CAM	[increased wideband background noise consistent with landing gear extension].		
1326:37.2 CAM-J	gear doors.		
1326:40.1 CAM-?	* * * *.		
		1326:41.9 RDO-2	got a main uh nose gear down for American fourteen hundred now?
		1326:47.1 TWR	we're looking.
		1326:57.6 RDO-1	and uh just in case we haven’t said these words yet American fourteen hundred we are declaring an emergency.
1327:02.0 CAM-2	yeah, I told **.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1327:02.4 TWR	American fourteen hundred understand that and from where we are right now it looks like the nose gear might be down as you get ah abeam the tower we'll take another look at it.
		1327:09.7 RDO-2	okay yeah it uh indicating now we don't have any indications but uh the noise appears that it's down.
1327:19.5 CAM-?	okay.		
1327:20.3 CAM-2	anything you can think of on that piece of #?		
1327:22.1 CAM-J	ah no * * * * * *.		
1327:25.8 CAM-2	no we got, we've got no # hydraulic pressure on the right side for some odd reason.		
1327:32.6 CAM-2	that engine's runnin'.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1327:33.3 CAM-1	totally # up, we've got no left engine, we've got no right hydraulic pressure on the right side, we don't have any hydraulics on the left side.		
1327:39.4 CAM-2	well you know what? this might be dead because.		
		1327:41.2 TWR	American fourteen hundred uh it looks like all three gear are down there's a possibility that the gear doors on the mains are still hanging we can't tell from here.
1327:42.1 CAM-1	oh, yeah.		
1327:45.6 CAM-J	'kay.		
1327:47.2 CAM-J	(you have) hydraulics.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1327:49.1 RDO-2	yeah they probably are uh due to electronic sequencing so those will drag and uhm that isn't really gonna matter but uh to make sure got all the wheels down.
		1327:57.0 TWR	yes sir we see three uh three appear to be down and in place.
		1327:59.9 RDO-2	super thanks.
1328:02.0 CAM-2	I don't re-stow this lever do I?		
1328:03.6 CAM-1	no.		
1328:03.6 CAM-J	no.		
1328:04.0 CAM-2	okay.		

INTRA-COCKPIT COMMUNICATION / AIR-GROUND COMMUNICATION

INTRA-COCKPIT TIME and SOURCE	INTRA-COCKPIT CONTENT	AIR-GROUND TIME and SOURCE	AIR-GROUND CONTENT
1328:07.2 CAM-2	okay so one eighty-four you're good on that I let's see if this fails in the.		
		1328:11.7 TWR	American fourteen hundred traffic two o'clock four miles northwest bound twenty-four hundred descending's a company MD-80 we've moved him over to two nine you can start your base leg at your discretion and uh let me know when you start that base leg for thirty left.
		1328:24.4 RDO-2	okay we'll let you know and uh traffic there about what three o'clock?
		1328:28.2 TWR	eh yeah traffic's at two thirty now uh just over the outer ma- just inside the outer marker he's lined up for two nine so it won't be a problem for you.
1328:33.5 CAM-J	all right ah you want me to say anything to the passengers?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1328:35.0 RDO-2	okay.
1328:36.5 CAM-1	say again.		
1328:37.0 CAM-J	you want me to say anything to the passengers?		
1328:38.8 CAM-1	no.		
1328:39.5 CAM-J	you fly, you fly.		
1328:40.6 CAM-1	yeah go ahead and tell 'em what you can.		
1328:43.2 CAM-2	uuh.		
1328:45.2 CAM-2	depends on what you what you wanna do here you're the uh.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1328:48.8 CAM-1	we close enough (we close in)?		
1328:50.0 CAM-2	uum, I might swing it out		
1328:54.6 PA-J	well ladies and gentlemen from the uh flight deck obviously we have a problem with the aircraft ah we are returning to the uh airport for landing ah please pay attention to the flight attendants completely I you probably will have ah * * * * aircraft as we roll out on the runway ah at this point do not be alarmed by that * * but flight attendants * * * * information right now please everyone be in your seats with your seatbelts fastened.		
1328:58.7 CAM-?	* *.		
1328:59.2 CAM-2	you're good no no that's you're fine put it right here.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1329:01.6 CAM-J	goin' around * * * * *.		
		1329:06.7 RDO-2	American fourteen hundred we are startin' a base leg at this time for thirty left.
		1329:11.3 TWR	American fourteen hundred you're cleared to land runway three zero left there's an RJ on the runway he's rolling now wind zero correction three zero zero and niner gusting one six.
		1329:20.4 RDO-2	good thanks cleared to land thirty left American fourteen hundred.
1329:26.2 CAM-2	that's on.		
1329:29.8 CAM	auto-pilot [electronic alert and voice].		
1329:30.8 CAM-2	* * you got the power there now, don't you?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1329:33.8 CAM-?	where's the ah.		
1329:36.3 CAM-?	* *.		
1329:42.3 CAM-2	you're good, here.		
1329:44.1 CAM	[occasional traces of voice energy, completely unintelligible].		
		1330:07.0 TWR	American fourteen hundred still cleared to land three zero left you'll see a Southwest jet crossing the approach end he's heading for the parallel runway the trucks are set up for three zero left wind three one zero one niner gusting one five.
1330:16.0 CAM	altitude [electronic alert and voice].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1330:17.1 CAM-J	@ we are not going to do a ground evac yet * for now but be ready.		
		1330:18.8 RDO-2	cleared to land thirty left American fourteen hundred.
1330:21.9 CAM-7	okay.		
1330:26.1 CAM-1	what's my bottom bug?		
1330:27.6 CAM-2	you're fine.		
1330:28.5 CAM-2	you had ah, one thirty, I gotta get you set up here.		
1330:30.5 CAM	one thousand glide slope glide slope [electronic voice].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1330:38.9 CAM-2	you got uuh * * *.		
1330:41.1 CAM-J	yeah we're landing on thirty left.		
1330:42.7 CAM-2	yep keep 'er * around there.		
		1330:51.7 TWR	American fourteen hundred did you wanna be followed down the runway?
		1330:54.3 RDO-2	yeah affirmative.
1330:56.1 CAM-1	* * fifteen * * *?		
1330:57.5 CAM-2	fifteen.		
		1330:57.7 TWR	understand.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1330:59.5 CAM-2	got a lot of speed *.		
1331:03.9 CAM-1	okay, flaps twenty-eight.		
1331:07.9 CAM-2	okay well we got down three green now.		
1331:09.4 CAM-?	got you down three green.		
1331:09.8 CAM-2	gonna get ah spoiler lever.		
1331:11.9 CAM-1	armed.		
1331:12.3 CAM-2	arm flap slats.		
1331:13.8 CAM-1	okay I got twenty-eight twenty-eight land.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1331:16.4 CAM-2	twenty land.		
1331:16.8 CAM-1	(three).		
1331:17.6 CAM-?	do we have a split flap?		
1331:19.8 CAM-2	uuh no they're just they're just not working.		
1331:21.4 CAM-1	yeah they are.		
1331:23.3 CAM-2	(lost all) # power (to it I guess).		
1331:26.4 CAM-2	I don't know.		
1331:27.7 CAM-2	* there goes that.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1331:30.0 CAM-?	*.		
1331:31.9 CAM-J	(I don't know) why you're not.		
1331:33.1 CAM-2	uuh well we're landing checklist complete so.		
1331:37.4 CAM-1	landing.		
1331:38.1 CAM-?	* * * * *. [multiple voices].		
1331:42.8 CAM	five hundred [electronic voice].		
1331:44.0 CAM-2	well you're about twenty hot * chop that throttle there and we're going to roll way down to the end.		
1331:52.6 CAM-2	(float like) * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1331:54.7 CAM	too low, terrain [electronic voice].		
1331:57.0 CAM-1	turn that off.		
1331:58.1 CAM-?	*.		
1331:59.7 CAM	too low, terrain. too low, terrain. too low, terrain. too low, terrain. too low, terrain. [electronic voice].		
1332:00.2 CAM-J	* * * over on your side don't worry about it.		
1332:09.7 CAM	thirty [electronic voice].		
1332:10.6 CAM	twenty [electronic voice].		
1332:11.9 CAM	ten [electronic voice].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1332:12.2 CAM	[sound consistent with aircraft touch down on runway]		
1332:16.7 CAM-2	* have deployed.		
1332:19.7 CAM	[sound consistent with nose gear contacting runway]		
1332:29.4 CAM-2	pull her outta reverse, stand on the brakes.		
1332:45.2 CAM-1	'kay tell the flight attendants to stay in their seats.		
		1332:46.8 TWR	American fourteen hundred did you want to stop on the runway?
1332:48.1 CAM-J	@ stay seated.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1332:49.1 CAM-?	* * *.		
1332:49.1 CAM	[sound of passengers clapping]		
		1332:49.2 RDO-2	yeah we're gonna stop here.
		1332:51.0 TWR	all right let me know well they got the trucks commin' up from behind you let me know if you need anything.
		1332:54.7 RDO-2	all right.
		1332:55.3 RDO-2	yeah they're gonna have to take check out that left engine for us to make sure there's any uh. we're still showing * fire indication up here.
1332:56.2 CAM-?	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1332:58.5 CAM-J	and you don't have nose wheel steering do you?		
1333:01.1 CAM-1	nope, I don't think so.		
		1333:01.1 TWR	understand.
1333:03.9 CAM-1	nope.		
1333:05.2 CAM-2	brakes still workin' 'er?		
1333:06.4 CAM-1	yeah we're gonna roll up behind 'em here so, so I guess tow us back.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1333:13.3 PA-J	ah ladies and gentlemen you will ah see fire equipment ah moving towards the aircraft and checking the aircraft out that is ah precautionary we did have a left engine fire indication they are checking that out so ah right now we have no indications that it was an actual fire we did ah shut that engine down ah please stay seated.		
1333:16.3 CAM-?	* * * * * *.		
		1333:19.3 TWR	American fourteen hundred when you get just a moment change to ground twenty-one nine and uh he'll talk to you.
1333:26.3 CAM-?	two lights * * *.		
1333:32.7 CAM-?	* * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1333:32.8 RDO-2	and ground American fourteen hundred we're up on twenty one nine.
		1333:35.5 GND	thank you and I got the fire trucks if you need to talk to 'em, also on this frequency.
		1333:39.1 RDO-2	thank you.
		1333:43.3 RDO-?	*.
		1333:45.5 RDO-1	and this is American fourteen hundred do you read?
1333:48.9 CAM-2	* * * * *.		
		1333:49.7 RDO-1	American fourteen hundred uh to- ah rescue crew.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1333:53.8 TRK-42	yeah go ahead.
1333:56.1 CAM-J	you don't have to go to recurrent for two years.		
1333:58.0 CAM-2	[sound of laughter]		
		1334:03.8 TRK-42	ARFF to ground left engine still a little bit of fire in there.
1334:08.3 CAM-2	you gotta be # me.		
		1334:09.9 RDO-1	uh roger copy that uh.
1334:12.1 CAM-1	(you) fire the other bottle er * *?		
1334:13.9 CAM-2	(think they're) both gone I shot 'em both.		

INTRA-COCKPIT COMMUNICATION

TIME and SOURCE	CONTENT

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT
1334:15.8 RDO-1	de-.
1334:29.7 RDO-1	okay uh rescue this is uh American fourteen hundred you say you got still got some fire in the left engine?
1334:40.1 RDO-1	ground American fourteen hundred.
1334:41.8 GND	truck forty-two the aircraft's askin' is there still fire in that engine?
1334:46.3 TRK-42	roger that.
1334:48.0 GND	truck fourteen hundred yeah they say there is.
1334:50.4 RDO-1	all right are they gonnaowa spray it?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1334:53.0 GND	they're working on it now I believe.
		1334:54.8 RDO-1	okay.
		1334:58.8 TRK-53	ground this is truck fifty three putting a line on it right now.
1334:59.9 CAM-2	no place for anybody to go.		
		1335:01.4 GND	thank you.
1335:02.8 CAM-1	I think we're probably gonna need to be towed off 'cause I don't have any nose wheel steering we're down to one engine.		
1335:04.9 CAM-?	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1335:11.3 RDO-1	hey ground when uh American fourteen hundred when they get this thing all ah secured here we're gonna have to be towed back ah I don't have any nose wheel steering or anything.
		1335:19.9 GND	okay thank you.
1335:20.1 CAM-?	* the engines * * it's still on fire.		
1335:23.0 CAM-1	okay you gonna spray it?		
		1335:23.4 GND	American fourteen hundred are you going to be evacuating the aircraft?
1335:24.3 CAM-9	I gotta put it out.		
1335:25.2 CAM-1	okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1335:25.9 RDO-2	uuh no there's nowhere for anybody to go we've the guys got a handle on it right now they're gonna shoot it for us.
		1335:31.1 GND	okay.
1335:32.2 CAM-2	we don't want to get everybody off here.		
		1335:32.3 STL-CC	ground this is comm center we copied the uuh tow request.
1335:33.4 CAM-1	no		
1335:33.9 CAM-2	there's no where for them to go *.		
		1335:35.3 GND	thank you.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1335:37.7 CAM-J	well they got busses standing by over there.		
1335:39.9 CAM-2	sweet.		
1335:44.2 CAM-J	that can't be for us that'd be too well coordinated.		
1335:49.2 CAM-J	# of a job @.		
1335:50.6 CAM-2	* football team coming in.		
1335:52.9 CAM-2	he just said he had to be back before nine fifty-nine tonight.		
1335:55.5 CAM-?	*.		
1335:59.3 CAM-2	yeah # just went whack-a-doodle on us *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1336:02.0 CAM-?	* *. [multiple voices].		
1336:03.6 CAM-1	we had a left start valve open light.		
1336:05.8 CAM-J	open?		
1336:06.2 CAM-1	after we got airborne.		
1336:07.8 CAM-?	* * * *.		
1336:09.5 CAM-1	start valve open light.		
1336:09.7 CAM-J	hah.		
1336:11.0 CAM-1	now the thrust reverser was that.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1336:13.4 CAM-1	or is it the valve indication.		
1336:14.1 CAM-2	that came on too.		
1336:15.7 CAM-1	we had all kinds of # goin' on there.		
1336:17.2 CAM-2	you had that before you had here comes that came on and once all the # came on.		
1336:17.3 CAM-1	* * * electricity went away uh you know * I uh st- started the APU but it didn't come on line that AC cross-tie lockout goin' and (you know like) # I'm like baffled.		
1336:29.2 CAM-J	@ I'd hate to have been in the weather.		
1336:31.1 CAM-?	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1336:32.4 CAM-2	then I, you know you got too much # at one thing * *.		
1336:39.2 CAM-J	well.		
1336:40.4 CAM-J	obviously it's a pretty * (landing).		
1336:42.5 CAM-1	did you say something to the people?		
1336:43.9 CAM-J	I did told everybody to stay seated 'cause there was fire trucks will be out.		
1336:46.6 CAM-2	extra pay in this for you.		
1336:49.9 CAM-2	@ going to be waiting for you when you get *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1336:51.4 CAM-1	@ I appreciate you coming up here and helpin' out.		
1336:52.8 CAM-2	yeah.		
1336:54.4 CAM-J	you were like your hands were full.		
1336:56.5 CAM-2	# yeah I * * * no * [sound of laughter].		
1337:01.7 CAM-2	did I tell you this # always always happens to me?		
1337:04.0 CAM-1	no remind me to put you on my do not fly list.		
1337:08.6 CAM-2	* * * * talkin' to me * *.		
1337:08.8 CAM-?	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1337:11.7 RDO-1	hey ground American fourteen hundred.
		1337:16.8 GND	American fourteen hundred go ahead.
		1337:18.2 RDO-1	yes sir and ah was just wondering does anybody on the rescue crew ah are they monitoring this frequency 'cause they're not talking to me?
		1337:24.6 GND	they should be.
		1337:26.6 TRK-53	go ahead fourteen hundred this fifty-three.
1337:29.6 CAM-9	think you got smoke inside?		
1337:31.6 CAM-1	no is there * there no smoke inside?		
		1337:32.0 TRK-53	go ahead fourteen hundred this fifty-three.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1337:34.6 RDO-1	say again.
		1337:36.0 TRK-53	truck fity three.
1337:36.9 CAM-?	(now).		
		1337:37.2 RDO-1	yeah go ahead.
		1337:38.9 TRK-53	* with your message..
1337:39.7 CAM-?	nope.		
1337:40.5 CAM-1	no, no smoke inside.		
		1337:40.6 RDO-1	are you uh you guys spray that left engine already for us?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1337:42.1 CAM-9	hey we, you're basically out.		
		1337:44.3 TRK-53	yes they are.
1337:45.1 CAM-1	okay.		
1337:45.3 CAM-9	everything's good.		
		1337:45.4 RDO-1	super.
1337:46.5 CAM-1	okay.		
1337:47.6 CAM-9	(put) a little water on it that’s it.		
		1337:48.0 TRK-107	ground truck one oh seven.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1337:49.8 CAM-1	okay we think we can taxi in safely?		
		1337:50.7 TRK-107	truck one oh seven ground.
		1337:52.0 TRK-107	one oh seven one other truck on Charlie like to cross six two four.
1337:52.4 CAM-?	* @.		
1337:52.8 CAM-1	can we taxi in safely then?		
1337:54.8 CAM-9	yeah we're gonna follow ya.		
1337:56.4 CAM-2	(we're) gonna have to get a tug though.		
		1337:56.8 GND	cross two four.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1337:57.8 CAM-1	okay.		
		1337:58.3 TRK-107	one oh seven company crossing two four on Charlie.
1338:00.2 CAM-1	* * * * nose wheel steering.		
1338:00.9 CAM-?	* * *. [sound similar to voice originating from outside the cockpit].		
1338:01.9 CAM-2	I think you lose it but you lose it when we do that though don't you?		
1338:04.3 CAM-J	what?		
1338:04.7 CAM-2	nose wheel steering.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1338:06.0 CAM-?	*. [sound similar to voice originating from outside the cockpit].		
1338:06.4 CAM-J	it might be.		
1338:07.7 CAM-?	* * * *.		
1338:09.1 CAM-2	it's all that system # I that don't remember.		
1338:10.5 CAM-J	yeah stuck in the back page *.		
1338:13.2 CAM-2	I'll uh * *.		
1338:13.9 CAM-1	* * * all right let's let's uh, let- let's at least at least taxi clear.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1338:18.3 CAM-1	but I don't know where they want us to park 'cause I don't think I have any nose wheel steering in here.		
		1338:22.2 TRK-107	one oh seven and company clear of two four.
		1338:22.6 RDO-2	hey operation ah operation America ah fourteen hundred.
		1338:24.9 GND	thank you.
		1338:29.7 RDO-1	ground American uh fourteen hundred.
		1338:32.1 GND	American fourteen hundred go ahead.
		1338:33.2 CAM-OPS	flight fourteen hundred?

INTRA-COCKPIT COMMUNICATION

TIME and SOURCE	CONTENT

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT
1338:34.2 RDO-1	sir uh they say the fire's out uh we're gonna taxi clear uhm but I don't have nose wheel steering we're gonna have to probably park someplace ah off the gate uh and uh uh not- we're checking with our OPS now what they want us wher- theyr- aw where they want us to go.
1338:34.2 RDO-2	yeah uhm we're down here at the end of thirty left and ah I think we're going to be able to taxi clear but ah we don't have any nose wheel steering so they're gonna have to have a tug * * out.
1338:48.1 GND	okay understand I was- understand I believe they're bringing a tug out to you.
1338:48.2 CAM-OPS	sir uh, (I inform you) we have no information we didn't know you were coming back they didn't tell me what's going on what kind of emergency.
1338:52.1 RDO-1	oh they are bringing a tug out?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1338:53.7 GND	yes they are and I believe they've got some vans * * ready for you if you want eh evacuate that aircraft also, right there off to your left you can see 'em.
1338:55.6 CAM-2	huh.		
		1338:56.3 RDO-2	they didn't call you huh? ahm yeah we're * on the ground had an engine ah left engine fire and a multitude of other failures and ah we're on the ground now they've got it all * * uhm and ah were gonna taxi * * Victor Charlie * * * .
		1339:00.1 RDO-1	no I don't think there's any need to evacuate the airplane I see the vans uhm but if uh you see the tug coming out?
		1339:08.0 GND	no let me call and find out what they're planning on doing to but the * said * * * have a tug come out.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1339:12.8 RDO-1	okay 'cause I think I can get clear of the runway uh but I ah don't really wanna try taxiing into a gate without nose wheel steering.
1339:13.3 CAM-J	I think can * * hydraulic pressure * * extend the gear to (twenty) * * *. [multiple voices].		
		1339:17.0 CAM-OPS	and ah I will inform maintenance ah (can you) go to maintenance on one two niner point eight five?
		1339:20.5 GND	okay I understand that uhm comm center ground are you with me?
		1339:21.7 RDO-2	ahh we really didn't have any time to speak to anybody but I'll give them a call, you know we didn't even have any-

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1339:23.8 STL-CC	yes sir I did talk to maintenance they should have a crew on the way and our uh city vehicle will meet them at the Charlie pad.
		1339:25.9 CAM-OPS	well we didn't know what flight you were okay please call maintenance one two niner point eight five.
		1339:28.8 GND	okay so * me just go ahead and taxi him off the runway then?
1339:31.8 CAM-1	so we * even have any hydraulics.		
		1339:31.9 STL-CC	at pilot's discretion sir.
		1339:33.7 GND	okay American fourteen hundred you're discretion you go ahead and taxi off the runway uh you do have a lot of vehicles still around you tho-.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1339:34.1 CAM-1	you think we can safely taxi off the runway or should we stay here?		
1339:35.7 CAM-?	* * * * * *. [multiple voices].		
1339:36.5 CAM-?	stay here?		
1339:37.5 CAM-2	let him tow it off.		
1339:38.4 CAM-J	you know you gotta pin the gear before you try you make * * * pressure.		
		1339:39.8 RDO-1	okay we uh uh ground uh American fourteen hundred uh upon further review here we think probably we're smarter to just wait and let 'em tow us so we're not sure we have enough hydraulic pressure to hold the gear up.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1339:43.1 CAM-?	* * * * * * (over center lock) * *. [multiple voices].		
1339:47.2 CAM-J	yeah.		
1339:47.8 CAM-2	(#it they just want you to tow it *).		
		1339:50.5 CAM-OPS	fourteen hundred go ahead.
		1339:50.8 GND	okay eh com center you copy that?
		1339:51.8 RDO-2	yeah I don't know if you copy just what's goin' on uhm went back we had a left engine fire indication * * fire we had gotten the fire out and one of the mult- multitude of problems one of the things is there are no both hydraulics are out we are on thirty left we gonna need someone to pin and pin the gear and send a tug out to pull us * *.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1340:08.7 C-19	ground car nineteen.
		1340:10.4 GND	car nineteen go ahead.
		1340:11.7 C-19	I did not copy that last transmission from the aircraft sir could you repeat it please?
		1340:12.9 CAM-OPS	ah we're waiting for a city escort right now let's get all that out there so they'll be there shortly.
		1340:15.5 GND	yeah he don't know if he has enough hydraulics to ah steer that think so he wou- re- he would like to be towed off the runway.
		1340:18.3 RDO-2	okay.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1340:21.1 C-19	that's affirmative I'm waiting to see the tow crew on the Charlie pad and I'll meet them and bring them out to the aircraft.
1340:21.7 CAM-2	* * * do they have * things goin' on they're worried about what you know. # it.		
1340:24.9 CAM-J	yeah.		
		1340:27.2 GND	okay thank you.
1340:27.6 CAM-2	we got some A-C goin' on. that's cool.		
1340:34.4 CAM-J	@ you want me to say anything more to the passengers er.		
1340:37.2 CAM-1	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1340:37.7 CAM-J	* * *.		
1340:38.6 CAM-1	no *.		
1340:39.2 CAM-J	okay.		
1340:40.0 PA-1	okay folks this is captain @ speaking ahm we have ah things under control here for the most part ah they are gonna to bring a tug out to the ah runway here to tow us off the runway ah hydraulic ah pressure is gone and ah we don't really have any steering capability right now the safest thing to do is tow the airplane in ahm we're talkin' to operations ah to see where they're gonna put us but ah the rescue people have ah secured ah the airplane and everything is good on the outside so ah just be a couple of minutes here I think before we ah standby.		
1340:40.2 CAM-2	# * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1340:58.9 CAM-2	well that's comin' up.		
1341:00.7 CAM-J	hey.		
1341:01.2 CAM-2	* * * *.		
1341:02.8 CAM-J	[sound of laughter] * * * *.		
1341:08.0 CAM-2	* like ah * * then I couldn't even shut this * * * and shut fuel *.		
1341:16.8 CAM-?	(yeah like).		
1341:17.6 CAM-2	pull the fire handle couldn't couldn't rotate it.		
1341:21.1 CAM-J	(wow).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1341:22.2 CAM-2	* I don't know what * * really * this this is it * * * (release) and then couldn't even get couldn't get it to ah go any further than that * * push it on down.		
1341:27.1 CAM-1	* come on?		
1341:28.2 CAM-A	* * * * * * * *. [sounds similar to voice originating outside the cockpit].		
1341:31.4 CAM-1	do you wanna come on board?		
1341:34.2 CAM-A	* * * * *. [sounds similar to voice originating outside the cockpit].		
1341:37.3 CAM-1	up here okay.		
		1341:39.4 GND	car nineteen ground.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1341:41.1 CAM-1	fire department's coming on board so * * * *.		
		1341:41.8 C-19	go ahead ground.
1341:42.9 CAM-2	* * she get that (out) the door there.		
		1341:43.4 GND	yeah we just called ah talked to American they said the tug is on it's way.
1341:45.9 CAM-A	* * * fire department * * [multiple voices].		
		1341:46.9 RDO-1	okay thank you I guess fire department wants to come on board they're gonna ah come on the airplane.
		1341:52.1 GND	'kay I got about five airc- or five people callin' I was lookin' for car nineteen on that one did you copy that car nineteen?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1341:54.1 CAM-2	eh we're on the clock.		
		1341:57.5 C-19	roger that car nineteen copy.
		1341:60.0 GND	thank you who else's callin' me?
1342:02.7 CAM-7	okay it's done.		
1342:03.6 CAM-J	all right thanks.		
		1342:04.1 GND	who else is callin' ground on point niner?
1342:04.5 CAM-?	*.		
1342:04.8 CAM-J	doors disarmed.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1342:08.0 CAM-2	(not) sure why this (lights) still on here.		
1342:11.4 CAM-1	yeah they said the fire's out.		
1342:12.4 CAM-2	'kay.		
1342:15.9 CAM-1	ahm try the loops switch.		
1342:23.1 CAM	fire right engine [electronic voice and alarm] fire right engine [electronic voice and alarm].		
1342:24.8 CAM-2	well (what about the) see that's what we initially got was the ah well when everything started going crazy we got a loop light and then...		
1342:34.6 CAM-1	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1342:34.8 CAM-2	...right after that this kicked in I'm like well okay maybe its a loop but then the fire bell started going off and then that's when we.		
1342:41.6 CAM-1	I never did look at the EGT. saw the fire saw that big red light and that's all I. I don't ah know what it was either.		
1342:53.1 CAM	[unintelligible background voices].		
1343:06.8 CAM-1	did the did they disarm the door?		
1343:08.0 CAM-2	yeah.		
1343:08.4 CAM-J	yeah.		
1343:08.8 CAM-?	*.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1343:09.2 CAM-J	(yeah).		
1343:11.4 CAM-2	huh great job man.		
1343:13.3 CAM-1	* say couldn't ah done it withoutchya.		
1343:14.5 CAM-2	yeah [sound of laughter].		
1343:16.4 CAM-1	* #.		
1343:19.2 CAM-J	like * * * *.		
1343:19.6 INT-1	everyone needs to remain in their seats with their seatbelts fastened and please keep all of your carry on items stowed.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1343:27.8 CAM-J	(okay) * * * * (firemen on board ah there is no indication of fire) * * *.		
1343:28.4 PA-1	ah folks this is captain @ the ah rescue crew just said they wanted to come on board and check things out inside ah they're gonna be comin'; up on the ah front door here of the left side ah.		
1343:33.7 CAM-?	* * *.		
1343:34.5 CAM-J	I know.		
1343:37.1 CAM-?	* * *.		
1343:38.8 CAM-J	* * (nobody wants to go quietly).		
		1343:39.0 GND	car nineteen ground.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1343:40.9 C-19	go ahead ground.
		1343:42.6 GND	okay do you to swing- * go arou- ba ah run down ah thirty left see if there's any debris on that runway at the end?
1343:44.2 CAM-2	* didya get that whisky yet?		
1343:46.0 CAM-J	yeah.		
1343:46.4 CAM-7	yeah I got it for ya.		
1343:47.3 CAM-J	[sound of laughter].		
1343:47.7 CAM-1	what's the brake temperature.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1343 :49.9 C-19	yes ah I'll do that ah once the aircraft starts to move sir.
1343:51.6 CAM-1	it doesn't doesn't matter I don't I don't guess I have anything uh?		
		1343 :54.4 GND	okay.
1343:55.8 CAM-1	I'm holdin' these but they're probably just wasting my time.		
1343:58.1 CAM-2	he chocked ya too so that was the ah uhm first guy came out but.		
		1344:01.9 C-19	ground car nineteen.
		1344:03.6 GND	car nineteen go ahead.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1344:04.8 C-19	yeah ground I have car two zero with me ah he'll do ee- the ah runway inspection on three zero left from two four down.
1344:05.3 CAM-2	yeah I don't, I mean he's still got, * * out on that block us out on that eh eh, according to that.		
1344:08.1 CAM	[sound of double chime].		
		1344:11.8 GND	okay yeah we got ah I believe they got thirty left and two four right now shut down also.
1344:13.8 CAM-?	* * * * (come on back).		
1344:15.6 INT-7	@.		
		1344:16.3 C-19	and that's affirmative he'll * * from here out on two four make the turn on * left * *.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1344:16.3 INT-5	hey this is * is * any way they can use their cell phones?		
1344:19.9 INT -7	ahm ah are I don't just a minute I'll ask thos- guys are comin' on.		
1344:21.3 CAM-?	I don't * * double check before I *.		
1344:21.7 CAM-1	(hi there).		
1344:22.3 CAM-?	'kay.		
1344:22.4 INT -5	oh okay.		
1344:23.0 CAM-1	* * * * *?		
1344:23.4 CAM-2	Thanks @.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1344:23.6 INT -5	okay I'll tell 'em.		
1344:24.8 INT -6	can they use their cell phones they wanna know. cell phones.		
1344:28.0 CAM-?	(cell phone)? [multiple voices].		
1344:28.9 CAM-2	yeah.		
1344:29.0 INT -7	yeah they use *cell phones.		
1344:29.3 CAM-J	yeah.		
1344:30.0 CAM-J	yeah your not gonna 'fear for the navigation equipment now eh.		
1344:33.5 CAM-2	[sound of laughter] what left we have.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1344:35.2 CAM	[sound of double chime].		
1344:38.2 CAM-1	that was a good catch though, * * nose gear.		
1344:39.8 CAM-2	* * *.		
1344:40.3 INT -6	this is @.		
1344:40.8 INT -7	yes they can use their cell phones.		
1344:41.5 CAM-2	well I didn't e- I'm like seemed awfully quiet that's the only way.		
1344:42.1 INT -6	okay thank's, bye.		
1344:45.9 CAM-1	we're halfway down final the first time and he's goin' oh # shouldn't that be up? *I'm goin'.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1344:51.1 CAM-2	# #.		
1344:52.5 CAM-J	yeah.		
1344:53.3 CAM-2	but that that # all mechanical why the # would that stick up?		
1344:57.6 CAM-J	(don't know).		
1344:58.2 CAM-1	I don't know.		
1344:58.3 CAM-2	there’s nothin' electronic in the-.		
1345:00.6 CAM-1	* * * hydraulic unlocks.		
1345:00.6 CAM-2	well other than.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1345:00.6 CAM-?	* * *.		
1345:02.6 CAM-?	* *?		
1345:03.5 CAM-1	no no you're right it's a mechanical lock.		
1345:04.4 CAM-2	it's just a mechanical uplock and it it hydraulically drops but.		
1345:10.5 CAM-2	he had.		
1345:11.1 CAM-2	he said nothin' was down. gear doors were * draggin' too.		
1345:12.4 CAM-1	so when this thing * * * when you (cut) this and the left engine shut down so didn't even get follow any checklists like we're supposed to you know.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1345:20.9 CAM-1	I'm just like keep this this thing flyin'.		
1345:24.8 CAM-2	yeah * like bring it around and land it you know get what # you can get done and then, course we'd a been down quicker if it was.		
1345:31.9 CAM-2	ah you got 'er do an overweight landing.		
1345:33.9 CAM-J	[sound of laughter].		
1345:37.7 CAM-2	you can punch me any time * * just don't hit my shoulder.		
1345:41.4 CAM-2	I just had I broke my collarbone in May and had it screwed back together so it's just a little sore right there.		
1345:45.2 CAM-J	ouww.		

INTRA-COCKPIT COMMUNICATION | AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1345:52.3 CAM-2	I suppose now we're gonna have to debrief all this #.		
1345:52.4 CAM-1	* * *.		
1346:00.5 CAM-2	yup.		
1346:02.0 CAM	[sound of multiple bells].		
1346:05.5 CAM-1	that's probably the ACARS wants your in fuel.		
1346:06.4 CAM-2	ah, oh missing arrival fuel.		
1346:09.2 CAM-J	[sound of laughter] update your ETO as necessary.		
1346:15.9 CAM	* * * * *. [multiple voices].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1346:20.6 CAM-2	(we had) plenty of fuel.		
1346:23.6 CAM-1	those guys did not. all (I) had to figure is they did not make sure that start valve was, (set).		
1346:29.0 CAM-2	that would be my only indication that they didn't have it fully seated. 'cause it was but it was cycling on and off. I * this was goin' on and off and a bunch of different * * * * *.		
1346:30.8 CAM-?	* * * *.		
1346:36.9 INT -6	yes.		
1346:38.0 CAM-1	alright everything good?		
1346:38.1 INT -5	the fireman said ah on the flyby we were on fire, half of the engine is gone.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1346:40.4 CAM-2	thank you.		
1346:41.6 CAM-?	we got it captain.		
1346:43.2 CAM-1	okay.		
1346:46.8 INT -6	oh my #. ah.		
1346:47.7 CAM-?	* * * *.		
1346:50.0 INT -5	just though you might wanna know.		
		1346:51.7 CAM-OPS	fourteen hundred go ahead.
1346:51.7 INT -6	thank you honey. thank you thank you.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1346:53.0 INT -5	[sound of laugher] okay.		
		1346:53.0 RDO-2	* * * * * *.
1346:53.8 CAM-?	* (exit) * fire * so [sound of laugher].		
		1346:55.6 OPS	ah we're waitin' on the city they don't move too fast around here we- we're got people standin' by ready to come out there but we have to wait for the- them to escort us.
1346:59.9 CAM-A	okay every- everything is looking good ah.		
1347:02.9 CAM-A	no well there’s nothin' back there we just wanted to be ah on the safe side.		
		1347:03.2 RDO-2	okay I'll talk to the ground guys see if ma- they can ah nudge them along a little bit.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1347:06.0 CAM-1	alright.		
1347:06.4 CAM-?	and the engine is completely out.		
		1347:07.2 OPS	okay.
1347:08.3 CAM-2	super.		
1347:09.1 CAM-1	okay so where was the fire front end front section aft section?		
		1347:11.0 RDO-2	hey ground American fourteen hundred.
		1347:12.7 GND	go ahead American fourteen hundred.
1347:13.4 CAM-A	well in the ah middle toward the rear of the engine.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1347:14.2 RDO-2	yeah er ah maintenance guys are all set standin' by to send out a tug and to ah pin us but ah I guess they're havin' a delay with the city to get clearance to come out here?
1347:20.3 CAM-1	and you can see it from the rear you cannot see it from the front?		
1347:23.6 CAM-A	well I mean it's burnt it's burnt all the way through underneath that (that engine).		
		1347:23.8 GND	* the city's waiting for you guys at Charlie pad.
		1347:26.5 RDO-2	oh I guess everybody's waitin' for everybody ahh is there somebody else they should call?
1347:28.4 CAM-1	okay I see alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1347:29.8 CAM-A	ah ha.		
1347:30.9 CAM-1	yeah ah huh alright.		
		1347:32.1 RDO-2	er is there ah someone in the tower can give our guys a shout and let them know they're clear to come out?
1347:34.4 CAM-?	* * *. [multiple voices].		
1347:36.0 CAM-A	good flyin' you ‘all.		
1347:36.9 CAM-1	thanks guys.		
		1347:37.0 GND	ah * * * car nineteen ground you with me still?
1347:37.5 CAM-1	thanks.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1347:38.7 CAM-?	* * *. [multiple voices].		
1347:39.6 CAM-?	* * * * (heard a pop) * *.		
		1347:40.1 C-19	hmm hearin' everything he's sayin I got the American guy in the car with me we got four vehicles but no we're waitin' for it to show up.
1347:43.4 CAM-?	okay.		
1347:44.0 CAM-?	I don't know * * (in there) or not.		
1347:46.6 CAM-J	* but that was during the event not now.		
		1347:47.2 GND	yeah he was sayin' that they guess ah they're waitin' for you clearance from you guys I don't understand that either though.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1347:49.1 CAM-?	right.		
1347:49.5 CAM-?	* * * *.		
1347:51.4 CAM-?	(that's) okay.		
1347:52.1 CAM-?	alright we'll * the guys we.		
		1347:52.6 C-19	* little miscommunication on their part.
1347:53.4 CAM-J	appreciate that.		
		1347:55.3 RDO-2	alright so we just we needed them to find a tug then is that what it is?
1347:55.5 CAM-2	we really wanna.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1347:55.8 CAM-2	well we just we needed them to find a tug then is that what it was?		
1347:58.0 CAM-1	I don't really wanna let these people out right here in the middle of the runway.		
1348:00.2 CAM-J	ah I wouldn't either.		
		1348:00.7 C-19	ground tug is in route.
		1348:03.4 GND	okay.
1348:04.0 CAM-?	*.		
1348:04.3 CAM-2	tug's on the way.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1348:04.6 CAM-1	so we probably just cheated death by that much I think.		
1348:07.4 CAM-2	so.		
1348:07.9 CAM-2	what happened to it?		
1348:08.9 CAM-1	ah the engine was burned through it burned *.		
1348:10.8 CAM-1	cowling burned.		
1348:11.2 CAM-J	burned the cowling.		
1348:12.3 CAM-?	(burned through the cowling).		
1348:14.0 CAM-1	* * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1348:17.2 CAM-?	* * *.		
1348:19.0 CAM-J	yeah and ya know you you.		
1348:20.6 CAM-J	the electric the hydraulics * * melted lines and wires shorted # out.		
1348:27.3 CAM-J	there's no such thing as a simple fire is there?		
1348:29.5 CAM-?	[sound of laughter].		
1348:29.6 CAM-1	but what I was I was gettin' a little worried because it seemed like I was having to use more and more aileron to keep the the wing up and ah I wasn't climbin' and 'course I had the gear down so you know I'm not gonna climb.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1348:31.5 INT-6	ladies and gentlemen we do need you in your seats please until we ahm taxi over to the gate thank you so much for your patience.		
1348:39.6 CAM-?	yeah.		
1348:41.8 CAM-2	yeah that's.		
1348:42.8 CAM-1	you know how you know and no you know no no guidance from this thing so I don't know how much can I how much can I do to the engine.		
		1348:43.4 GND	and car nineteen ah the tug is just comin' er ah by the base of the tower right now looks like.
		1348:48.3 C-19	roger that.
1348:53.5 CAM-J	whatever it takes.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1348:54.3 CAM-1	yeah yeah but I didn't wanna use up.		
1348:55.6 CAM-J	well I oh yeah right.		
1348:56.8 CAM-2	use up the only good one.		
1348:57.0 CAM-J	use up the last engine.		
1348:58.3 CAM-?	*.		
1348:58.3 CAM-?	[sound of laughter].		
1348:58.3 CAM-?	* * *.		
1348:59.8 CAM-2	well now we're down to APU power. [sound of laughter].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1349:02.5 CAM-1	okay now we're a glider.		
1349:03.7 CAM-J	* * * *.		
1349:04.9 CAM-2	there's a field right over here too * * * nice long runway but still you never woulda made it not with the gear down you (wouldn't make that).		
1349:22.7 CAM-1	but basically pullin' up that thing is what got the nose gear down.		
1349:25.1 CAM-2	yeah, which I do-I don't I'm gonna have to read 'cause I don't understand why *. 'cause I was under the ah.		
1349:30.8 CAM-7	(@) can you help me get this door shut?		
		1349:32.8 TRK-42	ground truck forty two.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1349:33.1 CAM-J	sure.		
1349:34.1 CAM-2	ahm.		
		1349:35.9 GND	truck forty two ground. go ahead.
1349:36.0 CAM-?	* * *. [multiple voices].		
1349:36.0 CAM-2	I would.		
		1349:37.5 TRK-42	we've checked out the aircraft the fire is out ah we ah the inside is good and ah we 'onna ahh prepare to let it taxi on it's own to the gate.
		1349:48.8 GND	okay he's gonna be tugged in ahm you wanna go ahead and secure the equipment just keep it come on with him?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1349:53.9 TRK-42	yeah we 'onna we gonna all follow 'im in on that side first.
1349:57.2 CAM-2	you know we ahm.		
		1349:57.8 GND	okay you gon- * you guy all gonna follow him into the * pen or * * *.
1350:02.7 CAM-2	yeah I don't get * we don't have a you don't have a red book so I er grey book but. I'm almost positive but that's *. the doors, everything's mechanical on it the doors are hydraulic.		
		1350:04.6 TRK-42	standby.
		1350:10.8 TRK-42	yeah ground we ah we just all follow him over to the terminal side and then we ah disperse from there.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1350:18.4 GND	okay yeah just let you know the tug is enroute he should be out there shortly.
1350:18.5 CAM-2	maybe that's what was holding (this) *.		
1350:20.5 CAM-1	what?		
1350:21.6 CAM-2	the doors should drop you have no hydraulic power.		
1350:22.5 CAM-1	yeah.		
		1350:22.6 TRK-42	roger.
1350:25.0 CAM-1	I don't know * either just the mechanical lock was holdin' it 'n it never released till you pulled up the handle?		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
		1350:25.8 TRK-42	* ground truck forty two.
		1350:27.9 GND	truck forty two ground.
		1350:29.3 TRK-42	truck forty's down here at the ah at the aircraft we lost a couple pieces equipment on the runway around Juliet I'm askin' for permission to go back down the runway and pickup that equipment.
1350:35.7 CAM-2	aw #.		
1350:40.9 CAM-2	sheddin' # on the runway too huh?		
		1350:41.1 GND	eh truck forty two that's approved.
		1350:44.6 TRK-42	ah could you repeat I I didn't hear you.

INTRA-COCKPIT COMMUNICATION

TIME and SOURCE	CONTENT

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT
1350:47.1 GND	truck forty ground that's approved you can drive down three zero left.
1350:50.8 TRK-42	ah message received thank you *.
1350:54.9 C-2	ground car this car two I picked that stuff up I'll meet him.
1350:58.8 GND	car two you got the stuff?
1351:00.7 C-2	yeah I got it.
1351:01.9 GND	yeah truck forty ah one of the city vehicles has got your equipment.
1351:05.6 TRK-42	okay message received thank you very much.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1351:11.2 CAM-1	what do we know about the tug?		
1351:13.0 CAM-2	it's on the way.		
1351:16.7 PA-1	okay folks ah the rescue folks have said the airplane is ah all safe and secure we're waiting on ah tug from ah the company to come out here and pull us off the runway ah as I said ah all my hy- hydraulics are ah gone and I don't wanna try and taxi the airplane ah without ah some way to steer it so ah we're gonna wait for the tug and I'm hopin' they'll be here shortly but ah please be patient we'll ah get ya back to the terminal as soon as we can.		
1351:44.8 CAM-2	he was he was passin' the tower they said the last.		
		1351:48.3 RDO-2	there is a tug gettin' close * fourteen hundred.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1351:50.1 CAM-?	* *.		
1351:52.0 PA-1	they should be * *those tugs don't drive very fast because ah all the ah power is a goes into the wheels for power not for speed.		
1352:02.6 CAM-2	you know what.		
		1352:03.6 C-19	ground car nineteen.
		1352:05.5 GND	car nineteen ground.
1352:06.3 CAM-2	it I bet ten bucks (it's) all (we go) * * # * *.		
		1352:07.3 C-19	yeah we got the tug here it'll be the tug and three pickups and myself I'll lead 'em out.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1352:11.8 CAM-1	yeah.		
		1352:12.1 GND	okay yeah yeah kinda waitin' for ya I guess.
1352:12.6 CAM-1	yeah * as soon as that happened I'm thinkin' (well) you know if you were doin' on an engine start and it didn't ah close what do ya do you shut the engine down. we shoulda just immediately headed back to the field when that happened * *.		
1352:22.5 CAM-2	well yeah in in retrospect yeah but I mean *.		
1352:25.2 CAM-1	but I mean we were headed back to the field almost (right away).		
1352:27.1 CAM-2	but it was.		
1352:28.4 CAM-1	I mean yeah it was like seconds.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1352:30.2 CAM-2	and you weren't even at what four thousand feet?		
1352:32.4 CAM-1	so huh.		
1352:33.2 CAM-1	I never got we never got above four thousand.		
1352:34.9 CAM-2	basically what is says is go to in-flight shutdown, * * * again so.		
		1352:36.3 C-2	ground car two.
		1352:38.9 GND	car two ground.
		1352:40.1 C-2	yeah three zero left's clear ah debris and I'm a leavin' the field.
		1352:43.9 GND	thank you.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1352:44.8 CAM-2	but anyway.		
1352:47.0 CAM-1	naw I guess we're not goin' to Orlando today.		
1352:48.8 CAM-2	probably not probably not naw good chance that's not gonna happen. (that) * *. * water * * * * water anyway.		
1352:57.2 CAM-1	yeah.		
1352:57.6 CAM-?	* * *.		
1353:09.6 CAM-2	well good thing he was on board * * * too # much for # two people to be # with * you got just a simple thing * you got this now we got this.		
1353:18.4 CAM-?	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1353:20.7 CAM-1	well wha- what do they say you know in the simulator they're not allowed to give us compound emergencies (right)?		
1353:25.1 CAM	[unidentifiable sound].		
1353:26.2 CAM-2	I'm thinkin' maybe it's not them * * *. [sound of laughter].		
1353:30.6 CAM-2	I mean you lost, electrical, you never and it and it never cross-tied.		
1353:35.9 CAM-1	no. * * *.		
1353:37.4 CAM-2	when this is runnin'.		
1353:38.4 CAM-1	and then when the engine went down I lost the whole left side.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1353:40.4 CAM-2	yeah.		
1353:41.3 CAM-2	and now the odd thing is this the APU picked up the left side.		
1353:44.6 CAM-1	probably shoulda gone over ta.		
1353:47.0 CAM-2	yeah * * (but).		
1353:51.8 CAM-2	we're here safely now.		
1353:53.2 CAM-?	do you have no right hydraulics? [sound similar to voice originating from outside the cockpit].		
1353:55.7 CAM-1	it's all gone * looks like it's all gone I didn't have any nose wheel steering.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1353:59.9 CAM-2	(comin' 'em) back?		
1354:00.6 CAM-J	yeah.		
1354:01.1 CAM-2	alright.		
1354:01.2 CAM-J	I wanna * * * enjoy this.		
1354:03.4 CAM-2	[sound of laughter]. tug ride in?		
1354:07.4 CAM-2	maybe we'll get a fire truck salute.		
1354:09.6 CAM-1	* * *.		
1354:10.1 CAM-J	it already did. whsss.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1354:11.4 CAM-?	* *.		
1354:12.3 CAM-2	you you should have it 'cause you got ah.		
1354:15.3 CAM-1	is there any fluid is that like pegged ah that's (on) zero * * any (right) hydraulic?		
1354:15.4 CAM-?	* *.		
1354:24.3 CAM-1	what have I got now?		
1354:29.3 CAM-2	* (have) quantity gotta (de-pressurize).		
1354:33.2 CAM-?	hm.		
1354:34.5 CAM-2	that's odd I just shut it off and look what it did?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1354:37.2 CAM-?	* * *.		
1354:40.0 CAM-2	hey I.		
1354:41.1 CAM-?	* * *. [sound similar to voice originating from outside the cockpit].		
1354:42.2 CAM-2	okay.		
1354:43.9 CAM-?	* *. [sound similar to voice originating from outside the cockpit].		
1354:45.1 CAM-1	well thanks.		
1354:45.7 CAM-?	* * * * *. [sound similar to voice originating from outside the cockpit].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1354:48.5 CAM-1	yeah I just wanted to get on the ground.		
1354:51.2 CAM-?	touch down at. [sound similar to voice originating from outside the cockpit].		
1354:53.8 CAM-1	ah probably about one fifty.		
1354:55.6 CAM-?	* * *. [sound similar to voice originating from outside the cockpit].		
1354:58.1 CAM-2	you have right pressure.		
1355:00.1 CAM-1	okay we got it now where was it before?		
1355:02.5 CAM-2	don't know.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1355:05.4 CAM-2	I just cycled the switch and then it started workin'.		
1355:09.2 CAM-2	you don't have left.		
1355:11.0 CAM-1	I don't have left don't have right.		
1355:13.2 CAM-2	ah # it the caravan's here. but the transfer * this died though.		
1355:17.3 CAM-1	yeah.		
1355:19.8 CAM-J	now it just went back zero.		
1355:21.5 CAM-2	yeah I just * cut the transfer off. but that should be well that should workin' 'cause you got power on.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1355:32.6 CAM-2	I don't know man.		
1355:33.6 CAM-J	(you got).		
1355:42.3 CAM-2	yeah but it's not ah.		
1355:46.1 CAM-1	what we have where'd that go?		
1355:47.8 CAM-2	(great shape). well that popped out when I pushed it.		
1355:49.1 CAM-1	* *.		
1355:51.0 CAM-2	right generator's workin'. and that should be dead, that's (working).		
1355:56.6 CAM-2	that should be pickin' up, (do this).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1356:01.2 CAM-1	so the APU's not pickin' up the right bus?		
1356:03.2 CAM-2	ah uh.		
1356:04.0 CAM-1	well that's 'cause the engine's running.		
1356:05.9 CAM	[sound similar to truck's backup horn].		
1356:06.1 CAM-2	but the ah but the engines not even runnin' it.		
1356:09.4 CAM-1	the engine's not runnin the right bus either?		
1356:13.5 CAM-1	you get one reset.		
1356:15.0 CAM	[unidentified sound].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1356:16.2 HOT	[sound of electronic bell and tone].		
1356:23.7 CAM-2	why are we * *? trans fails to wherever you had it set. taken out provided you don't get any power back if we have to it it aughta work.		
1356:24.9 CAM	[unintelligible voices and sounds similar to a truck's backup horn].		
1356:41.1 CAM-2	yeah that was working.		
1356:45.9 CAM-J	you got it now.		
1356:47.1 CAM-1	yeah but this aughta be aughta be be three thousand.		
1357:00.5 CAM	[unintelligible voices].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1357:05.5 CAM-2	I don't know.		
1357:12.8 CAM-1	we should have them pin the gear anyway and tow it after all the # we went through I don't need to have the gear collapse taxiing in.		
1357:18.2 CAM-2	yeah.		
1357:30.0 CAM	[unintelligible voices].		
1357:41.8 CAM-4	[warning bell and electronic voice] fire left engine [warning bell and electronic voice] fire left engine.		
1357:43.0 CAM-2	oh, you gotta be # me.		
1357:44.8 CAM-1	oh.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1357:46.2 CAM-2	I just moved that thing and it just.		
1357:51.4 CAM-2	that's 'cause it went back in when I pulled it yeah *. I was just lettin' the air back in. * * * * * pull it back out. # # it was hot.		
1357:54.8 CAM-?	* * * * * * *. [multiple voices].		
1358:02.2 CAM-?	(pull) fire alarm shutoff for the left engine. [sound similar to voice originating from outside the cockpit].		
1358:06.2 CAM-2	yeah, careful it's really hot.		
1358:06.3 CAM-?	dumping gas. [sound similar to voice originating from outside the cockpit].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1358:07.7 INT-M	cockpit ground.... pull the left engine isolation. pull the left engine shutoff valve. you're dumping fuel.		
1358:09.7 CAM-1	is it still dumpin'?		
1358:12.7 CAM-2	how the # * this # all off?		
1358:14.3 CAM-?	* * gear pins? [sound similar to voice originating from outside the cockpit].		
1358:16.8 CAM-1	you got the gear pins?		
1358:17.8 CAM-J	they're over there I think.		
1358:18.7 CAM-1	get the gear pins for him.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1358:18.9 INT-M	cockpit you read?		
1358:30.1 INT-M	cockpit, ground?		
1358:32.1 CAM-2	suppose that is?		
1358:34.4 CAM-1	hm.		
1358:36.4 CAM-1	* * the start valve?		
1358:38.5 CAM-2	(ah something ain't good).		
1358:41.9 CAM-2	yeah * for the start valve.		
1358:43.4 INT-M	cockpit, ground?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1358:46.0 CAM-2	you know this whole thing is fricken gone here.		
1358:48.4 INT-M	cockpit, ground?		
1358:49.5 INT-1	you read me?.		
1358:50.6 CAM-J	yeah you know when you have a you don't know what burned through and what's what's you know melted back there and get to be.		
1358:52.2 INT-1	uh eh this is cockpit to ground how do you hear?		
1358:56.6 CAM-2	yeah.		
1358:57.5 CAM-J	anything or nothing, this point.		
1359:01.5 INT-1	cockpit to ground how do you hear?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1359:01.7 CAM-2	it's hot.		
1359:03.8 INT-1	okay, you're pu-		
1359:04.4 INT-A	yeah read you loud and clear.		
1359:04.5 CAM-2	load closeout's been updated.		
1359:05.2 INT-1	yeah you're plugged into the cabin.		
1359:06.1 INT-M	do you have the left engine fire pull pulled?		
1359:08.5 INT-1	yeah uh yeah w- we did uh we pushed it back in for a moment, but it's out now.		
1359:14.5 INT-M	copy groun-? copy cockpit?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1359:17.6 INT-1	yeah, I copy you're plugged into the cabin interphone * plug into the flight side?		
1359:23.1 INT-7	and we we need everyone * in their seats with their seatbelts fastened with all carry on items stowed please.		
1359:26.3 INT-M	uh you copy uh cockpit?		
1359:28.5 INT-1	I hear you yeah I hear you.		
1359:30.7 INT-M	you can hear me?		
1359:31.7 CAM-1	yes.		
1359:32.4 INT-M	do you have the left engine fire pull pulled?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1359:34.9 INT-1	yes.		
1359:35.4 CAM-1	yes.		
1359:36.3 INT-M	okay do you have uh are the right hyd- why do you have uh you have no right hydraulic either?		
1359:37.4 CAM-2	but the loop's testing right?		
1359:40.6 CAM-J	well * * * * *.		
		1359:44.1 GND	American fourteen hundred ground.
		1359:46.1 RDO-2	yeah go ahead.
		1359:47.1 GND	yeah is there * * another problem now?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1359:48.1 CAM-?	* * * * *.		
		1359:49.4 RDO-2	well no they're just uhm trying to pin the gear and uh I guess a couple of other things.
1359:53.2 CAM-1	you're plugged into the cabin interphone. can you plug into the other interphone slot?		
		1359:56.2 GND	okay.
		1400:00.6 TRK-53	St. Louis ground truck fifty three.
1400:00.6 CAM-1	plug into the other interphone.		
		1400:02.3 GND	truck fifty three ground go ahead.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1400:04.2 TRK-53	truck fifty three I need ground I need to expedite to the D-concourse with a medical emergency of one of the fire personnel.
		1400:10.5 TRK-53	I'm on ah thirty left.
1400:13.1 CAM-2	no good. * * emergency for fire personnel.		
		1400:13.5 GND	abs- proceed as requested where do you need to go again.
		1400:16.0 TRK-53	D-concourse.
		1400:17.3 GND	D-concourse? go ahead and proceed it.
1400:17.9 INT-M	cockpit ground, copy?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1400:19.1 CAM-2	ah.		
1400:19.4 INT-1	yeah can you hear me now? how do you hear? you still don't hear me?		
		1400:19.8 TRK-53	truck fifty three proceeding down thirty left to Papa heading for D-concourse fifty three.
1400:19.9 CAM-?	(yeah).		
1400:21.1 CAM-1	* (here).		
1400:29.3 INT-1	how do you hear me now?		
1400:32.7 CAM-2	man look at this #.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1400:34.2 CAM-1	I don't know I can't even talk to him what what do you mean we have a medical emergency for the.		
1400:37.7 CAM-2	these guys.		
1400:39.1 CAM-2	why they ah one of them get sick or somethin?		
1400:40.8 CAM-2	naw.		
1400:41.0 CAM-2	hey they probably got a call they're going to the terminal.		
1400:42.7 CAM-1	he was said he was said for it was an emer- er ah medical for emergency personnel.		
1400:48.7 INT-2	you guys there?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1400:50.6 CAM-?	[unintelligible voices in background].		
1400:52.6 INT-1	you guys hear me?		
1400:53.5 CAM-1	what?		
1400:53.8 CAM-?	* * * * * * *. [sound similar to voice originating from outside the cockpit].		
1400:56.4 CAM-1	okay.		
1400:57.1 CAM-?	[unintelligible voices in background].		
1401:00.1 CAM-1	now they want to take everybody off.		
1401:02.9 CAM-2	why where we going to put 'em?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1401:04.4 CAM-?	[unintelligible voices in background].		
1401:13.6 CAM-2	no no no. naw that's *.		
1401:23.4 CAM-2	(#).		
1401:25.8 CAM-?	do you have you have the APU on line? [sound similar to voice originating from outside the cockpit].		
		1401:25.8 GND	and truck fifty three you said * * * the D-concourse or the Bravo concourse.
1401:29.6 CAM-1	yes.		
		1401:29.9 TRK-53	D-concourse ground.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1401:30.6 CAM-?	shut the right engine off. shut the right engine off. [sound similar to voice originating from outside the cockpit].		
		1401:31.8 GND	'kay the Delta concourse okay thank you.
1401:33.6 CAM-2	*?		
1401:34.0 CAM-1	shut the right engine off he says.		
1401:35.6 CAM-?	*.		
1401:36.6 CAM-2	see if that works.		
1401:42.1 CAM	[sound of single electronic chime].		
1401:45.2 CAM	[sound similar to automobile horn].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1402:07.6 CAM-2	(just) hope to @ that doesn't quit.		
		1402:10.6 GND	car nineteen ground.
		1402:12.5 C-19	go ahead ground.
		1402:14.2 GND	understand youse gonna be deplaning the ah aircraft you need a stepper out there?
		1402:19.8 C-19	I'm sorry sir say again.
		1402:22.1 GND	yeah we're bein' told you're gonna be * deplaning that aircraft now?
		1402:24.8 C-19	yes the firefighters want to get the passengers off I'm calling for the busses now.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1402:28.5 CAM-?	okay.		
		1402:29.0 GND	okay do you need some stairs out there also 'cause the stairs just left we saw?
1402:29.3 CAM-?	(you count the passengers).		
1402:30.8 CAM-1	well it appears that now we do but there was a period there where a lot of things were giving us funny indications and we we appeared to not have any right hydraulics ah I was landing the airplane I had a pretty good handful trying to maintain directional control and uh we just kinda decided that we didn't have nose wheel steering you know or you know very little.		
		1402:38.1 C-19	roger that ah operations center should be calling 'em.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1402:42.2 GND	okay.
1402:53.4 CAM	[unintelligible voices from outside the cockpit].		
1402:58.8 CAM-1	yeah but now we've got the uh aux pump on.		
1402:59.3 CAM-2	that's it.		
1403:02.0 CAM-2	it's off right now but.		
1403:03.8 CAM-2	so far.		
1403:04.4 CAM-1	I mean when we turn the aux pump on we get everything back now but there was a period there wh- where I think we didn't have the aux pump.		
1403:11.3 CAM-1	* there's been some strange electrical.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1403:12.8 CAM-J	yeah *.		
1403:13.1 CAM-2	the trans pump's dead though I.		
1403:15.2 CAM-1	what's that?		
1403:15.8 CAM-2	the trans pump is dead which is a.		
1403:15.9 CAM-?	okay ah I don't want to know why they wanna move the people off the airplane here. [sound similar to voice originating from outside the cockpit].		
1403:19.8 CAM-1	who's idea who's * *?		
		1403:20.4 TRK-107	ground truck one oh seven.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1403:20.9 CAM-?	* * the fire department said they were gonna. [sound similar to voice originating from outside the cockpit].		
1403:23.3 CAM-1	why do they want to do that?		
		1403:23.4 GND	truck one oh seven if you're on Charlie cross two four.
		1403:25.9 TRK-107	one oh seven and company crossin' two four on Charlie yes sir.
1403:27.1 CAM-?	* * * * *. [sound similar to voice originating from outside the cockpit].		
1403:29.2 CAM-1	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1403:29.7 CAM-?	what we're gonna do is we're gonna. [sound similar to voice originating from outside the cockpit].		
1403:34.3 CAM-1	what are you gonna do?		
1403:34.9 CAM-?	what we're gonna do is I'm gonna go up there I'm gonna ah we got the bypass * * about here we're gonna stow that bypass get the flaps slats gear doors back up and then we'll we'll either tow or tug back to the gate. [sound similar to voice originating from outside the cockpit].		
1403:45.9 CAM-1	okay.		
1403:47.1 CAM-?	* * *?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1403:47.9 CAM-?	I don't think they want to take the people off out here. [sound similar to voice originating from outside the cockpit].		
1403:50.0 CAM-2	no.		
1403:50.3 CAM-1	I didn't think so either.		
1403:51.8 CAM-2	no, no, no.		
		1403:51.9 RDO-1	hey ground ah this American fourteen hundred.
		1403:54.7 GND	American fourteen hundred go ahead.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1403:56.3 RDO-1	yes sir uuuh some of the crash folks are saying they want to deplane the people here but we don't understand why they want to do that we d- we're ready to we're hooked up and ready to be towed t-ah in just a couple of minutes and uh that's all just going to take that much longer.
		1404:10.6 GND	stand by just a minute truck uh or car nineteen with me?
1404:14.6 CAM-2	never gonna get everybody on those busses *.		
		1404:15.7 C-19	that's affirmative ground I'm right here.
		1404:18.2 GND	'kay he was ah American would like to know why they're wantin' to deplane the aircraft eah do you know why?

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1404:20.5 CAM-?	where is you're uh where's your gear handle selector. [sound similar to voice originating from outside the cockpit].		
1404:23.6 CAM-1	it's down.		
		1404:23.9 C-19	for the safety of the passengers I believe sir let me try contact the chief I'll be right with ya.
1404:24.9 CAM-J	the emergency gear.		
1404:25.3 CAM-?	trouble with your emergency extension. [sound similar to voice originating from outside the cockpit].		
1404:27.0 CAM-1	it's up we pulled it up.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1404:28.5 CAM-?	okay. [sound similar to voice originating from outside the cockpit].		
		1404:29.3 GND	okay.
		1404:30.1 RDO-2	well. it's actually gonna be safer to leave the folks here on the airplane everything is under control uhm they're just trying to get all the gear pinned and everything just for safety's sake and uh, we don't want to be dumping people out here on the ah on the runway.
1404:30.9 CAM-?	huh? [sound similar to voice originating from outside the cockpit].		
1404:31.7 CAM-?	* * * *. [sound similar to voice originating from outside the cockpit].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1404:33.0 CAM-?	no no. * * * stow that handle. you know how to stow the handle? [sound similar to voice originating from outside the cockpit].		
1404:37.5 CAM-1	yeah well we had to pull that up to get the nose gear down.		
1404:41.5 CAM-?	* * the right hydraulic * *. [sound similar to voice originating from outside the cockpit].		
1404:43.8 CAM-1	for a while there we didn't have much of anything.		
1404:47.2 CAM-1	I don't know what was going on. I was just trying to keep the blue side up.		
		1404:48.7 GND	nkay yeah the ther city's going to try to find out why the fire chief wants to deplane 'em stand by.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1404:51.4 CAM-?	I know uh. [sound similar to voice originating from outside the cockpit].		
		1404:52.7 RDO-2	yeah okay.
1404:54.9 CAM-1	we just basically in the end just said put the gear down (give me my) flaps * * landed.		
1405:00.7 CAM-?	to stow the handle just push the lever and push it down. [sound similar to voice originating from outside the cockpit].		
		1405:01.9 C-19	ground car nineteen.
1405:03.9 CAM-1	yeah yeah you got the nose gear pinned?		
		1405:04.0 GND	car nineteen go ahead.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1405:05.3 C-19	I spoke directly to the chief they wanna to deplane the passengers there's still heat and uh smoke coming out of the left engine they want to deplane the passengers outta here.
1405:05.5 CAM-?	* * * * *. [multiple voices originating from outside the cockpit].		
1405:08.9 CAM-?	gear gear handle's down? [sound similar to voice originating from outside the cockpit].		
1405:09.4 CAM-1	no.		
1405:11.3 CAM-1	the main gear handle is down 'kay.		
1405:15.5 CAM-2	is there still smoke coming out of the engine?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1405:15.5 GND	okay American fourteen hundred did you copy that?
1405:17.3 CAM-?	nosegear. [sound similar to voice originating from outside the cockpit].		
1405:18.6 CAM-1	I don't know is that what they're saying?		
		1405:18.7 RDO-2	yeah.
		1405:20.3 GND	okay that's the reason they're gonna be deplaning the aircraft.
1405:23.2 CAM-2	they said there's smoke coming out of the engine still.		
1405:24.7 CAM-1	still showing smoke coming out of the engine or something?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1405:25.9 OPS	ground comm center.
		1405:27.2 GND	comm center ground.
1405:28.0 CAM-?	no.		
		1405:28.2 OPS	yeah can you inquire if they're gonna need air stairs or if they have ah integrated ah steps that they can use?
1405:28.6 CAM-?	all the * * * (with you). [sound similar to voice originating from outside the cockpit].		
1405:31.1 CAM-1	well we pushed we pushed the handle in, we pushed the fire handle in for a moment.		
		1405:33.7 GND	car nineteen ground.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1405:35.6 CAM-?	okay *. [sound similar to voice originating from outside the cockpit].		
1405:36.1 CAM-2	* * started dumpin' (fuel).		
1405:36.1 CAM-J	* why * *.		
		1405:36.2 C-19	car nineteen ground yes we're gonna need the air stairs.
1405:37.0 CAM-?	* * * * * * * * * *. [sound similar to voice originating from outside the cockpit].		
1405:40.4 CAM-2	aw okay.		
1405:41.6 CAM-2	alright.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1405:42.1 CAM-2	there're gonna.		
		1405:42.4 GND	com center did you copy that?
		1405:44.7 OPS	that's firm.
		1405:45.7 GND	okay.
1405:45.7 CAM-2	they're ga- they're gonna deplane it.		
1405:46.6 CAM-?	* * * * *. [sound similar to voice originating from outside the cockpit].		
1405:47.7 CAM-2	* said there's smoke coming out of the engine still so.		
1405:47.9 CAM-1	talking to ground?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1405:51.3 CAM-1	huh?		
1405:52.7 CAM-2	okay.		
1405:54.1 CAM-1	do you want us to put the emergency handle?		
1405:55.7 CAM-?	* * * *. [sound similar to voice originating from outside the cockpit].		
1405:56.9 CAM-?	(stop). [sound similar to voice originating from outside the cockpit].		
1405:59.4 CAM-?	all three gear are pinned.		
1406:00.8 CAM-2	cool.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1406:06.0 CAM-2	I think it's asinine to send people out on the busses but.		
1406:12.9 CAM-1	when you ah pushed the fire handle in that started dumping fuel * *.		
1406:16.4 CAM-2	uh * lifted this up * *.		
1406:18.2 CAM-?	* * * * *. [sound similar to voice originating from outside the cockpit].		
1406:21.3 CAM-2	that's my fault there.		
1406:22.2 CAM-1	so now that's why the fire department wants to take everybody off.		
1406:24.6 CAM-2	oh.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1406:28.7 CAM-2	well that's my ah # up there.		
1406:30.6 CAM-1	okay.		
1406:31.0 CAM-?	* * * person * landing gear doors (and are closed). [sound similar to voice originating from outside the cockpit].		
1406:34.4 CAM-1	okay.		
1406:35.5 CAM-?	* *. [multiple voices].		
1406:36.2 CAM-1	'kay go ahead and.		
		1406:36.4 TRK-100	truck one hundred ground.
1406:36.6 CAM-2	but all it's he's gonna get I can't.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1406:38.8 CAM-1	okay.		
		1406:39.3 GND	truck one hundred ground.
		1406:40.4 TRK-100	leaving field maintenance we're gonna go west of the aircraft on three zero left and pick up the passengers.
1406:40.6 CAM-?	huh.		
1406:40.9 CAM-?	(there ya go) *.		
1406:42.2 CAM-2	but it's you know they're not.		
1406:43.5 CAM-1	yeah.		
1406:45.6 CAM-1	well he's * (wants) you to stow the handle.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
		1406:46.8 GND	thank you.
1406:48.4 CAM-1	* they got the gear pinned so they wanna get the.		
		1406:48.4 TRK-53	St. Louis ground truck fifty three.
1406:50.7 CAM-J	stow the emergency handle.		
		1406:50.9 GND	truck fitty three ground.
1406:51.8 CAM-2	aw okay.		
1406:52.5 CAM-1	stow the gear handle. yeah he wants to try the get the uh. he wanna try and get get the doors up.		
		1406:53.5 TRK-53	truck fifty three is on leaving the D-concourse like to go back out to the incident on thirty left.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1406:59.4 CAM-2	piece a #. ah.		
		1406:59.4 GND	truck fifty three at Kilo or Lima proceed on two nine and drive down thirty left.
1407:05.8 CAM-1	hang on a second he's trying to get the handle down.		
1407:07.7 CAM-?	* * * the handle comes * * * little lever comes * * door * *. [sound similar to voice originating from outside the cockpit].		
1407:08.4 CAM-2	(in a best spot).		
		1407:08.9 TRK-53	ground this truck fifty three I'm leaving D-concourse I'm over on the Charlie pad right now I'd like to go back out on thirty left.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1407:09.0 CAM-1	okay.		
1407:13.6 CAM-?	* * * * * *. [multiple voices originating from outside the cockpit].		
1407:14.0 CAM-2	* sumpin'.		
		1407:16.7 GND	truck fifty three proceed back on thirty left to the aircraft.
1407:16.8 CAM-1	got it down?		
1407:16.9 CAM-2	they go up?		
1407:17.6 CAM-?	* * * *. [sound similar to voice originating from outside the cockpit].		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1407:17.8 CAM-2	yeah.		
1407:18.3 CAM-J	I heard something happenin'.		
		1407:19.8 TRK-53	(fifty) three proceeding thirty left to the aircraft.
1407:25.2 CAM-?	got the handle stowed now? [sound similar to voice originating from outside the cockpit].		
1407:26.6 CAM-1	yeah.		
1407:31.4 CAM-1	the handle is stowed right?		
1407:32.4 CAM-2	yeah.		
1407:36.1 CAM-2	I just don't have any hydraulics for some reason.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1407:37.6 CAM-1	do you got @ there?		
1407:40.1 CAM-J	*.		
1407:40.2 CAM-2	* * * *.		
1407:48.4 CAM-2	we're gonna boar- * kick everybody off out here * * *.		
1407:50.7 CAM-1	even with the pumps on we're not gettin' any pressure.		
1407:53.3 CAM-?	*.		
1407:54.0 CAM-2	weee no we're * fight with them but the fire department says do it so.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1407:58.4 CAM-7	where are they go. where are they going to go?		
		1408:00.3 SWP-145	St. Louis ground sweeper one four five.
1408:01.6 CAM-2	they're gonna put 'em all on busses.		
1408:02.3 CAM-1	there's three busses right there they're gonna de- they wanna deplane the fire department insists because they saw some residual fuel coming out of the engine, it's still smoking or something so.		
1408:03.7 CAM-7	oh oh okay. okay I thought I smelled fuel. okay.		
		1408:03.7 GND	sweeper one forty five ground.
		1408:05.4 SWP-145	sweeper one four five is at Victor and thirty left requesting to go out to the aircraft just in case.

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1408:12.8 CAM-7	alright so I need I need to disarm this door and we'll use the front entry with stairs. and and do we need to talk them into keeping all their crap on the plane. 'cause they're all gonna try to carry all their crap.		
1408:12.9 CAM-1	we want to ah *.		
		1408:13.3 GND	proceed on thirty left.
		1408:15.1 SWP-145	one four five proceeding on thirty left.
1408:16.1 CAM-2	yeah.		
1408:17.3 CAM-1	yeah.		
1408:18.3 CAM-2	yeah yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1408:23.1 CAM-?	* * * *. [multiple voices].		
1408:26.7 CAM-2	well.		
1408:28.6 CAM-1	is there a- can we just let 'em take all their stuff off they probably should just take everything with them.		
1408:29.8 CAM-7	* * * * *.		
1408:34.2 CAM-1	that isn't quite right.		
1408:35.8 CAM-2	got a screw driver?		
1408:37.2 CAM-1	naw I'm not allowed to carry one, but I do have something that might work just as well. here try this.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1408:38.2 CAM-?	[sound of laughter] * * *.		
1408:43.2 CAM-7	I have scissors.		
1408:44.7 CAM-?	* * *.		
1408:46.1 CAM-2	(there we go those # are hot).		
1408:51.3 CAM-?	whoo.		
1408:51.5 CAM	[unintelligible voices, multiple speakers].		
1408:52.4 CAM-2	that thing burn your hand too?		
1408:53.7 CAM-1	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1408:54.0 CAM-2	I gonna * I-O-D on that.		
1408:56.6 CAM-1	* didn't burn it that bad I I used a rag I didn't.		
1409:02.9 CAM-2	see they're making some calls here trying to.		
1409:05.2 CAM-1	(are we still on the clock then)?		
1409:06.6 CAM-2	* * * *. [sound of laughter].		
1409:07.0 CAM-7	yeah would you be sure on that that's important. ahm. I'm not sure about all their stuff I (think) they'll fall down the stairs and break their necks carrying all their bags so I'm not sure what the procedure is on the *.		
1409:18.6 CAM-2	no.		

INTRA-COCKPIT COMMUNICATION

AIR-GROUND COMMUNICATION

TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1409:21.4 CAM-?	[unintelligible voices, multiple speakers].		
1409:22.2 CAM-J	yeah.		
1409:28.5 CAM-?	* * * * * *. [sound similar to voice originating from outside the cockpit].		
1409:34.7 CAM-2	okay.		
1409:35.1 CAM-?	* * *.		
1409:36.9 CAM-1	do you care whether they take all carry on stuff with 'em or what? leave it on? they want 'em to leave it on.		
1409:45.6 CAM-1	alright thank you.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1409:46.5 CAM-1	the fire department says to tell them to leave everything on the airplane. and he wants you to open the door. maybe you ought to do that @ can you do that?.		
1409:54.8 CAM-J	* yeah.		
1409:57.6 CAM-1	all right you want to do it, @? @ gonna do it.		
1409:58.7 CAM-?	*.		
1409:59.6 CAM-2	I'll do this.		
1409:59.6 CAM-7	are you gonna make an announcement or do you want me?		
1410:01.3 CAM-1	yeah, I'll make an announcement.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1410:02.6 CAM-?	* * * *. [sound similar to voice originating from outside the cockpit].		
1410:05.8 CAM-?	* *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1410:05.9 PA-1	okay uh folks this is captain @ speaking uuhm the fire department now has decided they saw some rel- residual fuel draining out of the uh left engine which was the engine that we had a problem with ah they want to uh in the interest I guess of being very cautious they want to deplane all of you folks uh out here there are some busses standing by uhm they've told me that they would uh request that you leave your carry-on luggage on the airplane you'll be able to get it once we get back to the terminal area but they want to take for in the interests of safety they want you folks to get off the airplane and then they're gonna tow us back into a gate uhm so I'd appreciate you cooperation ah just take the minimum amount of ah things you need to take with you but if you could leave your carry-ons on the airplane ah that's what the fire departments instructions were thank you.		
1410:10.5 CAM-?	[unintelligible voices, multiple speakers].		
1410:23.0 CAM-J	* tired * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1411:07.3 INT-7	when you're ready you can deplane but once again leave your carry-on items on the airplane we- we'll get them back to you as soon as the plane gets to the gate.		
1411:22.5 CAM-1	how much of a gap do they have to cross there?		
1411:25.7 INT-7	ladies and gentlemen once again leave your carry on bags * * * * *		
1411:26.1 CAM-7	the ca- the fireman has * * *.		
1411:27.5 CAM-?	anybody need any help gettin' down the stairs * *? [sound similar to voice originating from outside the cockpit].		
1411:28.4 CAM-1	there's somebody there helpin' 'em?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1411:29.9 CAM-7	yeah the firemen.		
1411:32.9 CAM-?	(what's up). [sound similar to voice originating from outside the cockpit].		
1411:33.5 CAM-?	(I don't know) * * *. [sound similar to voice originating from outside the cockpit].		
1411:35.0 PA-1	and folks as you ah deplane through the front door here please ah use caution there's a slight gap between the aircraft and the stairs ah so just watch your step as you go off the airplane please thank you.		
1411:48.9 CAM-?	* * * * *. [sound of laughter].		
		1412:00.2 C-19	ground car nineteen.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1412:00.6 CAM-7	well this has been exciting you did a wonderful job.		
		1412:01.6 GND	car nineteen ground.
		1412:03.4 C-19	yes ground car nineteen I'll be out of the vehicle ah for a couple of minutes OPS center is gonna be monitoring the frequency they can get me on my eight hundred radio if you need me.
1412:03.6 CAM-1	thanks.		
1412:03.8 CAM-7	he to- he told me that it wasn't pretty.		
1412:06.6 CAM-1	yeah it was.		
1412:07.7 CAM-J	* these guys act like she thinks *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1412:09.2 CAM-1	thank you.		
1412:09.4 CAM-7	all stuff you learned paid off today.		
1412:11.7 CAM-1	I guess so well I'm just glad it was a nice bright sunny da-.		
		1412:12.2 GND	okay.
1412:13.3 CAM-?	thank you very much.		
1412:14.8 CAM-1	oh you're welcome thank you thank you.		
1412:15.3 CAM-7	thanks your welcome.		
1412:18.1 CAM-?	nice job guys.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1412:19.3 CAM-1	thanks.		
1412:19.9 CAM-?	great job.		
1412:21.0 CAM-1	thanks.		
1412:21.8 CAM-?	* * that ah.		
1412:24.6 CAM-7	we're all fine.		
1412:25.5 CAM-?	yeah thank you.		
1412:27.1 CAM-1	there was never a *. there was never a problem.		
1412:30.1 CAM-?	no * is good.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1412:31.3 CAM-?	*.		
1412:35.7 CAM-1	we were just overwhelmed (when stuff happen).		
1412:37.9 CAM-7	(that's what) I said everything went wrong at once isn't that what they always say on T-V, the cascading of events. probably always say that when they talk about *.		
1412:45.9 CAM-1	* * stuff happening and you know when * it all goes back to changing that start valve.		
1412:50.4 CAM-?	thanks guys.		
1412:51.7 CAM-1	thank you.		
1412:53.2 CAM-7	thanks for flyin' American.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1412:55.6 CAM-1	even though the flight was short.		
1413:00.0 CAM-7	all back to that? 'cause @ said he been flyin' around for a couple of days in this airplane * *.		
1413:06.8 CAM-1	first thing we had was we * we got the gear up and we got up to about I don't know twenty three twenty five hundred feet or so and was just turnin' out of traffic and we got a indication that the left start valve was open which you can't have * you can't in flight it's not a good thing you know * I goin' oh shh.		
1413:27.4 CAM-7	I heard all that stuff goin' on.		
1413:28.2 CAM-1	time to think about yeah before we had time to even figure out okay what are w- do with that next thing we got was * fire light and ah and then we're losin' stuff and ah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1413:40.3 CAM-7	and the gear wouldn't go down?		
1413:41.7 CAM-1	gear wouldn't well the nosegear wouldn't go down that's why I went around the first *. and then I'm out there and I'm goin'. I'm havin' a # of a time holdin' altitude.		
1413:52.7 CAM-7	oh my @.		
1413:55.1 CAM-1	* so main gear were down we're down to one engine can't get the gear back up.		
1414:01.4 CAM-1	but we didn't want to put the gear back up.		
1414:03.5 CAM-7	no.		
1414:04.1 CAM-1	I didn't think * * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1414:05.1 CAM-7	(no). (you did a good job).		
1414:09.1 CAM-1	(thanks).		
1414:09.6 CAM-7	both of ya.		
1414:11.3 CAM-1	* * * * @ was * I was just tryin' to fly the airplane and @ was tryin' to deal with radios and work figure out what the you know problem was.		
1414:11.5 CAM-7	or all three of you.		
1414:21.8 CAM-?	thank you all.		
1414:22.9 CAM-7	# door kept opening I couldn't get the door shut.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1414:23.9 CAM-1	* * * we lost *, we're losin' our instruments up here. and ah so I said get @ up here we need a third guy.		
1414:32.9 CAM-7	yeah that's good.		
1414:40.8 CAM-1	so I guess you guys aren't gonna do your La Guardia turn.		
1414:43.0 CAM-7	Hmmm?		
1414:43.6 CAM-1	at least your not gonna do your La Guardia turn.		
1414:45.1 CAM-7	darn it I just love that so much.		
1414:49.9 CAM-?	go ahead?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1414:51.8 CAM-1	I should.		
1414:53.8 CAM-1	you know in.		
1414:57.2 CAM-1	thirty five years of flyin' that's the first time I've ever had anything like that happen.		
1415:02.3 CAM-7	that's what @ said he never had * done * ever neither.		
1415:07.5 CAM-7	the only thing I've had are a couple of aborted landed because there's a plane or somethin' on the runway and that's it I've never had anything I was really kinda hopin' once we're on the ground I really wanted to do that evacuation 'cause I've never done * * * training.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1415:19.7 CAM-1	oh yeah well I just I was you know unless we were burnin' up I didn't wann dump all the people out here.		
1415:25.7 CAM-7	yeah oh yeah 'cause then they'll all break their legs goin' down the slide.		
1415:29.7 CAM-1	* * * * *?		
1415:32.8 CAM-7	we've * right on it with the busses and the firemen and all that stuff.		
1415:43.2 CAM-1	'cause I was one point (when) we were halfway over after we landed got on the runway it just started goin' to the right * * pushin' with everything I got on the left and.		
1415:59.2 CAM-7	oh my @.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1416:07.1 CAM-1	* * (do that) * * put the engines in reverse so the right engine was probably helpin' to push us over * * *. didn't have any nose wheel steering.		
1416:22.3 CAM-?	yeah that's it.		
1416:26.7 CAM-?	nice work skipper.		
1416:28.3 CAM-1	thank you.		
1416:33.8 CAM-7	when we started I could hard you know I could hardly see but I after we were thinking it's gonna be in just a couple minutes we're landing and when we didn't land and I saw fields and stuff I though oh my @ he's gonna put it down in a field that's what I'm thinkin' you're gonna land in out there somewhere.		
1416:49.2 CAM-1	* * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1416:51.9 CAM-1	we turned we're turned on to final and put the gear down and the nosegear didn't (go down) and I'm goin'.		
1416:59.8 CAM-7	ohhhh.		
1417:00.7 CAM-1	I wa- I'm just tryin' to fly the airplane at that point.		
1417:02.2 CAM-7	yeah.		
1417:02.6 CAM-1	@ looks over and see this little thing?		
1417:04.4 CAM-7	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1417:04.6 CAM-1	when the nose gear’s down this sticks up, when the nose gear’s up that's down and flush. @ looks over there and he says isn't that supposed to be stickin' up? I'm goin' aw #.		
1417:14.6 CAM-7	oh my @.		
1417:15.9 CAM-1	so we call the tower he says ehh it looks like only your mains are down * * goin' around.		
1417:20.7 CAM-7	oh @.		
1417:21.5 CAM-1	figure out why we * how we're gonna get the nose * I I though we were comin' back I thought we were gonna come back and land * with the nosegear up. and I was gettin' ready for that.		
1417:31.7 CAM-7	oh my @.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1417:32.7 CAM-1	and @ was able to pull up the emergency gear handle and when he pulled that up that unlocked at that point we lost all the power that would've unlatched should have unlatched the gear when we put the put the main gear handle down. whatever was supposed to have unlocked the nosegear didn't unlock it.		
1417:46.2 CAM-?	* * a good job I was impressed. yeah okay you did you did. * heckuvajob hey I was impressed, * you brought it in safe. say (sumpthin'). (yeah but you did it) * (did it did it * * (that engines though).		
1417:49.6 CAM-7	oh my @.		
		1417:52.9 TRK-167	St. Louis ground this is truck one sixty seven I'm on Charlie I'd like to cross two four.
1417:52.9 CAM-1	hey thank you.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1417:55.7 CAM-1	well that's what they train us for [sound of laughter]. I guess the trainin' works.		
		1417:57.0 GND	cross two four.
		1417:58.6 TRK-167	sixty seven crossing two four.
1418:00.3 CAM-1	yeah well I'm sure glad that it was no I * * glad it was a bright sunny day.		
1418:03.8 CAM-?	yeah [sound of laughter].		
1418:05.0 CAM-?	yeah I'll (stand) for * *.		
1418:06.3 CAM-1	thank you.		
1418:07.6 CAM-4	thank * guys heluvajob I mean I.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1418:10.1 CAM-4	unbelievable, no flaps no spoilers.		
1418:13.6 CAM-2	did we have any flaps? I mean I don't know.		
1418:17.4 CAM-4	you didn't have anything for the landing.		
1418:18.6 CAM-2	didn't we?		
1418:19.7 CAM-1	is that right? we didn't have any flaps. flaps?		
1418:21.4 CAM-4	huh?		
1418:21.8 CAM-1	we didn't have any flaps huh?		
1418:22.8 CAM-4	no flaps. and you had no spoilers.		

INTRA-COCKPIT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
1418:23.4 CAM-1	we didn't. we didn't really know what we had.		
1418:26.0 CAM-4	yeah.		
1418:26.1 CAM-2	it's showin' that they're down to twenty eight (but).		
		1418:26.8 TRK-167	truck one sixty seven cleared two four thanks.
1418:27.9 CAM-4	no.		
		1418:29.1 GND	thank you.
1418:29.2 CAM-2	they're twenty eight now.		
1418:30.8 CAM-4	they were nothin' (when we landed).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1418:33.5 CAM-1	so I don't even know, I didn't know what was wrong with the airplane it was just all kinds of (goofy) stuff.		
1418:35.1 CAM-2	so like I said it just everything started going start valve light came on and then the then the fire light came on and then after tha- everything just went * * *.		
1418:48.0 CAM-2	everything froze. I mean and then had A-C crosstie and then you wouldn't believe all the # that went wild I mean it's just.		
1418:53.7 CAM-?	I just need to know the numbers * * * *. * at everybody, I mean left on the plane * * *.		
141902.2 CAM-?	* *.		
1419:02.6 CAM-?	* * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1419:04.2 CAM-2	* * *.		
1419:05.1 CAM-2	well (he was) * * yeah but (he's got seven) * *.		
1419:07.8 CAM-?	you got it.		
1419:11.5 CAM-4	it's eight it's eight it's eight eight eight eight eight eight eight. [multiple voices overlapping].		
1419:13.5 CAM-?	ah.		
1419:16.1 CAM-?	* * * *.		
1419:16.7 CAM-?	* * * you sure now? you sure? [sound similar to voice originating from outside the cockpit].		
1419:19.2 CAM-?	yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1419:28.4 CAM-4	(I haven't looked at the union but I understand that) * *.		
1419:29.8 CAM-6	hey you did a good job.		
1419:31.4 CAM-1	thank's.		
1419:32.2 CAM-6	did a good job.		
1419:38.6 CAM-6	I kept tryin' to get ahold of the number four goin' can you see the ground yet can you see the.		
1419:45.5 CAM-1	oh well then what did you think when we went around?		
1419:48.4 CAM-6	well I I know we went around a couple- I knew the minute we took off something was wrong.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1419:53.8 CAM-1	did ya?		
1419:54.4 CAM-6	yea as soo- like when we took off and you s- you like stopped a little bit.		
1419:59.2 CAM-1	oh yeah.		
1419:59.8 CAM-6	and we we hesitated. and I though oh well maybe there's some traffic in the way and then when we didn't climb any more I thought somethin's not right.		
1420:07.7 CAM-2	start valve *.		
1420:09.0 CAM-1	we had the we had a whole bunch of stuff happinin' and we can't even figure out why * * some of it doesn't make any sense.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1420:12.6 CAM-2	because because we were climbing out it cyc- * * it cycled on and then right after that * *.		
1420:19.4 CAM-1	start valve the start valve that they changed uhm I don't know if they didn't secure it properly but by the time we were * but		
1420:27.5 CAM-6	is that in the same?		
1420:28.8 CAM-1	but on the on the left engine 'bout the 'bout the time we got through about two thousand twenty five hundred feet the light came on up here that told us that start valve was open it can't be open when the engine's running.		
1420:39.5 CAM-J	but they the first one that they had they couldn't get it * * * open and so then they swapped it out.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1420:40.6 CAM-1	and then I don't know within ten or fifteen seconds they had an engine fire *.		
1420:48.0 CAM-1	he he couldn't.		
1420:49.1 CAM-M	you need to shut that hy- hydraulic pump off it's it's not * * in here it's gonna just overheat here in a second I sure do not understand, what is goin' on with this airplane.		
1420:55.2 CAM-1	* (you want me to depress-) * well we're not quite sure what happened either I mean it it was just there was so many different things happenin' and uh. but I think was started it all was uhm we had a they brought this thing in it's been flyin' around with a left start valve inop.		
1421:14.8 CAM-M	mmh hmm.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1421:16.1 CAM-1	required manual opening (okay) when we were gonna start to leave the gate they said they could not get it open manually so they did it they did it they changed it.		
1421:16.4 CAM-2	* last leg. last leg (I'm tired). I should get a picture of myself * too.		
1421:24.7 CAM-M	yeah.		
1421:27.7 CAM-2	yeah we didn't have nosegear * * * *.		
1421:28.9 CAM-1	they slipped a news- they put a new start valve in and-		
1421:31.0 CAM-M	no they didn't change the start valve.		
1421:32.6 CAM-1	hah?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1421:32.9 CAM-M	they jus- they didn't change the start valve they just opened it up manually.		
1421:34.1 CAM-1	oh they didn't?		
1421:36.0 CAM-1	well.		
1421:37.2 CAM-1	he said they were gonna change it.		
1421:38.8 CAM-M	well * well they couldn't open it up we they couldn't open up there's there's a button on there that you could can use to open it up ahm manually but the button wouldn't open the valve.		
1421:39.1 CAM-2	well when we came around the first * * I looked (up) and it's just quiet * I mean * * * * *.		
1421:39.9 CAM-?	* * whatever.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1421:46.9 CAM-?	uhm.		
1421:49.0 CAM-1	yeah.		
1421:51.2 CAM-1	thought you hadda put a wrench on it er ah.		
1421:53.1 CAM-M	well that's what they did they put a wrench on it.		
1421:55.8 CAM-1	okay.		
1421:56.2 CAM-M	you didn't see the start valve light come open did it?		
1421:56.9 CAM-2	no that was ta to go back around and com here ah we already knew * * but then * * * * * * * * nosegear * * had no indication either I don't what's wrong * think * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1421:58.2 CAM-1	yeah.		
1421:58.6 CAM-M	the start valve came open?		
1421:59.9 CAM-1	about oh when se- when we were starting?		
1422:02.5 CAM-M	no no when you were ah in cruise *.		
1422:03.7 CAM-1	yeah about twenty five hundred feet the start valve light came on.		
1422:06.9 CAM-M	it came on?		
1422:07.7 CAM-1	yeah and then shortly after that we got the engine fire light and uh fire left engine warning and all that stuff.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1422:15.5 CAM-1	then we ah stopped our climb ah between I don't know about thirty five hundred we didn't make it to four thousand feet.		
1422:15.5 CAM-4	* * * * * * * so people around me wouldn't think that we were about to die I read the same page like twenty five times I couldn't tell ya what * * *.		
1422:20.0 CAM-2	I jus- I jus- I just threw that (cap) *.		
1422:24.3 CAM-1	that wouldn't go out the light in this thing wouldn't go out the light bulbs are down here they were just it was made it so hot. the reason that it dumped fuel was because he was I don't know what he was doin' with the he pushed it back in for a moment and that's when it started dumpin it- that was the fuel between here and the spar I guess.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1422:44.0 CAM-1	ahm what else happened okay so then we were getting that and then ah we were just gonna go back to land and we were lined up on thirty right and put the gear down and the nosegear didn't go down.		
1422:52.7 CAM-2	so * * come dow- see what's really weird now turn the transfer pump on? turn the * * turn the aux pump * * turn the transfer pump on goes dead.		
1422:57.6 CAM-M	well see something happened to the hydraulic system too.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1423:01.2 CAM-1	yeah we couldn't figure out what was goin' because about that time ah we had cut off the fuel to the left engine you know to shut it down and my left generator wound down and next thing I knew my instruments were goin' crazy we got a cross a ah crosstie lockout up here I reached up and turned on I moved the ah APU master switch to start I'm tryin' to get the APU up and it came up I guess but I could never really tell that I ever got electricity back. so then when we got on the runway ahm.		
1423:07.3 CAM-2	you gotta be # me.		
1423:14.1 CAM-2	I wondered where it said that. (whaddya say?)		
1423:18.2 CAM-M	well there's a lot of wiring that burned up.		
1423:19.7 CAM-4	can't can't wait.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1423:28.5 CAM-4	stick this one where the sun doesn't shine I mean you had fifty percent man.		
1423:33.6 CAM-2	you know when you got what time you gotta be to work?		
1423:35.6 CAM-M	no there.		
1423:36.6 CAM-1	I ah.		
1423:37.2 CAM-M	you never had you never had any hydraulic you mighta.		
1423:39.0 CAM-1	did I ever get the did I ever get the reverser out? Just wonder if I got the right reverser out because it did start-.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1423:44.4 CAM-M	(the) accumulator would've shut the reverser down.		
1423:46.8 CAM-1	yeah so I got the right reverser open then I started goin' to the right and I almost couldn't stop it. * pushin' with everything I had on the left rudder and uh once we got down to slow speed I couldn't even work the the tiller.		
1423:49.1 CAM-2	* * * the eagle thing after that?		
1423:52.1 CAM-?	what's that?		
1423:55.1 CAM-M	oh okay.		
1424:01.8 CAM-M	well you have see there's no hydraulics on the airplane at all now. I don't know why you had see you have two failures here you had the engine failure and hydraulic failure.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1424:11.1 CAM-M	seems strange.		
1424:12.4 CAM-1	don't we have hydraulic fluid now?		
1424:14.3 CAM-M	yeah you got fluid.		
1424:15.1 CAM-1	but we don't have any pressure so.		
1424:16.3 CAM-M	no.		
1424:17.2 CAM-2	you know they were what was your name again?		
1424:19.2 CAM-?	it's @.		
1424:19.7 CAM-1	so we didn't know what.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1424:20.2 CAM-2	he was. he was saying that we had no flaps when we landed.		
1424:24.2 CAM-4	you guys had nothin' you had you had a- you had the slat you had nothin' else.		
1424:25.6 CAM-M	no because you-.		
1424:28.6 CAM-1	no #.		
		1424 :28.7 V-61	St. Louis ground vehicle sixty one.
1424:29.2 CAM-2	and then.		
1424:30.1 CAM-1	good thing I didn't go any slower, huh?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1424:31.5 CAM-2	yeah well yeah in retrospect yeah.		
1424:33.2 CAM-4	* and you know you- and the same thing was when you were up in flight when you were doin' the pattern.		
		1424 :34.3 GND	vehicle sixty one ground.
		1424 :36.5 V-61	St. Louis ground vehicle sixty one requests permission to enter taxiway Sierra from the Charlie pad to go to the incident on three zero left.
1424:37.8 CAM-1	yeah.		
1424:38.1 CAM-4	and you were tryin' to * a little bit to get the gear down.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1424:40.3 CAM-1	yeah. nothin' huh?		
1424:42.3 CAM-4	slats that it.		
1424:43.3 CAM-2	what uhm isn't the nosegear all mechanical?		
1424:46.5 CAM-M	the the nosegear would should ahm mechanically fa- fall out in here when you pull up on this handle here you are actually physically kickin' the over-center open.		
		1424:49.3 GND	okay that was truck sixty one is that correct?
		1424:51.4 V-61	that is correct I'll have one in trail.
		1424:54.8 GND	proceed * on thirty left.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1424:56.1 CAM-4	right.		
1424:56.5 CAM-M	and also what you do to when you pull this up is you in the hy- in the control valve all the spools line up to where there there's the pressure goes to return so there's no pressure on the gear up or down or nothin' and so basically the hydraulic system is not even there basically it's just ah it's just a mechanical thing that falls.		
		1424:56.7 V-61	vehicle sixty one.
1424:57.3 CAM-M	also.		
1425:07.8 CAM-2	okay that okay.		
1425:10.2 CAM-2	right okay.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1425:13.4 CAM-2	okay.		
1425:13.9 CAM-M	why the gear didn't fall ahm.		
1425:16.1 CAM-2	the mains did but the nose didn't.		
1425:17.6 CAM-M	did you get a ahm did you get an unlock, light.		
1425:20.9 CAM-2	we had nothin' was workin'.		
1425:22.5 CAM-1	yeah we no * * *.		
1425:23.5 CAM-2	all the * everything was out.		
1425:24.3 CAM-1	the electricity was all screwed up up here I mean we didn't know what we (had).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1425:26.3 CAM-2	I mean the cross-tie failed and so it was just kind of a multitude a.		
1425:27.8 CAM-?	yup.		
1425:29.7 CAM-M	well we'll have to let well I guess what we'll do then is we'll put down uhm.		
1425:29.8 CAM-2	(missing).		
1425:33.9 CAM-2	you guys gonna take it outta service or?		
1425:35.3 CAM-M	oh yeah it's out of service yeah.		
1425:36.5 CAM-1	[sound of laughter].		
1425:37.9 CAM-2	I know I'm just wonderin' ah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1425:38.3 CAM-M	ahm we need to we need to write up that we have ah that we lost the right hydraulic * * * hydraulic system.		
1425:44.7 CAM-1	both hydraulics?		
1425:45.8 CAM-2	I don't know if this'll.		
1425:46.0 CAM-M	* * and lost both hydraulic system and you also need to write up that the nosegear didn't free-fall.		
1425:50.9 CAM-1	okay.		
1425:51.7 CAM-4	and when when you guys finally came to a stop.		
1425:51.7 CAM-2	yeah 'cause.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1425:53.7 CAM-1	yeah?		
1425:54.7 CAM-4	the the ground and flight spoilers popped up.		
1425:57.0 CAM-1	uh huh.		
1425:57.1 CAM-4	momentarily and then fell back down and the flaps went down to whatever you had it set at twenty eight.		
1426:01.9 CAM-1	soooo that's. 'cause the handle 'cause the handle deployed.		
1426:03.0 CAM-4	you landed with zero flaps.		
1426:04.5 CAM-2	they deployed but they didn't come up.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1426:05.8 CAM-4	spoilers * * deploy.		
1426:08.5 CAM-?	* * *. [multiple voices].		
1426:09.8 CAM-1	no #.		
1426:10.2 CAM-2	that's why you didn't slow down #.		
1426:10.8 CAM-4	you didn't have anything until you came to a stop.		
1426:13.0 CAM-1	wow.		
1426:14.2 CAM-2	and then we nose had no nose wheel steering.		
1426:16.0 CAM-4	well I'm wonderin' if you had any brakes did you just accumulator brakes?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1426:16.6 CAM-?	I down know na- * * * * *.		
1426:19.0 CAM-1	* I well I did- I didn't take my feet off the brakes till we stopped I don't know.		
1426:23.1 CAM-4	* good thing you didn't because you probably woulda- I would if you didn't have that stuff I can't imagine you had more than accumulator brake pressure.		
1426:29.0 CAM-2	* that's * * that shoulda that shoulda * * * * * * * * * *.		
1426:29.9 CAM-M	but you were done I don't think there's any pressure on it now well see that left * that left stop somethin's not right about that either.		
1426:37.8 CAM-1	well once we got stopped both of these needles were over here in the red.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1426:41.2 CAM-M	yeah.		
1426:41.4 CAM-2	we got some training here right?		
1426:42.6 CAM-M	yup yeah we got some training.		
1426:43.9 CAM-1	so I just I can * * *.		
1426:45.6 CAM-?	* * * * brand new truck [multiple voices].		
1426:47.3 CAM-M	yeah.		
1426:48.1 CAM-1	stuff kept happinen' I go what the # now.		
1426:50.1 CAM-M	yeah yeah.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1426:51.0 CAM-1	get this # thing on the ground before.		
1426:52.4 CAM-M	yeah.		
1426:53.4 CAM-M	yeah you know what * * * * *.		
1426:57.4 CAM-2	I'm goin' take a picture for us on the cell phone.		
1426:59.8 CAM-1	yeah might as well.		
1427:01.1 CAM-2	everybody else was.		
1427:03.5 CAM-?	* * * * captain you helped the crew out a whole lot you did a # job there yes sir thank you.		
1427:07.4 CAM-1	* * thanks appreciate it thanks for being there for us.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1427:10.9 CAM-?	no problem.		
1427:13.1 CAM-?	good job * *.		
1427:14.8 CAM-2	so are you gonna retire early now or what?		
1427:21.5 CAM-?	take a look at that *.		
1427:23.9 CAM-?	(you got all kinds of) * *. [sound similar to voice originating from outside the cockpit].		
1427:24.6 CAM-?	* * (I can't drink this water). [sound similar to voice originating from outside the cockpit].		
1427:27.0 CAM-2	* * * did you need anything er * * *.		
1427:38.2 CAM-7	(bring it on).		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1427:40.0 CAM-7	* did you have water here?		
1427:50.0 CAM-2	catch.		
1427:51.1 CAM-?	[sound of laughter].		
1427:55.9 CAM-A	couple more'll do it that'll get it thank you.		
1427:59.5 CAM-A	* * happens to me (eat) in the firehouse supperclub too much.		
1428:02.2 CAM-?	[sound of laughter, multiple voices].		
1428:06.3 CAM-F	* * who's the FO.		
1428:07.9 CAM-2	right here.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1428:08.5 CAM-F	did you pull the breakers for the ah voice recorder and ah.		
1428:11.6 CAM-2	no.		
1428:12.2 CAM-1	no.		
1428:12.7 CAM-F	go ahead pull 'em.		
1428:13.5 CAM-2	alrighty we'll get 'em wherever the # they're at.		
1428:16.8 CAM-F	you'd wanna preserve that you're a hero.		
1428:18.5 CAM-2	yeah well it's probably gone by now.		
1428:20.0 CAM-?	* have no idea how big a hero * * * * * * *.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1428:21.7 CAM-2	well the # are things at flight you want flight recorder and what else?		
1428:25.3 CAM-?	ah he wants to pull the ah if you got voice recorder and flight recorder		
1428:28.8 CAM-2	(look) at this left engine oil pressure (popped).		
1428:30.9 CAM-?	should be on the emergency checklist look on you yoke clip.		
1428:31.7 CAM-2	yeah it would it woulda popped.		
1428:33.7 CAM-?	it'll tell ya on the yoke clip.		
1428:35.3 CAM-2	look at you guys man.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	CONTENT	TIME and SOURCE	CONTENT
1428:38.1 CAM-2	voice recorder F-six.		
1428:40.4 CAM-1	(okay) there we go.		
1428:43.2			
End of Transcript			
1428:46.6			
End of Recording			

Appendix C

Combustible Fluid Source

Investigators considered the possibility that either a preexisting, latent failure condition of a nacelle component or degradation of an engine component caused by the hot air might have compromised the containment of a combustible fluid source in the nacelle making the fluid readily available to the ignition source presented by the freewheeling air turbine starter (ATS). Several combustible fluids, including fuel, oil, and hydraulic fluid, are contained in components within the nacelle cavity, but it is unlikely that a preexisting combustible fluid leak existed in the left engine nacelle. If a combustible fluid leak were present in the nacelle when the airplane was on the ground, the American Airlines maintenance personnel who opened the lower engine cowl door to manually start the engine would likely have noticed any leaking fluid. During postaccident interviews, maintenance personnel indicated that they did not see or smell anything unusual.

Still, a small hole in the fuel or hydraulic lines could emit a mist of fuel or fluid that could be ignited if an ignition source was available. However, no pinholes were found in the fuel lines aft of the ATS exhaust. Some of the hydraulic lines could not be inspected for leaks because they were destroyed in the fire. Several small components in the nacelle had reservoirs that contained oil, but the quantity was too small to sustain a fire of the magnitude observed in this accident. The oil quantity within the ATS gearbox was also too small to sustain such a large fire. The engine main gearbox is the only oil reservoir that contained enough oil to sustain a significant fire in the nacelle; however, all the engine main gearbox oil was found in the gearbox. Therefore, oil was eliminated as a potential fuel source of the fire.

No hydraulic fluid was found in the left hydraulic reservoir; however, the reservoir's indicating piston was found at the full fluid-level position. Postaccident testing of the reservoir determined that the reservoir was functioning properly. The only way for the indicating piston to remain at the full position with no fluid remaining in the reservoir was if the system pressure and hydraulic fluid were released simultaneously. If the system had leaked while the system was still pressurized, the indicating piston would have moved to a lower level. Flight data recorder data indicated that the hydraulic system did not go into a low-pressure (below 900 pounds per square inch) condition until about 16 minutes after the Left Engine Fire Warning light illuminated. Therefore, the left hydraulic system most likely lost its fluid and pressure well after the Left Engine Fire warning light illuminated, and this evidence eliminates hydraulic fluid as a potential initiating fuel source of the nacelle fire. However, hydraulic fluid residue was found, indicating that hydraulic fluid served as a combustible fluid source for the nacelle fire later in the event.

Further examination of the engine nacelle revealed that one stainless steel fuel fitting had been exposed to hot exhaust. The stainless steel fuel fittings are assembled using a rubber packing, which is certified to maintain its integrity when exposed to temperatures from -40º to 100º Celsius (C), to create a liquid-tight seal that, if compromised, could cause a leak. Because the fitting was subjected to an exhaust temperature of about 600º Fahrenheit (F), or 316º C, tests were conducted by NTSB investigators to determine if the fitting was compromised by the heat and allowed fuel to enter the nacelle cavity, providing a source for the fire. Further, forced air combustion heater tests exposed a fitting to a hot airstream of 600º F for 5 and 10 minutes, and the seal did not leak. An analysis of the flight data recorder indicates that this fuel fitting was subjected to the 600º F ATS exhaust stream for no more than 2 minutes 18 seconds when the pilot reduced the engine power, causing the ATS exhaust stream temperature to return to about 200° F. The fitting might have been temporarily exposed to temperatures of about 2,000º F; however, oil burner high-temperature testing, which replicated the certification heating conditions and test fitting placement to the extent possible (the tests did not replicate vibration into the test fitting), showed that, when the fitting was exposed to a 2,000º F flame, it lasted about 4 minutes before enough fuel leaked to support a secondary fire. Therefore, the fuel fitting most likely would not have failed after exposure to a 600º F ATS exhaust stream for only 2 minutes 18 seconds. Further, because of the low torque tolerance of the fitting, tests were conducted to determine if the fitting became more fire sensitive if a low torque setting was applied (15 inch-pounds instead of the torque requirement of 30 inch-pounds). After 10 minutes of exposure to a 600º F exhaust stream, no leaks were detected.