NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, DC 20594

April 16, 2001

Operations Group Chairman's Factual Report

DCA00MA030

TABLE OF CONTENTS

1. Interview Summaries
2. Dispatch Release/Flight Plan for SWA 1455
3. Jeppesen Charts
4. Aeronautical Information Manual (AIM), Speed Adjustments
5. Flight Management System (FMS)
6. Flight Management Computer (FMC), Progress Page 3/3
7. Onboard Performance Computer (OPC), Landing Performance
8. Tailwind landings/Approach speeds
9. Landing Distance Chart
10. Normal Procedures
11. Checklist Use
12. APPROACH DESCENT–FINAL DESCENT CHECKLIST
13. EMERGENCY EVACUATION CHECKLIST
14. Procedures for All Approaches
15 Approach Envelop for All Approaches
16. Visual Approach Procedure and Crew Coordination Callouts
17. Visual Approach Profile
18. Close in Descent Procedures
19. Final Descent Procedures
20. Normal Landing Dry Runway
21. Deviation Callouts for All Approaches
22. Warning Systems, Excessive Descent Rates (Mode-1)
23. PULL-UP Warning Escape Procedure
24. Go-around and Missed Approach Procedure/Profile
25. Air Conditioning and Pressurization Controls
26. Flap Load Relief System
27. Speedbrakes/Spoilers System
28. Brake System
29. Thrust Reverser System
30. Pilot in Command Airport Qualifications, Special Airports, FAR 121.445

A. ACCIDENT

Operator:	Southwest Airlines (SWA)
Location:	Burbank-Glendale-Pasadena Airport, Burbank, California (KBUR)
Date:	March 5, 2000
Time:	1811 Pacific Standard Time (PST)[1]
Airplane:	B-737-300, N668SW, SN 23060

B. OPERATIONS GROUP/HUMAN PERFORMACE GROUP

Captain Thomas R. Curran
Operations Group Chairman (AS-30)
National Transportation Safety Board
490 L'Enfant Plaza East, S. W.
Washington, D.C. 20594-2000

Mr. William E. "Swede" Gamble
Operations Group Member
Federal Aviation Administration
San Francisco Flight Standards District Office (SAN-FSDO)
8525 Gibbs Drive
San Diego, CA 92123

Captain John Gannis
Operations Group Member
Southwest Airlines Pilots' Association
2444 E. Indigo Brush Road
Phoenix, AZ 85048

Captain Gary Platner
Operations Group Member
Southwest Airlines
120 Cedarcrest Lane
Double Oak, TX 75077

Captain Steve Swauger
Human Performance
Southwest Airlines Pilot's Association
1500 E. Gary Drive
Chandler, AZ 85225

Captain Carl Kuwitzy
Human Performance
Southwest Airlines
4545 Timberview Drive
Plano, TX 75093

Malcolm Brenner, Ph.D.
Human Performance
National Transportation Safety Board
409 L'Enfant Plaza East, SW
Washington, D.C. 20594-2000

Kevin Williams, Ph.D.
Human Performance
Federal Aviation Administration
FAA Civil Aeromedical Institute
5801 NW 31st Terrace
Oklahoma City, OK 73122

C. SUMMARY

On Sunday, March 5, 2000, at 6:11 PST, a Southwest Airlines Boeing 737-300, N668SW, operating as flight 1455 from McCarran International Airport, Las Vegas, Nevada, overran the departure

[1] All times are in Pacific standard time as read on a 24-hour clock, unless specifically noted. The actual times associated with the accident are approximate and were determined by the flight data recorder (FDR) and Air Traffic Control (ATC) transcripts.

end of runway 08 following a landing at Burbank-Glendale-Pasadena Airport, Burbank, California. The airplane traveled through a blast fence at the departure end of the runway and came to rest on a highway outside the airport perimeter. There were no fatalities to the 137 passengers and 5 crewmembers aboard. Southwest Airlines flight 1455 operated on an instrument flight rules (IFR) flight plan, and was conducted under Title 14 Code of Federal Regulations (CFR) Part 121. Visual meteorological conditions (VMC) prevailed at the time of the accident.

D. DETAILS OF THE INVESTIGATION

The Operations Group convened at the Mercury Air Center, Burbank, California, from March 6 through March 10, 2000. The Group interviewed the captain and first officer of the accident flight and other Southwest Airlines personnel, including the Oakland Chief Pilot, the captain and the first officer of Southwest Airlines (SWA) flight 1713 that landed just prior to SWA 1455, and six pilots who had flown with the accident pilots on previous occasions. The pilots consisted of three FOs who had flown with the accident captain and three captains who had flown with the accident FO. The crew of an Executive Jet Falcon 2000 ("Execjet" flight 278), which was on final approach behind the accident flight, were interviewed by telephone.

The Operations Group reconvened at the Southwest Airlines Flight Operations Office at Dallas-Love Field (DAL), Dallas, Texas, from March 11 through March 16, 2000, to conduct additional interviews with the accident captain and first officer. Interviews were also conducted with the SWA Dallas Headquarters Chief Pilot, the SWA Director of Training, the SWA Manager of Flight Training, the Federal Aviation Administration (FAA) Principal Operations Inspector (POI) assigned to the Southwest Airlines operating certificate, and the FAA Aviation Inspector assigned to the Air Transportation Oversight System (ATOS) for SWA.

In conjunction with this investigation, the Operations Group obtained manuals, records, and other materials relevant to the investigation from Southwest Airlines, Boeing Commercial Aircraft Company, and the Federal Aviation Administration.

The Operations Group concluded the field investigation phase on March 16, 2000. Captain Weston, who served as the NTSB Operations Group Chairman, left the NTSB in June 2000, and was subsequently replaced by Captain Thomas R. Curran on December 5, 2000. On February 15, 2001, Malcolm Brenner, Ph.D. replaced Barry Strauch, Ph.D. as the Human Performance Group Chairman.

1.0 HISTORY OF FLIGHT

According to SWA records, the accident crew was scheduled to fly a three-day flight sequence originating at McCarran International Airport (LAS), Las Vegas, Nevada. The first day of the sequence consisted of five flight segments: LAS to Burbank-Glendale-Pasadena Airport Burbank (BUR), Burbank, California; BUR to Salt Lake City International Airport (SLC), Salt Lake City, Utah; SLC to San Diego International-Lindbergh Airport (SAN), San Diego, California; SAN to Phoenix-Sky Harbor

(PHX), Phoenix, Arizona; and PHX to Albuquerque International Sunport (ABQ), Albuquerque, New Mexico. The first flight of the trip sequence was scheduled to depart from LAS at 1445. The accident occurred on that flight.

The captain stated that he lived in Las Vegas, Nevada, and he reported for duty at LAS, on March 5, 2000, about 1400. The first officer lived in Utah and commuted from SLC to LAS and arrived there about 2 hours before scheduled departure time. The flight crew met for the first time on their way to the departure gate at approximately 1400. The first officer said he informed the captain that the arrival of the airplane was delayed, so they decided to go to the LAS Southwest Airlines Operations Center to obtain more information.

Company records indicate that the accident airplane, which operated as SWA 1291, arrived from Los Angeles (LAX), California, about 1630, about two hours behind schedule. The inbound flight was delayed because of rain and gusting winds in the LAS area. The accident flight crew stated that they met the inbound flight crew to determine the status of the airplane and were told it was "fine." They said their preflight inspection was normal, with no maintenance discrepancies.

Flight documents indicate that SWA 1455 carried 137 passengers, 3 flight attendants, and one deadheading flight attendant, all of whom were seated in the main cabin. The flight was dispatched[2] with 16,900 pounds of fuel for the 44-minute flight to BUR. According to company records, the flight departed the gate at 1650, about 2 hours late. It was the first day of the crew pairing; the captain chose to be the pilot-flying (PF) and the first officer was assigned the duties of pilot-not-flying (PNF) for the flight to Burbank. The crew said the departure from LAS and the enroute portion of the flight to BUR were normal and uneventful.

The captain said the accident flight crossed the Daggett (DAG) VOR[3], and flew the LYNXX SEVEN standard terminal arrival route[4] (STAR). After crossing DAG, at approximately 8,000 feet MSL[5], the first officer obtained information "OSCAR" from the Burbank airport terminal information service (ATIS). Information "OSCAR" reported the winds were from 260 degrees at 18 knots, gusting to 26 knots, with aircraft landing on runways 33 and 26.

When SWA 1455 contacted approach control at approximately 1802:45, the crew was advised that the current ATIS was "PAPA." The first officer said that the captain flew the airplane and communicated with approach control, while he was switched off the primary communications frequency to acquire the new airport information. At 1803:33, the controller instructed SWA 1455 to turn left to a heading of 190-degrees for vectors to the final approach course and to descend to and maintain 6,000 feet MSL. The captain acknowledged these instructions.

At 1804:05, the approach controller instructed Southwest 1455 to maintain 230 knots or greater until further advised. The captain acknowledged the airspeed assignment.

---

2 Dispatch Release/Flight Plan for SWA 1455–See Attachment 2

3 VOR–Very high frequency omni-directional range navigation system. The ground based electronic navigation system that is the basis of the present U.S. National Airspace System.

4 LYNXX SEVEN Standard Terminal Arrival Route–A preplanned IFR-ATC arrival procedure, presented in graphic and/or textual form, which provides pilots with a common method for departing the enroute structure and navigating to the destination. See Attachment 3, Jeppesen Charts.

5 MSL (Mean Sea Level)

After the first officer had obtained information "PAPA", he switched back to the approach control frequency and informed the captain that the winds had changed to 240 degrees at 6 knots, the active runways were 8 and 15[6], and the cloud cover was clearing. The first officer said the captain told him that approach control had requested them to maintain 220 knots or greater.

At approximately 1805, SWA 1455 was instructed to turn left to a heading of 160-degrees. Shortly thereafter, the flight was cleared to descend to and maintain 5,000 feet and the controller asked whether they wanted to make a visual approach. Approach control advised the flightcrew that they were following another Southwest flight (SWA 1713), which was at their "one o'clock and 12 miles turning onto final out of 4,600." The flightcrew acknowledged the clearance and said they would be, "looking for company."

At 1807:45, approach control cleared SWA 1455 to descend to and maintain 3,000 feet and told the flightcrew that SWA 1713 was over Van Nuys at 3,000 feet. The flightcrew acknowledged the clearance and said that they were "looking for company traffic over Van Nuys."

At 1808:19, SWA 1455 notified approach control that they had SWA 1713 in sight. Approach control replied, "Southwest 1455, cross Van Nuys at or above 3,000—cleared visual approach runway 8." SWA 1455 acknowledged the clearance.

Both crewmembers said the captain's navigation radio was tuned to the ILS frequency for runway 8, and the first officer's radio was tuned to the Van Nuys (VNY) VOR. They further stated that the captain was controlling the airplane with the autopilot engaged in the VOR/LOC[7] mode, and that the airplane captured the localizer course, but then overshot the centerline before correcting back. The captain said the flight passed west of VNY at 3,000 feet at approximately 220–230 knots.

The captain stated that as they passed west of VNY at 3,000 feet, at approximately 220–230 knots, he deployed the speed brakes and as the airspeed decreased to 220 knots, he called for "flaps 5—gear down" in an attempt to further slow the airplane. During this time he noted a 20-knot tailwind indication[8] on the flight management system (FMS)[9] screen. He said he called for the "FINAL DESCENT CHECKLIST[10]" but did not remember whether the first officer read it. The captain said he remembered "looking out and seeing the Van Nuys Airport" when he disengaged the autopilot. He stated that he began the descent from 3,000 feet, and called for flaps 15, then flaps 25, then flaps 30 and then flaps 40-degrees.

---

[6] Airport description for BUR– See Attachment 3 Jeppesen charts.

[7] VOR/LOC–The navigation mode used to command the autopilot to intercept the selected radio course.

[8] Flight Management Computer (FMC) Progress Page 3/3–This page displays the present headwind or tailwind component, present true wind direction, speed, and crosswind component (left or right). See Attachment 6, SWA Flight Reference Manual (FRM), page 7.5.49.

[9] Flight Management System/Flight Management Computer (FMS/FMC)–The FMS aids the flightcrew in managing automatic navigation. The FMC, the "heart" of the FMS system, uses its navigation database, airplane position, and supporting system data to calculate commands for manual or automatic flight path control. See Attachment 5, SWA FRM, page 11.2.1.

[10] "FINAL DESCENT CHECKLIST"–See Attachment 12, SWA FOM, page 7.1.3.

The first officer stated that he saw the captain check the position of the flight visually over Van Nuys Airport and begin the descent, when he (first officer) switched his radio to BUR tower frequency. The first officer said, "things started to happen quickly;" and they were closing on the airplane in front of them. The first officer also stated that when the captain called for flaps "40," the airspeed was about 180 knots. The first officer said that he pointed to his airspeed indicator to alert the captain of the flap limit speed. The captain responded, "yes—I know."

The captain reported that he saw flap settings of 5, 15, 25, and 30-degrees but he did not remember seeing the flap indicator at the 40-degree position. He said he could not remember the airspeed, but he did state that they were "a little fast for 40 to come down.[11]"

The first officer stated that he remembered setting the flap lever to the 30 and 40-degree positions, but he did not remember seeing the flap indicator at either 30 or 40-degrees. The first officer said he selected the "Progress" page on the FMS cockpit display unit (CDU), but he could not recall what the wind values were during the approach. He stated that there was a "pretty good tail wind" and the ground speed was faster than normal, but he did not "verbalize" these concerns to the captain. During the initial interview, the first officer said he felt the approach was "stabilized and they were in a position to land," but he subsequently stated that he should have told the captain they were not in a position to land.

The captain said he did not remember descending through 1,000 feet above ground level (AGL), but he was aware that Southwest's standard procedure was to call "1,000 feet (AGL), airspeed, and sink rate." He further stated that he did not remember what the airspeed of the airplane was at 500 feet AGL or whether the first officer made the required callout at 500 feet.

The first officer said that the captain called for the "FINAL DESCENT CHECKLIST." The first officer stated that he was in the process of obtaining the landing clearance from the tower and instead of reading the checklist, he visually confirmed the checklist items and said he remembered seeing the captain arming the ground spoilers. According to ATC transcripts, at 1809:38, approach control told SWA 1455 to contact the Burbank tower, which then cleared the flight to land on runway 8.

The captain reported that he heard the aural alert from the ground proximity warning system[12] (GPWS) "SINK RATE," but he could not recall when the warning began. He said the weather was visual meteorological conditions (VMC), and he did not react to the warning because he did not feel he "had to do anything special." He stated that he did not remember hearing any other GPWS warnings during the approach. The first officer said he heard the "SINK RATE" and "PULL UP" GPWS aural warnings, but he believed that the captain was correcting.

The captain stated that he did not remember seeing the "VASI[13]" lights for runway 8. He also said he could not recall what the airspeed was at 500 feet, or whether the first officer called any airspeed deviations during the approach.

---

[11] Flap Load Relief–This feature protects the flaps from excessive air loads and is operable only at the flaps 40-degree position. See Attachment 26 Southwest FRM, page 9.2.15, SWA FOM, pages 3.6.5 and 3.6.6.

[12] GPWS–See Attachment 22, SWA FRM, page 15.2.10.

[13] VASI (Visual approach slope indicator), Runway 8 at BUR actually has a PAPI visual approach aid–See Attachment 3, page 4 of 8, Jeppesen Runway Information Chart, page 10-9A.

The captain stated that he visually perceived that the airplane was fast as it crossed the approach end of the runway. Both pilots said "they touched down smoothly at the 1,000-foot marker" and the airplane decelerated normally after it landed. During the initial post accident interview, the first officer could not remember what the airplane's speed was as it touched down or whether the ground spoilers deployed, but he stated that the engine reversers deployed. However, during a subsequent interview, the first officer reported that he saw the speed brake lever[14] "come back" after touchdown, indicating deployment of the ground spoilers. The captain said after touchdown, the end of the runway appeared to be closer than it should have been; he thought that they might hit the "wall." The captain stated that he "got on the brakes pretty good" and used "maximum braking" while attempting to stop the airplane.

The first officer said he could not recall how much engine reverse thrust the captain applied, and neither pilot reported hearing engine compressor stalls [15] during the rollout. The first officer said the captain applied the wheel brakes before 80-knots, but the first officer could not remember whether he made the required 80-knot callout.

As the airplane passed abeam the Southwest passenger boarding gates, the first officer stated that he joined the captain on the brakes and said that he applied them as "hard" as he could. He said he did not think that the airplane was going to depart the runway, but that "it would be close." The captain said that as the airplane neared the end of the runway, he initiated a right turn using only the nose wheel steering tiller. The airplane departed the runway about 30 degrees from the runway heading, impacted and penetrated the blast fence, and came to a stop on a highway off the airport property.

The captain stated that after the airplane stopped, he made an announcement on the passenger address system (PA) instructing the passengers to "remain seated," and then he shut down the engines. He said he could hear the flight attendants calling for the passenger evacuation, and he thought that the flight attendants knew more about the cabin condition than he did. The captain said that he did not call for the EMERGENCY EVACUATION CHECKLIST[16], but he was "pretty sure" that all checklist items were accomplished.

After the airplane stopped, the first officer stated that he asked the captain whether he was "Okay," and the captain replied, "Yes." The first officer said he told the captain that he had to go into the cabin to see whether the passengers were all right. The first officer stated that he did not read any checklists before leaving the cockpit, but he did ensure that the flaps were set to 40 degrees and the pressurization mode switch was in the "ground mode[17]." The first officer reported that as he left the cockpit, he saw that the forward service door evacuation slide had inflated inside the cabin and it had trapped the "C-flight attendant." He said he assisted in freeing her and then he exited the airplane through the "front" door.

---

[14] Speedbrake Lever–See Attachment 27, SWA FRM, page 9.1.8.

[15] Compressor stall–Loss of reverse thrust caused by the disruption of air through the compressor section of a turbojet engine and is similar to an automobile backfire.

[16] EMERGENCY EVACUATION CHECKLIST, Passenger Evacuation–See Attachment 13.

[17] Ground mode–Placing the FLIGHT/GROUND switch to the "GRD" position drives the outflow valve open, which allows the airplane cabin to depressurize. The emergency exit doors can be opened and passenger evacuation can take place. See Attachment 25, SWA B-737 Operations Manual, page 6.10.04.

The captain stated that after he completed the "EMERGENCY EVACUATION CHECKLIST," he transmitted on the control tower frequency to request emergency equipment. The control tower replied that the emergency equipment was already on the way, and the flight crew should be able to see it momentarily. The captain further stated that his egress from the cockpit was hindered by an escape slide that had inflated inside the passenger cabin, and someone assisted him in getting through the cockpit door. He said he was the "next-to-the-last" person to leave the airplane and that a firefighter caught him after he exited the airplane through the forward cabin door.

2.0 FIGHTCREW INFORMATION

2.1 General

Both crewmembers held valid driver's licenses for the states in which they lived. A search of the records at the National Drivers Registry found no history of driver's license revocation or suspension for either pilot.

Both flight crewmembers were current and qualified in accordance with Southwest Airlines, Co., and Federal Aviation Administration (FAA) requirements.

According to FAA documents, neither the captain nor the first officer had any previous history of accidents, or enforcement action for violation of Federal Aviation Regulations.

2.2 Toxicology

Urine specimens and breath alcohol samples were obtained from both accident pilots in accordance with post-accident drug and alcohol testing requirements. The results of those tests were negative.

2.3 The Captain

A review of the FAA records indicated that he had no history of failures or retesting for FAA pilot certificates and ratings.

The captain stated that he was a pilot in the United States Air Force from 1970–1975 based at Mather Air Force Base, Sacramento, California. In 1976, he acquired his B-737 type rating through United Airlines and then flew as a first officer for Wien Air Alaska from 1977–1979. From 1979–1980, he flew the G-159 (Gulfstream 1) and the King Air as a captain for Coleman Air Transport. From 1980–1988, he was employed by the EG&G Corporation where he flew as captain and first officer on the B-737-200. The captain began his employment at Southwest in 1988.

One first officer at Southwest with whom the accident captain had flown described him as being a "usual captain" who was "standard" in all respects. He said that he found him easy to get along with and rated him as an average captain in all respects; i.e., "standard." He also said that he never felt uncomfortable flying with him, and that he operated according to company procedures. A captain's colleague described him as congenial, mild-mannered, and someone who got along well with everyone.

Date of Birth: [redacted]
Date of hire with Southwest Airlines: 07-07-88

Certificates and Ratings

Airline Transport Pilot Certificate issued 10-25-79
Airplane Multiengine Land B-737, G-159
Commercial Privileges
CV-240, CV-340, CV-440
Airplane Single Engine Land

Medical

First Class, must have corrective glasses in his possession while flying, (Issued 10-19-99)

The captain stated that his FAA medical certificate required him to have corrective glasses in his possession while flying, but that he normally used them only at night. He did not remember if he was wearing them at the time of the accident.

Flight Time

Total (reported by pilot):	11,000.0 hours
Total B-737 at Southwest:	9,870.0 hours
Total PIC B-737	5,302.0 hours
Last 24 hours	01.4 hours
Last 7 days	14.4 hours
Last 30 day	47.0 hours
Last 60 days	89.0 hours
Last 90 days	124.0 hours

Training & Proficiency Checks

B-737 ground school & simulator training	Date
Initial B-737 type rating	08-13-76
Completed B-737 upgrade operating experience	10-22-93
Most recent recurrent training (Systems training)	10-10-99
Most recent proficiency check	10-11-99
Most recent proficiency training	10-11-99
Most recent B-737 line check	10-29-99

2.4 First Officer

A review of the FAA records indicated that he had no history of failures or retesting for FAA pilot certificates and ratings.

The first officer stated that he began his flying career in the United States Air Force (USAF), where he flew F-15 fighter airplanes. After completing his active service, he continued to fly F-16s in the United States Air Force Reserve. His total flight military flight time is about 2,500 hours.

Pilots who had flown with the first officer described him as being an excellent pilot. A captain who had flown with him earlier in the year, said that he found him to be very well qualified, an "above average" co-pilot, very likable, pleasant, and someone who had good aviation skills. Additionally, the same captain stated that he had never heard anything negative said about either accident pilot.

Date of Birth: [redacted]
Date of hire with Southwest Airlines: 11-14-96

Certificates and Ratings

Airline Transport Pilot Certificate issued 12-18-95
Airplane Multiengine Land B-737
Commercial Privileges
Airplane Single Engine Land

Medical

First Class, no limitations (issued 10-18-99)

Flight Time

Total (reported by pilot):	5,022.0 hours
Total at Southwest:	2,522.0 hours
Total PIC B-737	0.0 hours
Last 24 hours	1.0 hours
Last 7 days	14.0 hours
Last 30 days	30.0 hours
Last 60 days	124.0 hours
Last 90 days	210.0 hours

Training & Proficiency Checks

B-737 ground school & simulator training	Date
Initial B-737 type rating	12-18-95
Completed B-737 initial operating experience	12-26-96
Most recent recurrent training (Systems training)	10-25-99
Most recent recurrent proficiency training	10-31-98
Most recent B-737 line check	10-29-99

2.5 **72-Hour History – The Captain**

The captain lived in the Las Vegas area. During the three-day period before the accident, he said he exercised moderately by jogging and playing golf. He stated that he performed light household chores, and consumed regular meals and an occasional snack. He normally went to bed about 2300 and awoke between 0730 and 0830. On March 4th, the night before the accident flight, the captain said that he went to bed about midnight and felt well rested when he awoke the morning of March 5 at about 0830. After awakening, he called crew scheduling about 0900, jogged about 4 miles, lifted weights, and ate breakfast. He left his home at approximately 1330 and arrived at the departure gate about 1400.

2.6 72-Hour History – The First Officer

The first officer lived in Salt Lake City, Utah, and had four days off prior to this the accident trip During the three days before the accident, he usually went to bed at or before 2300 and awoke between 0700 and 0730. He performed light household chores; such as, preparing meals for his daughters, and also worked at his Air Force reserve unit, the 419th Fighter Wing at Hill AFB, where he performed paperwork duties on March 2, and flew one flight in an F-16 fighter airplane during the afternoon of March 3.

The first officer did not say what time he went to sleep on the evening of March 4, but stated that he awoke the following morning, March 5, at 0800 and called SWA crew scheduling. He checked in and told the scheduler that he would report directly to LAS for the LAS–BUR flight. He then made breakfast for his daughters and packed for his trip.

The first officer said that he left the house at 1000, boarded the 1120 SWA flight from SLC to LAS, and arrived about 2-hours before his trip was scheduled to depart. He ate lunch at the airport and met the captain on his way to the departure gate.

3.0 AIRPORT INFORMATION

According to the Jeppesen Airport Flight Description page 10-9 and the Air Nav airport guide:

3.1 General

Latitude/Longitude:	34-12-0.0N / 118-21.30.5W
Elevation:	775 feet
Variation:	14 E (1985)

3.2 Runway 8

Dimensions:	6032 X 150 feet
Surface:	Asphalt / grooved. Good condition
Runway Lights:	High intensity
Approach Lights:	MALSR: 1,400 feet medium intensity approach lighting system with alignment indicator lights
Runway Markings:	Precision instrument, good condition
RVR Equipment:	Touchdown

Displaced Threshold:	No
Touchdown Point:	Yes
Touchdown Lights:	No
Overrun:	No
Obstructions:	Blast fence (14 feet high) 32 feet from departure end of runway 8

4.0 AIRPLANE INFORMATION

4.1 General

According to FAA documents, the airplane N668SW, was a Boeing-737-300, serial number 23060. The registered owner was Southwest Airlines Co., with a registration date of, January 25, 1996. Capacity of the airplane was a total of 137 passenger seats. The B-737 was approved for day and night operations, VFR, IFR, and for flight in icing conditions and required a 2-pilot crew.

4.2 Weight and Balance

The following information was obtained from the flight departure paperwork and the SWA Flight Operations Manual:

Basic Operating Weight	71,947 lbs.
Passenger Weight	25,299 lbs.
Baggage Weight	4,697 lbs.
Zero Fuel Weight (ZFW)	101,943 lbs.
Maximum Zero Fuel Weight Allowed	106,500 lbs.
Ramp Departure Fuel	16,402 lbs.
Ramp Weight	118,345 lbs.
Maximum Taxi Weight	139,000 lbs.
Taxi Fuel Burn	500 lbs.
Actual Takeoff Weight (TOW)	117,845 lbs.
Maximum Takeoff Weight for Operations	118,600 lbs.
Maximum Takeoff Weight for Airframe	135,000 lbs.
Estimated Fuel Burn to BUR	4,600 lbs.
Estimated Landing Weight	113,245 lbs.
Maximum Landing Weight	114,000 lbs.
Index Unit Balance Limits for a ZFW of 101,943 lbs.	40 to 52
Actual Airplane Index Units for a ZFW of 101,943 lbs.	43
Index Unit Balance Limits for a TOW of 118,345 lbs.	39 to 51
Airplane Index Units for a TOW of 118,345 lbs.	45
Revised Airplane Index Units for a TOW of 117,845 lbs.	48

The flight crew departure documents indicated that the takeoff index units were within the approved limits of the airplane.

4.3 B-737-300 Limitations

Minimum Takeoff and Landing Altitudes	No limit listed
Maximum Takeoff and Landing Altitudes	8,300 feet
Minimum Takeoff and Landing Temperature	-52° C
Maximum Takeoff and Landing Temperature	+54° C
Runway Slope	±2%
Limiting Tail Wind (Dry/Wet)	10 knots
Maximum Demonstrated Steady Cross Wind Landing (Dry/Wet)	35 knots
Maximum Landing Gear Extension Speed (VLOE)	270 knots
Maximum Landing Gear Retraction Speed (VLOR)	235 knots
Maximum Landing Gear Extended Speed (VLE)	320 knots
Maximum Speed (Any Leading Edge in Transit)	230 knots
Maximum Speed (Any Leading Edge Fully Extended)	210 knots
Maximum Flap Placard Speeds (VFE)	1° = 230 knots
	2° = 230 knots
	5° = 225 knots
	10° = 210 knots
	15° = 195 knots
	25° = 190 knots
	30° = 185 knots
	40° = 158 knots
Maximum Tire Speed	195 knots

5.0 SOUTHWEST AIRLINES PROCEDURES

5.1 Southwest Airlines Normal Operating Procedures

The SWA Flight Operations Manual, Normal Operations, Introduction, Schedule and Cost Control[18], chapter 3, section 1, page 2 stated in part:

- *Pilots are expected to follow standard procedures.*

The SWA Flight Operations Manual, Normal Procedures[19], chapter 3, section 1, page 7 stated in part:

- *Normal Procedures are used by trained flightcrews to ensure the aircraft condition is acceptable for flight and to properly operate the aircraft for each phase of flight.*

The SWA Flight Operations Manual, Normal Operations, Introduction, Standardization and Coordination[20], chapter 3, section 1, page 6 stated in part:

[18] Normal Operations, Schedule and Cost Control–See Attachment 10, SWA FOM, page 3.1.2.
[19] Normal Procedures–See Attachment 10, SWA FOM, page 3.1.7.

- *Standardization and coordination are essential to safe and efficient operaton of Southwest Airlines aircraft. Captains are expected to demonstrate disciplined use of standard procedures and ensure First Officers understand and use standard procedures.*

5.2 Approach Briefing

Runway 8 is served by ILS and PAPI approach systems, which provide glideslope information to the pilot.

The Jeppesen Airport Qualification Chart[21] for runway 8 at BUR, page 19-03 stated in part:

Runway 8

- *Visual vertical guidance is provided by PAPI (3.0°) on the left side of the runway.*

- *High climb gradients due to rising terrain above 2000 feet within 3 NM from the departure end of this runway may require special attention to obstacle clearance during departures, rejected landings, and engine inoperative procedures.*

The Jeppesen Airport Qualification Chart[22] runway 33 at BUR, page 19-06 stated in part:

Runway 33

- *Visual vertical guidance is provided by PAPI (3.2°) on the left side of the runway.*

- *This is the favored runway during Santa Anna winds. Under these conditions, expect windshear during approach and chronic downdrafts near the departure end of this runway.*

- *Rejected landings, missed approach, and engine inoperative procedures may require special attention due to high climb gradients required for obstacle clearance...*

Burbank ATIS information PAPA, dated October 6, 2000, current at the time of the accident was:

burbank airport information papa zero one five three zulu wind two four zero at six visibility one zero few clouds at six thousand five hundred ceiling niner thousand overcast temperature niner dew point one altimeter two niner six five ils runway eight approach in use arriving runway eight and runway one five helicopter pilots use frequency one one eight point seven advise on initial contact you have information papa

---

[20] Standardization and Coordination–See Attachment 10, SWA FOM, page 3.1.6.
[21] Jeppesen Airport Qualification, BUR, Runway 8, See Attachment 3, page 8 of 9, Chart 19-03.
[22] Jeppesen Airport Qualification, BUR, Runway 33, See Attachment 3, page 9 of 9, Chart 19-06.

The SWA Flight Reference Manual, Onboard Performance Computer (OPC)[23], Landing Performance Module, chapter 8, section 4, page 19 stated in part:

> • *The Landing Performance module allows input of configuration and condition data for computation of approximate landing distance, speeds, and power settings for the actual landing weight.*

The SWA Flight Reference Manual, Onboard Performance Computer, Landing Performance, chapter 8, section 5, page 10 stated in part:

> • *The Landing module provides advisory landing information for both normal and abnormal flap configurations. In addition, it provides go-around climb performance...*
>
> • *The Landing module should be used anytime landing performance capabilities (approach climb and/or maximum quick turnaround limitations) are in question and include (but are not limited to) the following conditions:*
>
> - *Tailwind*
> - *High gross weight*
> - *Short runway*

The first officer stated that he did not use the OPC before landing on runway 8.

The SWA Flight Operations Manual, Normal Operations, Approach Descent Checklist[24], chapter 3, section 6, page 1 stated in part:

> *The pilot flying will normally state the final flap setting, VREF and target airspeeds, the planned approach, and call for the Approach Descent Checklist.*

The captain said he re-briefed the approach speeds, but he could not remember the speeds at which the airspeed "bugs" were set. The captain stated that it was Southwest's procedure to adjust the bugs for ½ the steady wind plus the entire wind gust factor, and that both he and the first officer reset the airspeed bugs to the appropriate approach reference speed.

The SWA Flight Operations Manual, Normal Operations, Approach Target Speeds—Tailwind Landings[25], chapter 3, section 6, page 7 state in part:

> • *Fly VREF +5 knots for tailwind landings.*

The SWA Flight Operations Manual, Normal Operations, Visual Approach[26], chapter 3, section 6, pages 44 and 52 stated in part:

---

[23] OPC–This device contains the Landing Performance Module, which allows for pilot input of configuration data for computation of approximate landing distance, V-speeds, and power settings for the actual airplane weight. See Attachment 7, SWA FRM, Onboard Performance Computer, Landing Performance, pages 8.4.19, 8.5.10, and 8.5.11, and Attachment 9, SWA FOM, Landing Distance Chart Advisory Information, page 10.2.16.

[24] Approach Descent Checklist–See Attachment 12, SWA FOM, pages 3.6.1, 3.6.2, and 7.1.3.

[25] Approach Target Speeds, Tailwind Landings–See Attachment 8, page 3.6.7.

- *The Captain or First Officer may plan to fly a visual approach*[27] *when an instrument approach is not required.*

- *Back up the visual approach with an instrument approach procedure if one is available.*

- *Plan to configure landing gear down, landing flaps, Final Descent Checklist, radio tuning completed by 1000 feet above the touchdown zone (TDZE), and stabilized on final approach with engines "spooled up" no later than 500* feet above TDZE.

- *High idle thrust is considered "spooled up."*

- *VMC weather exists and the flight can remain VMC.*

The SWA Flight Operations Manual, Normal Operations, Procedures for All Approaches[28], chapter 3, section 6, page 10 stated in part:

- *Approach altitude callouts will be made above the touchdown zone elevation TDZE for the landing runway.*

- *Use the barometric altimeter for all altitude callouts down to and including 200 feet.*

- *Below 200 feet use the radio altimeter for all callouts...*

- *Navigation receivers should be tuned and identified by the pilot not flying upon command, or in coordination with, the pilot flying.*

- *Use all available navigation aids for the approach.*

During post accident interviews, a SWA FO was given the hypothetical situation of receiving a runway change while at 10,000 [feet MSL] on arrival. He did not recall any special company procedure for adjusting to the new runway. He said that he would personally complete an OPC computation and brief the captain. He stated that in preparing for a visual approach, he would tune and identify the navigation aid and have the approach chart in front of him. If he were on a VOR and wanted to join the Captain on the ILS frequency, he would make the frequency change and announce, "joining you" to the captain, prior to the final approach fix (FAF).

The SWA Director of Training said that they needed to do a better job in training for the visual approach phases of operations. He said that everything was there, but he thought they needed to emphasize it more.

---

[26] Visual Approach–See Attachment 16, SWA FOM page 3.6.44.
[27] Configuration Profile–See Attachment 17, SWA FOM page 3.6.52.
[28] Procedures for All Approaches– See Attachment 14, SWA FOM, page 3.6.10.

5.2.1 **Special Airports**

FAR 121.445 Pilot in command airport qualification: Special areas and airports[29] stated in part:

> *(a) The Administrator may determine that certain airports (due to items such as surrounding terrain, obstructions, or complex approach or departure procedures) are special airports requiring special airport qualifications and that certain areas or routes, or both, require a special type of navigation qualification.*
>
> *(b) Except as provided in paragraph (c) of this section, no certificate holder may use any person, nor may any person serve, as pilot in command to or from an airport determined to require special airport qualifications unless, within the preceding 12 calendar months:*
>
> *(1) The pilot in command or second in command has made an entry to that airport (including a takeoff and landing) while serving as a pilot flight crewmember; or*
> *(2) The pilot in command has qualified by using pictorial means acceptable to the Administrator for that airport.*

According to AC 121.445-1D – Pilot in Command Qualifications For Special Area/Routes and Airports, Federal Aviation Regulations (FAR) Section 121.445, Appendix 1, Western Pacific Region, BUR was designated a special airport because of mountainous terrain, and SWA provided its flight crews with Jeppesen airport qualification charts. Pilots were required to stay current with special airports by reviewing the company charts and plates.

The SWA Flight Operations Manual, Normal Operations, Limitations[30], chapter 2, section 1, page 3 stated in part:

> *Prior to arriving at or departing any airport designated as a "Special Airport," pilots will review the Jeppesen supplied pictorial representation of that airport.*

The SWA Vice President of Operations said that the flight crews were required to conduct an approach descent check passing through 18,000 feet, which included a review of "page 10-7," for any station information regarding arrivals. He said that this was an historical document about problems about that particular airport. Pilots briefed the Jepps page, the flap setting, Vref and target speed, and who would fly approach. If the assigned runway were changed thereafter, the crew would have to give a modified briefing of any changes by reconfirming flap settings and discussing any changes, including environmental changes that they need to be aware of. He said that when there was no time to brief the new approach, flight crews had to make time by: holding, vectors, etc. He said that the last thing you wanted to do was put yourself in a rushed environment.

The SWA Headquarters Chief Pilot stated that BUR was designated a special airport because of the mountains, the heavy general aviation aircraft traffic around Van Nuys, and the single engine

[29] Special airport–Certain airports, due to items such as surrounding terrain, obstructions, or complex approach or departure procedures, are designated as special airports–FAR 121.445: Pilot in command airport qualification. See Attachment 30.
[30] Special Airport Briefing–See Attachment 30, SWA FOM, page 2.1.3.

performance considerations near the mountains. He believed that on the descent you had to stay at or above 3,000 until east of Van Nuys. He had not experienced any problems because of this. The Jeppesen pictorials alleviated the need for special training. He said that there was no requirement for a special briefing or checkride. He also said that there were no special minimums or requirement for either pilot to fly the approach.

The accident captain stated that the company didn't have requirements for a visual approach briefing like they did for an instrument approach, but basically they just discussed the winds, and he set up the ILS as a back-up. He didn't remember what he had briefed the FO, but stated that he had the ILS on his side, and he wanted the FO to tune in Van Nuys (VOR) on his side to help judge the distance from the airport.

The accident first officer said that when they got the first ATIS, he and captain talked about it; but because it was VMC, it was not an official briefing.

5.3 Checklist Use, Callouts, and Crew Coordination

The SWA Flight Operations Manual, Normal Operations, Approach, chapter 3, section 1, page 5 stated in part.

> • *The success attained by flightcrew in the execution of normal and emergency procedures is largely attributable to the dual reliability of the challenge and response checklist system*[31].
>
> • *The checklist will be removed from its holder and read out loud in a clear voice. Response should be equally loud and clear and answered as listed. Responses different from those listed should mean that something is abnormal. The checklist reader should continue challenging an item until a proper response is obtained. The checklist reader is responsible for visually confirming that the proper action has been taken. When a checklist is completed, the reader will announce: "_____**Checklist complete.**"*

The SWA Flight Operations Manual, Normal Operations, Final Descent Procedures[32], chapter 3, section 6, page 4 stated in part:

> *Captain or FO Wing Flaps—As Directed.*
>
> • *Set airspeed cursor to approach target speed if not previously accomplished.*
>
> • *The pilot not flying will repeat the command and move the flap lever to the requested position. Check the flap position indicator and the leading edge lights for agreement with the flap position.*

The SWA Flight Operations Manual, Normal Operations, Approach[33], chapter 3, section 1, page 7 stated in part:

---

[31] Checklist Use–See Attachment 11, SWA FOM page 3.1.5.
[32] Final Descent Procedures–See Attachment 19, SWA FOM, Page 3.6.4.

- *When an action is taken and associated indications are provided it is the crewmembers's responsibility to assure a proper system response. If an improper indication is noted, first verify that the system controls are properly positioned.*

The first officer said that he remembered setting the flap lever to the 30 and 40-degree positions, but he did not remember seeing the flap indicator at either 30 or 40-degrees.

The SWA Flight Operations Manual, Normal Operations, Final Descent Procedures, chapter 3, section 6, page 4 stated in part:

- *These procedures and the Final Checklist will normally be completed prior to reaching 1000 feet AGL on final approach.*

- *Captain or First Office—Autopilot Disengaged.*

At the time the Final Descent Checklist is accomplished, the wing flaps may not be in the landing position, and the autopilot may be engaged. In that case, the entire Final Descent Checklist should be read, but not announced complete. After the wing flaps are in the landing position, the green LE FLAPS EXT light is illuminated with hydraulic pressure and quantity normal, and the autopilot is disengaged, the pilot not flying should announce, ***"Final Descent Checklist Complete."***

The SWA Flight Operations Manual, Normal Operations, Crew Coordination and Callouts During Visual Approach[34], chapter 3, section 6, page 44 stated in part:

	Captain	**First Officer**
1000 feet above TDZE	Call out, "**1000 feet.**" **Airspeed**_____ **Sink rate**_____	Call out, "**1000 feet.**"
On Final Approach	Radio altimeter callouts below 200 feet are at the Captain's discretion when the First Officer is flying.	Altitudes above TDZE "**500**" feet "**400**" feet "**300**" feet "**200**" feet If Captain lands the aircraft, continue callouts on radio altimeter. "**100**" feet "**50**" feet "**30**" feet "**10**" feet

[33] Approach–See Attachment 10, SWA FOM, page 3.1.7.

[34] Visual Approach, Visual Crew Coordination and Callouts–See Attachment 16, SWA FOM, page 3.6.44.

The first officer stated that he could not recall whether he made the required altitude callouts at 1000, 500, 400, 300, 200, 100, 50, 30, and 10 feet AGL or the required airspeed callouts in accordance with the "Southwest Airlines Flight Operations Manual."

The first officer said the airplane was a "little fast," but he did not recall checking the airspeed. He said he did not bring the excessive airspeed to the captain's attention, because he thought, "the captain was always correcting."

5.4 Stabilized Approach Procedure

The SWA Flight Operations Manual, Normal Operations, Approach Envelope for All Approaches[35], chapter 3, section 6, page 53 stated in part:

> • *Go-around must begin whenever adverse factors have piled up against you and the aircraft is not in the slot.*
>
> *Entry Slot 1000 feet AGL Landing Gear Down Final Flaps.*
>
> *500' AAE Final "Slot" Conditions:*
> - *Proper sink rate and on glidepath*
> - *Proper speed (for existing conditions)*
> - *Proper runway alignment—no further turning required*
> - *Trimmed for zero stick forces*
> - *Steady-state thrust setting*
> - *In final landing configuration*
> - *Touchdown target 1000-ft point*
> - *IF NOT IN THE "SLOT," YOU ARE NOT PREPARED FOR A NORMAL LANDING*

The Operations Group Investigators interviewed the SWA Vice President of Operations regarding stabilized visual approaches. He said for VMC approaches, "a pilot had to be in the slot, on glidepath, on airspeed, and in a position to make a landing." He said that it included the 1,000 feet AGL call where you should be fully configured and meet airport restrictions and the operational restrictions of the airplane. He said flaps should be at 5 degrees and the airspeed about 170–180 knots with the airplane on glide slope in order to meet the requirement to be fully configured at 1,000 feet. He stated that airplane approach criteria at 500 feet included: airspeed within ± 5 knots and rate of descent less than 1,000 feet per minute.

The SWA Chief Pilot at Oakland, California said a stabilized approach meant, "being fully configured at 1,000 feet on a visual approach and stabilized at 500 feet."

[35] Approach Envelope for All Approaches–See Attachment 15 SWA FOM, page 3.6.44.

The first officer said he did not remember seeing the "VASI" lights, or whether the captain made any "S-turns" to lose altitude during the approach. He stated that they eventually got "into the slot" when they were "about a mile out."

The SWA Flight Reference Manual, Normal Operations, Pull-Up Warning[36], chapter 15, section 2, page10 stated in part:

> • *If the aircraft barometric descent rate is excessive, the "SINK RATE" aural alert sounds twice, If descent rate becomes severe, the "WHOOP- WHOOP-PULL UP" aural sounds. A red PULL UP alert is displayed on both attitude indicators.*

The SWA Flight Operations Manual, Normal Operations, Pull-Up Warning[37], chapter 11, section 2. pages 54 and 55 stated in part:

> • *If a (Pull-Up) warning occurs when flying in Day and VMC conditions and positive verification is made that no ground contact hazard exists, the alert may be regarded as cautionary and the approach/cruise may be continued.*
>
> *Pull Up Warning Procedure*
>
> *Immediately and simultaneously:*
> • *Thrust Levers.....Maximum*
> • *Climb.....Best Angle*

The SWA Flight Operations Manual, Normal Operations, Ground Proximity Alert[38], chapter 11, section 2, pages 62 and 63 stated in part:

> • *If an (GPWS) alert occurs when flying under Day and VMC conditions, and positive visual verification is made that no hazard exists, the alert may be regarded as cautionary and the approach may be continued. If the verification cannot be made, immediately check/correct the aircraft flightpath, or go–around if necessary.*
>
> *Ground Proximity Alert Procedure:*
>
> *Simultaneously:*
> • *Flight Path.....Ensure Correct*
> • *Configuration.....Verify Correct*
> • *"Ground Proximity Alert Checklist Complete"*

A SWA line pilot, who was interviewed by the Operations Group, was asked what a "SINK RATE" aural warning meant to him. He said it meant that he should "get the nose up and adjust the sink

[36]Ground Proximity Alert–See Attachment 22, SWA FRM, page15.2.10.
[37] Pull-Up Warning–See Attachment 23, SWA FOM, page 11.2.54 and 11.2.55.
[38] Ground Proximity Alert–See Attachment 23, SWA FOM, page 11.2.62 and 11.2.63.

rate." He further stated that a "PULL UP" aural warning would get his attention even more, and he would make a larger correction.

The captain reported that he heard the GPWS "SINK RATE[39]" aural warning, but he could not recall when the warning began. He said that flight visibility was VMC, and he did not react to the warning, because he did not feel he "had to do anything special." He stated that he did not remember hearing any other GPWS warnings during the approach. The first officer said he heard the "SINK RATE" and "PULL UP" GPWS aural warnings, but he believed that the captain was correcting.

5.5 Crew Performance During Approach

The SWA Flight Operations Manual, Normal Operations, Deviation Callouts for All Approaches[40], chapter 3, section 6, page 11 stated in part:

> *If any of the following parameters are exceeded, the pilot not flying will make the corresponding callout and verify that the pilot flying takes appropriate corrective action. The pilot flying will acknowledge the callout verbally or with immediate corrective action.*

PARAMETER	LIMIT	CALLOUTS
Airspeed	Target speed minus 5 knots Target speed plus 10 knots Anytime below VREF	Airspeed
Localizer	±1 DOT displacement	Localizer
Glideslope	±1 DOT displacement	Glideslope
Sink Rate	2000 fpm (when below 2000') 1000 fpm (when below 1000") Significant change (when below 50')	Sink Rate

During a post accident interview, the captain said that the airplane was about 1–1½ dots[41] above the ILS glideslope at 1,000 feet (AGL) and was less than 1 dot high at 500 feet. The captain said he could not recall what the airspeed was at 500 feet, or whether the first officer had called any airspeed deviations during the approach.

The first officer said he selected the "Progress" page on the FMS cockpit display unit (CDU), but he could not recall what the wind values were during the approach. He stated that there was a "pretty good tail wind" and the ground speed was faster than normal, but he did not "verbalize" these concerns to the captain.

The accident first officer said he remembered the airspeed being about 180 knots at one point during the approach, and he saw it go as high as 190 knots when he pointed to the airspeed indicator

[39] Sink Rate–If the airplane barometric descent rate becomes excessive, the "SINK RATE" aural alert sounds twice.
[40] Normal Operations, Deviation Callouts for All Approaches–See Attachment 21, SWA FOM, page 3.6.11.
[41] Dot–A flight instrument unit of measure depicting vertical displacement above or below the center of the ILS glideslope beam. Full deflection of the glide slope needle from center beam is 0.7 degrees.

after the captain called for flaps 40. He did not remember the airplane leaving 1,000 feet or whether he made the required altitude callout. The first officer said his attention was focused primarily outside the airplane, and he did not call out airspeed deviations to the captain.

5.5.1 Close in Descent Calculations

The Aeronautical Information Manual, Speed Adjustments[42], page 4-4-11 stated in part:

> • *Approach clearances supercede any prior speed adjustments, and pilots are expected to make their own speed adjustments, as necessary, to complete the approach.*

At 1804:05, when SWA 1455 was about 21 nautical miles (nm) from BUR, the approach controller told Southwest 1455, to maintain 230 knots or greater until further advised. The captain acknowledged the airspeed assignment.

The SWA Flight Reference Manual, Pilot Techniques, First Officer Operating Techniques, Approach[43], chapter 4, section 2, page 4 stated in part:

> • *Probably one of the toughest areas to master during your first few months is deciding when to configure during the approach phase. The gouges you were given in class really do work, but throw in a lot of traffic and some tricks from ATC, and you may have a hard time applying them. Ideally, if you are at 2000 feet AGL and 250 knots about 12 nautical miles from the field on a straight in visual, you will have room to slow and configure by the book.*
> • *Avoid sudden pitch inputs and be aware that the aircraft will not slow down very quickly if you are descending. If you are behind you may have to need to level off and configure to landing flaps to be fully configured and stabilized prior to 500 feet AGL.*

At 1808:19, when SWA 1455 was approximately 10 nm from BUR and about 5 nm north of the localizer course for runway 8, approach control told Southwest 1455 to cross Van Nuys at or above 3,000 and cleared them for a visual approach to runway 8. The flightcrew acknowledged the clearance.

The SWA Flight Reference Manual, Flight Controls, Pilot Techniques, Close In Descent Calculations[44], chapter 4, section 2, page 22 stated in part:

> • *If you are really behind—the best choice:*
> *Level off, configure all the way to 40—then start down. Remember the flaps blow up to 30 just above 150 knots flaps 40, Landing Gear down and 140 knots will give about 1000 feet per nautical mile (almost 1 for 1).*
>
> • *In any case, have the engines spooled up by 500 feet AGL. You must lead with power—a good technique is to begin advancing power as the glideslope comes off the bottom of the case or the upper VASI turns pink.*

[42] Speed Adjustments–See Attachment 4, AIM, page 4-4-11.
[43] Pilot Techniques, Approach–See Attachment 15, SWA FRM, Page 4.2.14.
[44] Close In Descent Calculations–See Attachment 18, SWA FRM, page 4.2.22.

The flight crew stated that they could not remember seeing the "VASI" lights for runway 8. When the captain was asked why he ended up "high and hot" on this approach, he replied that having to keep his speed up and the tail wind were contributing factors. He said that, to the best of his knowledge, Southwest did not teach special procedures for a "high and hot approach" to expedite traffic. The first officer stated that there was no specific training at SWA for "high and hot approaches" when the airplane was required to come in high. He said he was taught during his initial operational experience (IOE) that the best way to get the airplane down was to get it "fully configured"

Interviews with SWA pilots revealed that they did not receive specific instruction during flight training for flying "high and hot" approaches.

Investigators who reviewed SWA manuals could not find any written guidelines describing procedures for pilots to make their own speed adjustments as necessary after ATC has issued an approach clearance.

5.5.2 **Flap Load Relief**

The SWA Flight Reference Manual, Flight Controls, System Descriptions, Flap Load Relief[45], chapter 9, section 2, page 15 stated in part:

> *A flap load limiter is installed in the trailing edge flap drive system to protect the flaps from excessive air loads. When the flap lever is in the 40-degree position only, the flap lever does not move, but the flap position indicator displays flap retraction and re-extension.*
>
> *When the flaps are set at 40 the TE flaps:*
> - *retract to 30 if the airspeed exceeds 158 ±2knots.*
> - *re-extend when airspeed is reduced below 152 ±2 knots.*

The first officer also stated that when the captain called for "flaps 40," the airspeed was about 180 knots. The first officer said he pointed to the airspeed indicator to alert the captain of the flap limit speed. The captain responded, "yes—I know."

The captain reported that he saw flap settings of 5, 15, 25, and 30-degrees but he did not remember seeing the flap indicator at the 40-degree position. He said he could not remember the airspeed, but he did state that they were "a little fast for 40 to come down."

5.6 **Landing Procedures**

The SWA Flight Operations Manual, Normal Operations, Normal Landing Dry Runway[46], Chapter 3, Section 7, page 5 stated in part:

---

[45] Flap Load Relief–See Attachment 26, page 9.2.15.
[46] Normal Landing Dry Runway–See Attachment 20, SWA FOM, page 3.5.5.

Once the landing runway has been visually acquired whether from a visual or instrument approach, remain on centerline and on proper glideslope (ILS, VASI, PAPI, etc.) until the middle marker or further descent is necessary for a safe landing. Maintain safe target speed and do not descend below the glideslope or "duck under" to solely facilitate an early turnoff from the runway. Touchdown should occur between 1000 and 1500 feet from the landing threshold with the runway centerline between the main landing gear.

*At touchdown, verify that the automatic speedbrakes have fully deployed or deploy them manually while lowering the nose to the runway. Initiate reverse thrust as the nosewheel touches down by rapidly raising the reverse levers to the reverse-idle interlock. After the interlock is released, modulate reverse thrust as required and avoid exceeding engine limits. A minimum of 65% should be attained. When required, maximum allowable go-around thrust may be used. At 80 knots, the pilot not flying will call, "**80 knots**." Normally, the pilot flying will begin braking at 80 knots and gradually reduce the reverse thrust levers so as to be out of reverse thrust when reaching taxi sped. On short runways or with adverse landing condition, do not hesitate to initiate braking prior to 80 knots if required.*

5.6.1 **Brakes and Anti-skid**[47]

SWA B-737-300 airplanes are equipped with hydraulic powered brakes. The brake pedals provide independent control of the left and right brakes. Brake pressure is controlled by the anti-skid system when the pilot uses manual braking. The brake system provides each main gear with individual antiskid protection during manual or automatic braking. When the antiskid system detects a skid, the associated antiskid valve reduces brake pressure until skidding stops. By modulating pressure to the brakes, the antiskid system can give the maximum allowable braking effort for the condition of the runway.

The captain stated that he "got on the brakes pretty good" and used "maximum braking" while attempting to stop the airplane. The first officer said the captain applied the wheel brakes before 80-knots, and as the airplane passed abeam the Southwest passenger boarding gates, he joined the captain on the brakes and said that he applied them as "hard" as he could.

Although SWA airplanes are equipped with autobrake systems, they have been deactivated on all airplanes. When this system is operational, the autobrakes provide immediate breaking after touchdown by automatically controlling brake pressure. It operates in conjunction with the antiskid to regulate and maintain the selected deceleration rate.

5.6.2 **Speedbrakes System**[48]

The speedbrakes system consists of two hydraulically powered flight spoilers and two ground spoilers on the upper surface of each wing. When the speedbrake lever is actuated, all the spoilers extend when the airplane is on the ground, and only the flight spoilers extend when the airplane is in the air.

[47] Brake System–See Attachment 28 SWA FOM, page 18.20.04.
[48] Speedbrake System–See Attachment 27, SWA FRM, pages 9.1.8, 9.2.12, and 9.2.13.

Operating the speedbrake lever to the FLIGHT DETENT causes all flight spoilers to rise symmetrically and act as speed brakes by increasing drag and reducing lift.

The captain stated that as the flight passed west of VNY at 3,000 feet, at approximately 220–230 knots, he deployed the speed brakes and as the airspeed decreased to 220 knots, he called for "flaps 5—gear down" in an attempt to further slow the airplane.

Ground spoilers operate only on the ground and can be deployed either automatically or manually. When the automatic mode operates during landing, all the flight and ground spoilers rise to full extension on landing if the Speedbrake Lever is in the ARMED position and both thrust levers are retarded to IDLE. To manually extend the groundspoilers, the speedbrake handle must be manually moved to the UP position after landing.

The first officer reported that he saw the speed brake lever "come back" after touchdown.

5.6.3 Thrust Reverser System[49]

Each engine is equipped with a hydraulically operated thrust reverser. When reverse thrust is selected, blocker doors on the engine deflect engine fan air forward to produce reverse thrust. The thrust reverser is for ground operations only and is used for rejected takeoffs and after touchdown to slow the aircraft, reducing stopping distance. However, airplane landing performance data is not predicated on the use of reverse thrust.

The first officer stated that the engine reversers deployed, but he could not recall how much engine reverse thrust the captain applied. Neither pilot reported hearing engine compressor stalls [50] during the rollout.

5.7 Go-Around and Missed Approach Procedure[51]

The SWA Flight Operations Manual, Normal Operations, Go-around and Missed Approach, chapter 3, section, pages 46 stated in part:

- *Go-around/missed approach procedures have been designed to make execution of the procedure as simple as possible. The procedure is nearly the same for every profile.*

- *A missed approach must be executed if the pilot determines that a landing cannot be safely accomplished in the touchdown zone.*

The Chief Pilot for SWA in Oakland, California, said that a stabilized approach meant, "being fully configured at 1,000 ft on a visual approach and stabilized at 500 feet." He said that in 25 years at Southwest he had made maybe 5 go-arounds for traffic, or other things. He said when he was a new first

[49] Thrust Reversers–See Attachment 29, SWA FRM, pages 7.2.9, 7.2.10, and 7.2.11.
[50] Compressor stall–Loss of reverse thrust caused by the disruption of air through the compressor section of a turbojet engine and is similar to an automobile backfire.
[51] Go-Around and Missed Approach Procedure–See Attachment 24, SWA FOM, pages 3.6.46, 3.6.47, and 3.6.54.

officer for about 2 months at Southwest, he had told a captain to go around because of an unstabilized approach.

The Operations Group Investigators asked the accident captain whether he had ever performed pilot-initiated go-arounds. He replied, "Yes, lots of places," but he could not remember if he had ever performed one at Burbank in particular.

The captain was asked whether the company had guidelines regarding a specific point at which a pilot should abandon an approach if things didn't look right. He stated that if you were not set up at 1,000 feet, with flaps and gear, and on glide slope, you should go around. The captain was asked whether he was within company operating guidelines at 1,000 feet and 500 feet. He answered, "No." He stated that the airport looked "normal" at 500 feet, but he was not "in the slot," because his airspeed was too high. He said that he became "fixated on the runway" and could not explain why he did not go around.

5.7.1 Company Policy

When asked by the Operations Group investigators whether SWA pilots are required to fill out go-around reports, the Chief Pilot for the Oakland, California base answered, "No," but he liked to have pilots file irregularity reports to help address any passenger complaints and/or ATC problems.

The SWA VP-OPS was asked to explain the flight pay system. He said there was no financial incentive for pilots to fly fast, because they received full pay for a flight when it arrived at the gate ahead of schedule, and they received additional pay when the flight arrived more than 11-minutes over scheduled block time.

6.0 COMPANY INFORMATION

Southwest Airlines has met the requirements of the Federal Aviation Act of 1958, as amended, and the rules, regulations, and standards prescribed thereunder for the issuance of a certificate of operation. Southwest was authorized to operate as an air carrier and conduct common carrier operations in accordance with the above act and the rules, regulations, and standards prescribed thereunder and the terms, conditions, and limitations contained in the approved operations specifications under certificate number SWAA 304A, effective January 30, 1989, issued at SW60, Southwest Region Flight Standards District Office-60 (FSDO).

6.1 Company History

Southwest began service on June 18, 1971 with three 737-200 airplanes. The airline began with six roundtrip flights between Dallas Love Field, Texas, and San Antonio, Texas, and 12 roundtrips between Dallas, Texas, and Houston Intercontinental. By the end of 1971, the airline added a fourth airplane, flew 6,052 trips, carried 108,544 customers, and employed 195 people.

The airline served 56 cities (57 airports) in 29 states, employed more than 29,000 active employees, flew more than 2,550 flights a day, and carried over 57 million passengers in 1999. The airline operated more than 300 Boeing 737 jets with an average age of 8.4 years.

7.0 FAA SURVEILANCE

7.1 Gordon Taylor, FAA Aviation Safety Inspector, Principal Operations Inspector

Mr. Taylor was the Principal Operations Inspector (POI) assigned to SWA. He joined the FAA in 1981 and had been assigned to the Southwest Airlines certificate for three years. He held a B-737 type rating, which he acquired in 1996 at Flight Safety International (FSI) in Seattle, Washington. Mr. Taylor stated that his oversight activity consisted of mostly administrative work and little surveillance of SWA. He said he had given no initial operating experience (IOE) check rides or enroute check rides to pilots since the beginning of the year. He stated that his agency was "very short-handed", with office staffing down to "only four assistants." He said he was concerned that any further reduction of personnel might impair the staff's ability to "do all the things that need to be done."

Mr. Taylor stated that his relationship with Southwest Airlines was professional. He said they shared information freely but did not "socialize." He also reported that Southwest was very proactive and had "gone the extra step to standardize check airman." From check rides that he has observed, Mr. Taylor said he thought Southwest Airlines was the "most standardized airline in the industry."

7.2 Phil Lehrum, FAA Aviation Safety Inspector, Aircrew Program Manager B-737

Mr. Lehrum was the Aircrew Program Manager for the B-737 assigned to Southwest Airlines. He had worked at the FAA since September 1985 and acquired his B-737 type rating in 1998. Mr. Lehrum described his duties as technical in nature. He said he was responsible for reviewing all flight manuals and making recommendations to the SWA POI for final approval. He stated that he observed approximately 50 pilot check rides a year, of which about 20 check rides were in the simulator, and about 30 check rides were in the airplane. Additionally, Mr. Lehrum said he attended the annual SWA check airmen's training meeting, and sought to attend the quarterly airmen meetings at the outstations.

Inspector Lehrum stated that the SWA FAA-Certificate Maintenance Unit (CMU) was understaffed. He said the POI, and three additional safety inspectors had oversight responsibility for Southwest Airlines. He stated that the FAA was eliminating two of those positions, and that a third inspector had submitted a bid for a different position. Mr. Lehrum reported that he did not have enough time to observe as many check rides or ground training classes, as he should. He said SWA did not track the evaluation history of individual pilots, but when he received notification about an unsatisfactory flight check, he took the appropriate corrective action.

Mr. Lehrum stated that Southwest taught that for a stabilized approach in the B-737, "to go down, you have to slow down." He also said SWA had no requirement for a pilot to submit a report for making a missed approach. He stated that he had a good working relationship with SWA and observed no chronic problems there.

Mr. Lehrum said the FAA recently had turned down a new program, "Volunteer Aviation Safety Information," (VASI), which had been accepted by SWA, the pilots union, and the CMU.[52] He said he thought the program was beneficial because it used the aircraft flight data recorder to gather information regarding airplane performance and flight profiles.

7.3 Tom Kersten, FAA Aviation Safety Inspector, Air Transportation Oversight System for Southwest Airlines

Mr. Kersten was the FAA Aviation Safety Inspector assigned to the Air Transportation Oversight System (ATOS) for SWA. He was based at the Chicago Flight Standards District Office (ORD-FSDO). He held a B-737 type rating, which he acquired in October 1997 at the Boeing Airplane Company. Mr. Kersten attended a 2-day ATOS familiarization course that was conducted by the FAA and SWA and also a 3-day dispatch recurrent course. He stated that this training qualified him to conduct line checks, but that an inspector did not have to be type-rated to conduct line checks.

Mr. Kersten reported that he was assigned to Southwest Airlines ATOS program in 1998 and he has spent about 30-percent of his time performing surveillance of SWA operations. He said he normally completed 7–8 IOE checks per month. He stated that he knew of "no chronic problems with SWA," and said any problem that developed was handled quickly.

Mr. Kersten stated that he has not taken any certificate action against a SWA pilot, and he did not feel there were any systemic problems at SWA. He said SWA did a good job on upgrade operating experience (UOE), and that "flying only the B-737 helps this training process."

8.0 INTERVIEW SUMMARIES

C. LIST OF ATTACHMENTS

		Number of pages
1.	Interview Summaries	67 pages
2.	Dispatch Release/Flight Plan for SWA 1455	1 page
3.	Jeppesen Charts	9 pages
4.	Aeronautical Information Manual (AIM), Speed Adjustments	3 pages
5.	Flight Management System (FMS)	1 page
6.	Flight Management Computer (FMC), Progress Page 3/3	1 page
7.	Onboard Performance Computer (OPC), Landing Performance	3 pages
8.	Tailwind landings/Approach speeds	2 pages
9.	Landing Distance Chart	1 page
10.	Normal Procedures	3 pages
11.	Checklist Use	1 page
12.	APPROACH DESCENT–FINAL DESCENT CHECKLIST	3 pages
13.	EMERGENCY EVACUATION CHECKLIST	3 pages
14.	Procedures for All Approaches	1 page
15	Approach Envelop for All Approaches	2 pages
16.	Visual Approach Procedure and Crew Coordination Callouts	1 page

[52] CMU–Certificate Management Unit

17.	Visual Approach Profile	1 page
18.	Close in Descent Procedures	1 page
19.	Final Descent Procedures	1 page
20.	Normal Landing Dry Runway	1 page
21.	Deviation Callouts for All Approaches	1 page
22.	Warning Systems, Excessive Descent Rates (Mode-1)	1 page
23.	PULL-UP Warning Escape Procedure	4 pages
24.	Go-around and Missed Approach Procedure/Profile	3 pages
25.	Air Conditioning and Pressurization Controls	1 page
26.	Flap Load Relief System	3 pages
27.	Speedbrakes/Spoilers System	3 pages
28.	Brake System	1 page
29.	Thrust Reverser System	3 pages
30.	Pilot in Command Airport Qualifications, Special Airports, FAR 121.445	8 pages

Submitted by:

[redacted]

Tom Curran
Air Safety Investigator, Operations
February 28, 2001