NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Operational Factors/Human Performance Group Chairman

Factual Report

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

December 4, 2009

OPERATIONAL FACTORS / HUMAN PEFORMANCE

Group Chairman's Factual Report

DCA10IA001

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A. INCIDENT

Operator:	Northwest Airlines, Inc.
Location:	Minneapolis, MN
Date:	October 21, 2009
Airplane:	Airbus A-320-212

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C. SUMMARY

On October 21, 2009, Northwest Airlines (NWA) flight 188, an Airbus A320, N374NW, did not respond to air traffic control communications for approximately one hour 17 minutes during cruise at FL370. Flight 188 flew past their intended destination while the flight was NORDO (no radio communications) but landed without further incident once radio communication was reestablished. There were no injuries to the 2 pilots, 3 flight attendants and 144 passengers onboard. The flight was a regularly scheduled passenger flight operating under 14 Code of Federal Air Regulation Part 121 from San Diego International Airport (SAN), San Diego, California, to Minneapolis-St Paul International/Wold-Chamberlain Airport (MSP), Minneapolis, Minnesota.

D. DETAILS OF THE INVESTIGATION

On October 22, 2009, a request was sent on to Northwest Airlines to secure both the cockpit voice recorder (CVR) and flight data recorder (FDR). Both recorders were sent to the NTSB in Washington**,** DC and received on October 23, 2009. Also on that day, a request was made to the FAA for the pilot records of the flight crew**.**

On October 24, 2009, the National Transportation Safety Board (NTSB) investigators on the Operations/Human Performance Group traveled to Minneapolis, MN.

From October 24 to October 27, 2009, the Operations/Human Performance group conducted their initial field phase of the investigation at the Delta North Training Facility formerly known as Northwest Aerospace Training Corporation (NATCO). On October 25, 2009, the group met with Northwest Safety Department officials. Flight manuals and dispatch release information for the flight, as well as other documents related to the flight were requested and obtained.

On October 25, 2009, the group interviewed the captain and first officer (F/O) of Northwest flight 188.

On October 26, 2009, the group interviewed the dispatcher of record for the incident flight, as well as the Chief Dispatcher on duty at the time of the incident. The Operations/Human Performance group observed an A-320 flight simulator depiction of the incident flight's approach and overfly of the Minneapolis – St Paul International/Wold-Chamberlain Airport (MSP), Minneapolis, Minnesota. This concluded the initial field investigation.

After completion of the initial field investigation, the group conducted numerous interviews via telephone from NTSB headquarters. The interviews included follow up interviews with some interviewees from the field investigation as well as interviews with software engineers from Aviation Spectrum Resources, Inc, and the Federal Aviation Administration (FAA) principal

operations inspector (POI) and aircrew program manger (APM) for the Northwest Airlines certificate.

On November 13, 2009, an NTSB investigator traveled to Atlanta and reviewed the personnel and training files for the flight crew of Northwest 188. In addition, a tour of the Delta/Northwest Operations Control Center was conducted, with a demonstration of Northwest Airlines NORDO procedures and with a simulated contact of an airborne aircraft conducted by dispatch personnel. The NTSB was provided additional information regarding ARINC communications addressing and reporting system (ACARS) capabilities of Northwest Airbus aircraft, and ACARS logs of communications between NW188 and dispatch.

E. FACTUAL INFORMATION

1.0 History of Flight[1]

On October 20, 2009, the flight crew began the first day of a five day trip sequence. This was the first time the incident captain and F/O had flown together. The crew operated a flight from MSP to San Diego International Airport (SAN), San Diego, California, where they were scheduled for a 19 hour layover. On October 21, 2009, the day of the event, the hotel van provided the flight crew transportation to the airport at 1300 Pacific daylight time (PDT). The incident flight attendants (F/A) arrived from MSP with the event aircraft which was approximately 20 minutes late in arriving. There were no significant flight related minimum equipment list (MEL) maintenance items on the aircraft.

The captain stated he was the pilot flying (PF) for the flight to MSP, and according to the current Delta Air Lines procedures, the PF was responsible for entering data and flight plan information into the flight management computer (FMC) while the pilot monitoring (PM) would conduct preflight preparations of the aircraft, including preparation the overhead cockpit panel. Both pilots stated that these were new procedures introduced to the Northwest crew as a part of a multi-phase integration of flight crew procedures during the merger of Delta Air Lines and Northwest Airlines, and were a departure from previous Northwest Airlines policy where the captain was always responsible for entering FMC data, as well as the preparation of the overhead cockpit panel. The captain mentioned that he noticed several items had not been completed on the overhead cockpit panel by the F/O, and completed them himself. As PF, the captain programmed the FMC, and entered a standard terminal arrival route (STAR) for MSP, but did not enter an anticipated arrival runway. The flight departed at 1459 Pacific daylight time, about 25 minutes late.

According to the pilots, the initial climb to cruise altitude was normal, and the F/O characterized the workload for the flight as “normal.” The autopilot was used for climb and cruise, and the route programmed in the FMC was flown with no direct routings. At the initial cruise altitude of FL350, they encountered turbulence and decided to climb to FL370 for a smoother ride. Both pilots commented on how slow the aircraft was in climbing to FL370. According to FDR data, the aircraft leveled off at FL370 at about 18:22 central daylight time (CDT) after a total climb

[1] See attachment 1 – Interview Summaries

time of approximately 1 hour and 23 minutes. The captain stated that the #1 radio was set for air traffic control (ATC) frequencies, and the #2 radio was set to the universal emergency frequency 121.50 MHz, which the crew monitored according to company procedures. As allowed by company procedures, once at cruise altitude, both pilots had their headsets off and monitored ATC through the cockpit speakers[2], which they stated were set at "normal" listening levels. The captain was performing the PF duties and autopilot inputs, and the F/O had PM duties and was responsible for the ATC radio communications. Both pilots stated that neither fell asleep during the incident flight. The captain did not send any position reports during the flight, and did not know if the F/O had sent any as a required PM duty under the Northwest standard operating procedures (SOP)[3]. The F/O stated that he complied with the SOPs. The captain reported a previous conversation with a jump seating dispatcher who discouraged the sending of position reports since dispatch already tracked each flight and said "they were getting inundated" with position reports. The captain could not recall if the F/O had completed a top of climb fuel calculation, which was typically recorded on the dispatch paperwork that the crew received prior to departure. The actual flight papers were not recovered.

Both pilots stated in interviews that during the flight, they both heard "chatter" on the radio frequencies, but did not recall hearing their call sign, and that the amount of ATC radio calls was "no more than usual".

According to the F/O, approximately two hours into the flight, one of the F/As called the cockpit to check if the flight crew wanted anything to eat (the captain could not remember the time frame of the call). At that time the captain responded that he would also use the opportunity to take a lavatory break. The captain exited the cockpit, while one of the F/As remained in the cockpit as required. The F/O did not leave the cockpit. Meals were provided to both pilots, and the captain ate first, followed by the F/O. The crew stated the cockpit lighting was set to high.

After they had completed their meals, the captain said he began a conversation regarding the current Preferential Bidding System (PBS). The Delta PBS system being used by the Northwest crews had been recently implemented as part of the integration of Northwest Airlines and Delta Air Lines. While computer tutorials, crew services volunteers and a 150 page manual had been provided to the Northwest crews to learn the new PBS system, both pilots characterized the system as confusing. The captain had recently received his November bid results and downloaded the results on his laptop computer. He commented to the F/O that he did not receive the bid results he had anticipated, and it would require him to commute to MSP more often. The captain then pulled out his laptop computer to show the F/O his bid results. According to the captain, he placed his laptop on his lap, although the F/O stated the captain had placed his laptop out on the extendable tray table. The captain stated that with his laptop out, his view of the Primary Flight Display (PFD) was not blocked. After 4-5 minutes of conversation, the F/O pulled out his laptop computer and placed it on top of the extendable tray table in front of him. The captain stated that he then placed his laptop to his left and on top of his flight bag and it remained there until he retrieved the arrival charts for MSP, but he also later stated that both laptops were out at the same time. The F/O stated that both laptops were out and opened at the

[2] See attachment 17- Northwest Flight Operations Manual (Headset Reference)
[3] See attachment 22 - Northwest Communications Manual

same time, and that the captain's laptop was on his tray table. Both pilots acknowledged there was a continued discussion on the PBS system, with the F/O tutoring the captain in regards to the bidding system and process because of his familiarity and comfort with the bidding system. They both stated they were not sleeping and were not arguing. Both pilots also stated that they did not hear any audible alerts in the cockpit, and did not see any ACARS message indications on the Electronic Centralized Aircraft Monitor (ECAM) during the time they had their laptops out. There were no cockpit print outs of the ACARS messages sent by dispatch. The captain stated that he believed the conversation regarding the bidding procedures lasted about 15 minutes. According to FDR data, at about 2001 CDT, the Flight Mode Annunciator (FMA) on the pilots' PFD indicated a lateral mode degradation from navigation (NAV) mode to heading (HDG) mode. This occurred about the time the airplane passed over the last point of its flight plan and maintained present heading in heading mode on the autopilot.

The pilots stated that their first indication of anything unusual with the flight occurred when they received a call from a F/A inquiring about their arrival. The captain said he looked down at his Multifunctional Control and Display Unit (MCDU) and saw there was no flight plan information depicted. They said they did not see the lights of Minneapolis due to the overcast sky conditions below. The captain then turned his NAV display from ARC mode to ROSE (compass) and saw Duluth, MN to his left and Eau Claire, WI at "the 2 o'clock" position with no estimated time of arrival (ETA) information shown for their destination. The F/O said he "immediately" contacted ATC, but neither pilot could remember what frequency they used, and said "someone" gave them a frequency to contact MSP Center. It was determined that the crew inadvertently contacted Winnipeg Center, which gave them a frequency to established contact with MSP Center. The F/O then noticed the ACARS message indication on the ECAM, and attempted to retrieve those messages. He stated that he noticed several "contact ATC" messages from dispatch, but "inadvertently" pushed the "delete all" button erasing all the dispatch messages.

Communication was reestablished with ATC at about 2014 CDT and the crew stated "we got distracted and we've overflown MSP". The crew stated they were are overhead Eau Claire, WI and wanted to make a 180 degree turn and join the arrival from Eau Claire." ATC issued a series of turns and descent clearances to facilitate an arrival into MSP. The captain stated that he made a passenger announcement (PA) to the passengers advising of an arrival into MSP in "25-28 minutes". ATC again asked for an explanation for overflying MSP, and the crews' response was "flight crew distraction". ATC issued arrival instructions, changing the standard terminal arrival route (STAR) arrival several times. The captain sent an ACARS message to dispatch indicating they were inbound to MSP. FDR data indicated that the aircraft landed at about 2107. The crew stated that airport police and company officials, including a Northwest Chief Pilot met the aircraft and approached the cockpit. After a brief conversation with officials, the crew was administered a field breathalyzer test. Neither pilot could remember what happened to the cockpit paperwork, but both stated they believed the Northwest Chief Pilot who met the aircraft may have taken possession of it.[4]

[4] See attachment 5 - Assistant Chief Pilot Statement

2.0 Flight Crew Information

The incident flight crew consisted of a captain, first officer, and three cabin crewmembers. The captain and first officer had not flown together prior to this pairing. The incident flight was the second flight of a five day pairing.

2.1 Trip Information

Below is the scheduled trip data as flown by the pilots of Northwest 188:[5]

Date	Flight	Depart MSP	Arrive SAN	Actual Flight Time	Layover
20OCT	185	17:45	19:24	3:39 hours	19:17 hours
	Report Time: 16:20		Release Time: 19:39		

Date	Flight	Depart SAN	Arrive MSP	Actual Flight Time	Total Time Away
21OCT	188	14:41	21:15	4:34 hours	29:10
	Report Time: 13:20		Release Time: 21:30		

2.2 The Captain[6]

Captain Timothy Brian Cheney, was 53 years old, and his home was near Seattle, Washington. He began flying as a private pilot in Anchorage, AK flying twin otters and turbo beavers, as well as his own private float plane. He flew air cargo for Ryan International on contract with Emery as a flight engineer and first officer on the Boeing 727. He was upgraded to captain on the Boeing 727, but never finished initial operating experience (IOE) before being hired by Republic Airlines on November 18,1985 (Republic later merged with Northwest Airlines). He qualified as F/O on the DC-9 on January 17, 1986. On February 19, 1987, he qualified on as flight engineer (F/E) on the Boeing 727. On October 17, 1988, he re-qualified as F/O on the DC-9. On May 24, 1991, he qualified as F/O on the A320. On July 9, 1995, he completed transition training as F/O on the Boeing 747-200. On January 17, 2002, he completed upgrade training as captain on the A320. He was based in MSP.

The captain stated he had no major changes in his personal life in the past year. He had been married for 27 years to the same spouse and they lived near Seattle, WA. He stated he had no major changes in his financial situation in the past year, and his finances were "good". However, he indicated that the Northwest Airlines Chapter 11 action prior to the merger made a financial impact on his retirement, and had been a distraction that created a "bitter and angry" environment that he tried to leave out of the cockpit. He characterized pilot morale as average and that it was better now than it was three years earlier. Since the merger, there had been many changes happening at the company, including four phases of changes to the operating manuals. The F/O characterized the captain as personable and nice with a good attitude. He also stated that the captain seemed like a conscientious pilot, made sure everything was done, a nice man, and they "hit it off well".

[5] Times for this chart are local. MSP was in central daylight time and SAN was in Pacific daylight time.
[6] See attachment 1 - Interview Summaries

The captain was current and qualified under Northwest Airlines and FAA requirements. A review of FAA records found no prior accident, incident or enforcement actions. A driving record background search found no convictions or accidents.

2.2.1 The Captain's Pilot Certification Record[7]

FAA records of the Captain indicated that:

Private Pilot – Airplane Single Engine Land "Night Flying Prohibited certificate issued August 7, 1977.
Private Pilot – Airplane Single Engine Land certificate issued November 10, 1977.
Flight Engineer – Turbojet Powered certificate issued March 12, 1982.
Private Pilot – Airplane Single Engine Land and Sea certificate issued July 15, 1978.
Private Pilot – Airplane Single Engine Land and Sea Instrument-Airplane certificate issued February 20, 1979.
Private Pilot – Airplane Single Engine Land and Sea, Multi Engine Land Instrument-Airplane certificate issued May 2, 1979.
Commercial Pilot – Airplane Single and Multi Engine Land, Private Pilot Privileges: Airplane Single Engine Sea Instrument-Airplane certificate issued December 16, 1979.
Commercial Pilot – Airplane Single and Multi Engine Land, Single Engine Sea Instrument-Airplane certificate issued June 6, 1981.
Flight Engineer – Turbojet Powered certificate issued March 12, 1982.
Airline Transport Pilot – Airplane Multi Engine Land, Commercial Privileges: Airplane Single Engine Land and Sea certificate issued May 13, 1982.
Airline Transport Pilot – Airplane Multi Engine Land B-727, Commercial Privileges: Airplane Single Engine Land and Sea certificate issued October 29, 1985.
Airline Transport Pilot – Airplane Multi Engine Land B-727 A-320, Commercial Privileges: Airplane Single Engine Land and Sea certificate issued January 6, 2002.

2.2.2 The Captain's Pilot Certificates and Ratings Held at Time of the Event[8]

AIRLINE TRANSPORT PILOT (issued January 6, 2002)
Airplane Multi Engine Land B-727 A-320, Commercial Privileges: Airplane Single Engine Land and Sea

FLIGHT ENGINEER (issued March 12, 1982)
Turbojet Powered

MEDICAL CERTIFICATE FIRST CLASS (issued May 5, 2009)
Limitations: must have available glasses for near vision.

[7] Pilot Certification Records were provided by the Federal Aviation Administration.
[8] Pilot Certification Records were provided by the Federal Aviation Administration.

2.2.3 The Captain's Training and Proficiency Checks Completed[9]

Initial Type Rating Airbus A320: January 6, 2002
Last recurrent simulator training: January 25, 2009
Last recurrent ground training: January 25, 2009
Last Line Check in A320: October 16, 2008
Last Proficiency Check: January 25, 2009

2.2.4 The Captain's Flight Times

The incident captain's flight times, based on Northwest employment records:[10]

Total pilot flying time	18, 641 hours
Total Pilot-In-Command (PIC) time	8,196 hours
Total A320 flying time	8,897 hours
Total A320 PIC time	5,996 hours
Total flying time last 24 hours	8:13 hours
Total flying time last 7 days	8:13 hours
Total flying time last 30 days	43:37 hours
Total flying time last 90 days	178:29 hours

2.2.5 The Captain's 72-Hour History

The captain stated that, when he was not working, his typical sleep schedule was to go to bed at about 2330 and awaken about 0730. He normally awoke once during the night around 0300 for a toilet break. He tried to obtain six hours of sleep per night. He did not nap, and wished he could.

For commuting, he bid trips that left late in the afternoon and ended early in the day so he could jumpseat into and out of MSP without having to remain overnight there. The previous Northwest Airlines policy was that if you booked up to 10 ½ days in advance or listed as a passenger, and if bumped with a back up, the company would provide you with a must ride seat to work on that back-up flight. However, the new Delta Air Lines policy, that was now being implemented, was more complex. It required booking trips from 1 ½ to 3 ½ days in advance, was not as user friendly, and might result in a pay cut if no jumpseat was available.

His October flight schedule was good. He had about six days off-duty before the incident trip. During this time, his sleep was average. He did routine activities around the house.

On Wednesday, October 20, he went to bed about 2230 and awoke at about 0400. He was awakened by the alarm and believed the quality of his sleep was OK. He departed SEA at about

[9] See attachment 8 - Captain Training Summary
[10] See attachment 10 - Crew Flight Times

0630 PDT and arrived at MSP about 1130 CDT. He spoke for about one hour with a preferential bidding system (PBS) instructor available in the crew room. He stated that the instructor was helpful. He then sat in a recliner chair in the crew room. Some Delta Air Lines crew schedulers were in the crew room and he spoke with them for about 35-40 minutes about Northwest and Delta company differences on jumpseat policy. He then checked in and went to the airplane. The preflight duties were normal. The airplane arrived in SAN about 1930, which was about ½ hour behind schedule. His wife joined him for the layover in SAN. The hotel drove them to a nearby restaurant where he "ate too much": a hamburger, two tacos, and a beer. They walked back to the hotel, watched the news, and he went to sleep about 2230-2300.
On Wednesday, October 21, 2009, he awoke about 0730. The quality of sleep received was "pretty good". He sometimes had difficulty falling or staying asleep at hotels, which could be noisy, requiring him to turn on the fan to mask the noise. The SAN hotel was "good", however. They walked about 20 minutes to a restaurant for breakfast, then returned to the hotel and sat on the deck. He had a 1300 pickup at the hotel. He characterized workload on the incident flight as normal. He felt rested at the time and was not hungry.

2.3 The First Officer[11]

F/O Richard Irwin Cole, was 54 years old. His home was in Salem, OR. He began flying with the Civil Air Patrol at age 14 in a Piper Cub. He flew in the ROTC at the University of Puget Sound, and joined the U.S. Air Force in 1980 and flew F-111s for about three years. He was an instructor at the Mountain Home AFB in Idaho. Neck problems caused him to leave the U.S. Air Force. He worked for Pan Am Airlines from 1989 to 1991. At Pan Am, he was a F/O on the Boeing 727. He worked for Express One International Airline from 1991 to 1996 as a Flight Engineer (F/E) and F/O on the Boeing 727. He was hired at Northwest Airlines on January 3, 1997 and served as an F/E on the Boeing 727 for 3 years. On December 6, 1999, he qualified as an F/E on the DC-10. On January 11, 2004, he qualified as F/O on the A320. He re-qualified as an F/E on the DC-10 on March 25, 2005 before returning to the A320 as a F/O on August 2, 2005. He was based in MSP.

The F/O stated there had been no major changes in his personal life during the past year. He was married, and he stated there were no major changes in his financial situation. He commented that he had no financial worry, but added that although the merger with Delta Air Lines had initially improved pilot salary by 10%, the Northwest pilots had previously experienced a 40% pay cut when the company underwent bankruptcy proceedings prior to the merger.

The captain characterized the F/O as "ok but I've flown with better". When asked about suggestions for the F/O to be better, the captain added that the new Delta Air Lines procedures could have been accomplished better, but stated everyone was "still struggling through it", but he thought the F/O could have been better on the preflight items.

The F/O was current and qualified under Northwest Airlines and FAA requirements. A review of FAA records found no prior accident, incident or enforcement actions. A driving record background search found no convictions, or accidents.

[11] See attachment 1 - Interview Summaries

2.3.1 The F/O's Pilot Certification Record

FAA records of the F/O indicated that: [12]

Flight Engineer – Turbojet Powered (Subject to the Provisions of Exemption No. 4901) certificate issued January 2, 1990.
Flight Engineer – Turbojet Powered certificate issued February 5, 1990.
Commercial Pilot – Airplane Multi Engine Land Limited to Center Line Thrust Instrument-Airplane certificate issued October 7, 1988.
Airline Transport Pilot – Airplane Multi Engine Land certificate issued February 23, 1989.
Airline Transport Pilot – Airplane Multi Engine Land B-727 certificate issued October 6, 1993.
Airline Transport Pilot – Airplane Multi Engine Land A-320, B-727 A320 SIC Privileges Only certificate issued December 9, 2005.

2.3.2 The F/O's Pilot Certificates and Ratings Held at Time of the Event[13]

AIRLINE TRANSPORT PILOT (issued December 9, 2005)
Airplane Multi Engine Land A-320, B-727 A320 SIC Privileges Only.

FLIGHT ENGINEER (issued February 5, 1990)
Turbojet Powered

MEDICAL CERTIFICATE FIRST CLASS (issued September 22, 2009)
Limitations: Holder must have available glasses for near vision.

2.3.3 The F/O's Training and Proficiency Checks Completed[14]

Initial Type Rating A320: January 11, 2004 (SIC privileges only)
Last recurrent simulator training: December 7, 2008
Last recurrent ground training: December 7, 2008
Last line check on A320: October 3, 2005
Last Proficiency check on A320: December 7, 2008

2.3.4 The F/O's Flight Times

The incident F/O's flight times, based on Northwest employment records: [15]

Total pilot flying time	13,811 hours
Total PIC time	2,350 hours
Total SIC time	5,345 hours
Total flying time in A320	4,500 hours

[12] Pilot Certification Records were provided by the Federal Aviation Administration.
[13] Pilot Certification Records were provided by the Federal Aviation Administration.
[14] See attachment 14 - First Officer Training Summary
[15] See attachment 10 - Crew Flight Times

Total A320 second-in-command (SIC) time	4,500 hours
Total flying time last 24 hours	8:13 hours
Total flying time last 7 days	23:15 hours
Total flying time last 30 days	83:05 hours
Total flying time last 90 days	210:42 hours

2.3.5 The F/O's 72-Hour History

The F/O stated that, when he was not working, his typical sleep schedule was to go to bed between 2300-0000, wake up about 0700. He generally slept straight through the night and felt rested with about seven hours sleep. When he was at home if he did not receive sufficient sleep, he sometimes took naps in the afternoon, from 1300 to 1400 or from 1400 to 1500. This happened about half the time. He normally had no trouble falling and staying asleep.

The F/O lived in Salem, Oregon but was based at MSP. For commuting, he stated that he preferred to fly long trips—5 day sequences-- so he did not have to fly too many times back and forth between his home and his base. He usually commuted to his base on the day prior to beginning a trip and stayed in a hotel at his own expense. He had a good schedule for the month of October: three 5-day trips with 2-days off between, which provided a compressed off-duty schedule but allowed him to commute to MSP twice without a hotel stay. The incident occurred on the second day of the last 5-day trip.

On Saturday October 17, he completed the second trip sequence at MSP, caught the 1430 CDT flight to Portland International Airport, (PDX), Portland, Oregon, arrived at PDX, drove about one hour to his home at Salem and arrived there about 1800 PDT. He ate dinner with his family, watched football on television, and went to bed between 2300-2400.

On Sunday October 18, he awoke after about 7-8 hours sleep. He used the computer and watched sports on television in the morning with his stepson. About 1600, the two children from his first marriage and other friends of his children came to visit and his children stayed over for the night. He spoke with them, ordered pizza for dinner about 1900, watched a movie with his wife, and went to sleep between 2300-2400. He said he did not conduct any company business over the weekend other than perhaps reading some computer messages.

On Monday October 19, an alarm clock awoke him about 0530 and he got the children ready for school while his wife slept in. About 0700, he drove the children to school who all attended the same high school. He said quality of his overnight sleep was limited as he was tired all day Monday, and probably took a nap in the afternoon. Also on Monday, he prepared for his upcoming trip, paid some bills, drove his children home from high school and watched Monday night football. He went to bed about 2300 to 2330.

On Tuesday October 20, he awoke about 0330. His sleep was good but "too short" and he felt "tired". He showered, dressed, drank coffee, and drove to the airport where he caught a 0630

PDT flight that arrived at MSP at noon. He slept on the airplane for about two hours, probably in and out of sleep but mostly asleep. Sleep quality on airplanes was not 100 percent but was restful. He was less tired when he arrived at MSP than when he departed PDX. He planned to take a nap in the reclining chairs available to pilots. There were several rooms for resting available to pilots at MSP. There was a quiet room with complete darkness and multiple recliner chairs. The recliner chairs lay almost flat and there were blankets and pillows. He normally did not use the quiet room because there were generally other crews asleep there and their alarm clocks would frequently sound. It was also very dark, causing one to stumble around looking for a recliner. There was also the main crew room with some chairs, but it was noisy and there were no pillows. Finally, there were smaller side rooms where the pilot could close the door, sleep individually, and set an alarm without disturbing others. He preferred those and they were available most of the time. He was unable to nap at MSP, because of vacation bidding issues. He was in the crew room computer area for about two hours, but was unable to access his e-crew account. He ate an early dinner of General Tso's chicken at a Chinese restaurant at the airport, which was always good. He was scheduled for a 1720 CDT flight to SAN and checked in at noon (pilots at Northwest were required to check in at least 12 hours prior to departure).[16] He met the captain at the airplane. They departed on time. The flight to SAN was uneventful. The flight was a little bumpy, maybe moderate turbulence, and the arrival was uneventful. They arrived at the SAN layover hotel about 2000-2030 PDT and he went to his room. He was tired, did not eat, and went to bed at 2230-2300. The captain met his wife who had flown to SAN.

On Wednesday October 21, the day of the incident, he awoke about 0600-0630. The quality of his sleep was good and he woke up rested and wide-awake. He received about seven hours sleep. He made coffee and accessed the computer to determine why he was off the company computer system. About 1000, he went for a walk along the docks. He ate fish and chips about 1100, and returned to the hotel to prepare for meeting the 1300 van to the airport. The trip to the airport took about 5-10 minutes. At the airport, he purchased a small salad to eat on the airplane since they normally were not provided food. He ate the salad at the top of climb. He also ate some of the crew meal that became available, which consisted of meat and potatoes with lemon pie. He normally drank 4-5 cups of coffee per day. That day, he drank 1-2 cups of coffee when he awoke and 1 cup on the airplane.

He said the captain was personable, nice, and had a good attitude. He was from Alaska but lived in Seattle where First Officer Cole grew up. On the first day they discussed their backgrounds and they "hit it off well". The captain seemed like a conscientious pilot. He was concerned about the appropriate things, and made sure everything was done. He was a very nice man. During the event, they allowed themselves to get distracted and "got deeper and deeper into it.

2.4 Medical and Pathological Information

2.4.1 The Captain

The captain held a First Class Airman's Medical Certificate issued May 5, 2009 with the limitation that "holder shall possess glasses for near/intermediate vision." The examination listed the captain's vision in both eyes as 20/20 for distant vision, 20/50 corrected to 20/20 for

[16] Reference Northwest Airlines Flight Operations Manual (FOM), page NW 3-2.3.

intermediate vision, and 20/100 corrected to 20/20 for near vision. According to his medical examination, his height was 69" and weight was 195 pounds.

Captain Cheney stated he was in excellent health and there had been no major changes in his health in the past year. He used reading glasses as required by his medical certificate, and had them for the incident flight. He characterized his hearing as normal. He did not use prescription medication, drank very little alcohol, and was a non-smoker. He drank coffee (3-4 cups per day), and in the 72 hours prior to the incident flight, only took an aspirin, which he took on a daily basis.

The captain once sought medical assistance for sleep issues. The Sleep Labs of Alaska performed an overnight sleep study many years earlier that concluded that he did not have apnea. However, he voluntarily began sleeping with a constant positive air pressure (CPAP) device to control snoring for his wife's sake. He did not take the CPAP device with him on overnight trips.

2.4.2 The First Officer

The first officer held a First Class Airman's Medical Certificate issued September 22, 2009 with the limitation that "must have available glasses for near vision", which the first officer stated he had with him on the incident flight. The examination listed the first officer's distant vision as 20/20 in the right eye and 20/15 in the left eye, and his intermediate and near vision as corrected to 20/25 in each eye. According to his medical examination, his height was 71" and weight was 192 pounds.

F/O Cole stated that there had been no major changes in his health in the past year. He characterized his health as good and his hearing as good. He had a personal physician but had not visited him in two years. He was not taking prescription medicine. He drank alcohol, but his last use was probably on Sunday, October 18 when he drank beer while watching football on television. He smoked tobacco, about 1 pack per day, but never smoked in the airport or airplane. His last use of tobacco before the incident was perhaps smoking a cigarette outdoors about one hour before departure. He normally drank 4-5 cups of coffee per day, and drank 1-2 cups when he awoke on the day of the incident flight, and 1 cup on the airplane. He never sought medical assistance for sleep issues.

2.4.3 The Flight Crew's Post-Incident Toxicological Testing

After arrival in MSP on October 21, 2009, the flight crew was administered a field breathalyzer test by airport police. The results were negative for both pilots. On the same date, the captain and First Officer complied with a company post incident/accident drug-testing program that administered a second alcohol breath test (at 2205 CDT for the captain and 2215 CDT for the first officer) and required urine samples for drug testing (provided at 2209 CDT by the captain and 2223 CDT by the first officer). All test results were negative for both pilots.[17]

[17] The substances tested in the company post-incident/accident drug program were: Urinary ethyl alcohol, Amphetamines, Barbiturates, Benzodiazepines, Cocaine metabolite, Opiates, Oxycodone, PCP, Marijuana metabolite (THC), Methadone, Methaqualone, and Propoxyphene.

3.0 Weight and Balance[18]

The following information was obtained from the weight manifest as shown on the dispatch paperwork received by the crew of Northwest 188:

Basic Operating Weight	93,300 lbs
Passenger Weight	27360 lbs
Baggage & Cargo	3,840 lbs
Zero Fuel Weight	124,500lbs
Fuel	33,100 lbs
Ramp Weight	157,600 lbs
Taxi Fuel Burn	500 lbs
Takeoff Weight	157,100 lbs
Maximum Takeoff Weight (performance limited)	163,000 lbs

3.1 Fuel Burn

Federal Aviation Regulations have specific fuel requirements for flights operating under Instrument Flight Rules. 14 CFR[19] 91.167 states in part:

> ***91.167 Fuel requirements for flight in IFR conditions.***
> *(a) No person may operate a civil aircraft in IFR conditions unless it carries enough fuel (considering weather reports and forecasts and weather conditions) to--*
> *(1) Complete the flight to the first airport of intended landing;*
> *(2) Except as provided in paragraph (b) of this section, fly from that airport to the alternate airport; and*
> *(3) (3) Fly after that for 45 minutes at normal cruising speed or, for helicopters, fly after that for 30 minutes at normal cruising speed.*
> *(b) Paragraph (a)(2) of this section does not apply if:*
> *(1) Part 97 of this chapter prescribes a standard instrument approach procedure to, or a special instrument approach procedure has been issued by the Administrator to the operator for, the first airport of intended landing; and*
> *(2) Appropriate weather reports or weather forecasts, or a combination of them, indicate the following:*
> *(i) For aircraft other than helicopters. For at least 1 hour before and for 1 hour after the estimated time of arrival, the ceiling will be at least 2,000 feet above the airport elevation and the visibility will be at least 3 statute miles.*

NWA188 was flight planned and filed under instrument flight rules (IFR) with an estimated time of arrival (ETA) of 2001 CDT (0101 Coordinated Universal Time [Z])[20] Weather forecast for

[18] See attachment 15 - Northwest 188 Flight Papers
[19] CFR – Code of Federal Regulations
[20] See attachment 15 - Northwest 188 Flight Papers

the ETA at MSP was 5 statute miles visibility and a 1200 foot overcast ceiling, requiring an alternate airport to be filed with the flight plan.

Gate release fuel from SAN for NW188 was 33,100 pounds of fuel. Hector International Airport (FAR), Fargo, North Dakota was listed as the alternate, which was 217 miles from MSP, that required 4,400 pounds of additional fuel. Additionally, NWA188 was dispatched with the required Federal Aviation Regulation of 4,100 pounds reserve fuel. Estimated total fuel burn was 21,000 pounds (500 pounds taxi fuel plus 20,500 pounds flight fuel burn). With SAN-MSP taxi, takeoff and climb/cruise fuel, approach, *estimated* fuel on arrival to MSP was 12,100.[21]

The original flight plan was for a cruise altitude of FL350. However, due to turbulence the crew climbed to FL370, decreasing their total fuel burn. The upper level tail winds at FL 370 were greater than the winds at FL350, giving NW188 a better tailwind component than forecasted at FL350.[22]

At 2009:52 CDT (0109:52Z), when NW188 was in the vicinity of MSP, the dispatcher sent an ACARS "query" to the airplane.[23] This caused the airplane to generate an auto response from the aircraft's onboard computer to dispatch, relaying inflight information such as altitude, position, temp, and fuel onboard. The fuel onboard at that time was indicated to be 11,700. [24]

At 2046:01 CDT (0146:01Z) the dispatcher sent another ACARS query to the aircraft when it was on the Gopher arrival inbound to MSP and received a report of 8,700 pounds of fuel onboard.[25]

The flight plan contained 3,600 lbs. of "contingency fuel" for the flight, and that was essentially what NW188 burned extra to get back into MSP. The flight arrived at MSP with about 7,500 lbs of fuel which was enough fuel to fly for more than an hour.

4.0 Company Overview[26]

Northwest Airlines, Inc. began operations in 1926. The airline operated 1,400 flights per day, with over 31,000 employees worldwide until it merged with Delta Air Lines on October 29, 2008. As a result of the merger, Northwest Airlines, Inc. and its subsidiaries became wholly-owned subsidiaries of Delta Air Lines. As of December 31, 2008, the combined airline had 84,306 employees worldwide, of which approximately 12,000 are pilots. Flight crews were based in New York, NY, Cincinnati, OH, Detroit, MI, Minneapolis, MN, Memphis, TN, Anchorage, AK Atlanta, GA, Los Angeles, CA, Salt Lake City, MS, and Seattle, WA The combined Delta/Northwest had a total fleet of 1,023 airplanes. Fleet types included 75 B-737s, 4 B-747s, 108 B-757s, 75 B-767s, 10 B-777s, 55 A-319s, 41 A-320s, 32 A-330s, 63 MD-88s, 16 MD-90s, 71 DC-9s, 90 CRJs, 36 EMB-175s, and 7 B-747 freighter airplanes.

[21] See attachment 15 - Northwest 188 Flight Papers
[22] See attachment 15 - Northwest 188 Flight Papers
[23] See attachment 1 - Interview Summaries
[24] See attachment 3 - Aircraft Communications Addressing and Reporting System (ACARS)
[25] See attachment 3 - Aircraft Communications Addressing and Reporting System (ACARS)
[26] See attachment 12 - Delta/Northwest 2008 10K

The Delta Air Lines executive offices were located at Hartsfield-Jackson Atlanta International Airport in Atlanta, Georgia, and the airline was incorporated under the laws of the State of Delaware.

5.0 Use of Personal Electronic Devices (PED)[27]

During interviews with the flight crew, both pilots stated that they had their laptops open in the cockpit and turned on during cruise flight while they discussed the new Preferential Bidding System (PBS) at Northwest Airlines. While FAR 121.542 prohibits non-operational activities while the aircraft is in flight operations below 10,000 feet, Northwest Airline policies further restrict certain activities regardless of altitude. Northwest/Delta Flight Operations Policy Manual, Page 3-2.9-10 dated April 1, 2009 states the following:

> ***Unauthorized Items on Flight Deck***
> *This guidance applies to the use of unauthorized materials on the flight deck and does not restrict the storage of materials in crew members' flight kits or bags.*
>
> *Crew Members will not read material or engage in activity not directly related to aircraft operation while at their duty stations.*
>
> ***Note:*** *On International flights, an off-duty pilot occupying the jumpseat may, at the Captain's discretion, fully relax and read material unrelated to flight, provided this activity does not disrupt the other pilots.*
>
> ***Personal Electronic Devices (PEDs)***
> *Crew members are prohibited from using any device not certified for use in the aircraft. Certain devices that are certified are further restricted to prohibit their use on the flight deck. These items include, but are not limited to, personal computers, hand held GPS units, CD players, MP3 players, DVD players, etc.*

6.0 Communication Issues[28]

6.1 Class "A "Airspace

NWA188 operated at a cruising altitude of 37,000 (FL370). Operation at this altitude placed it within Class A airspace as defined by the following Federal Aviation Regulation. Class A airspace is defined under Federal Aviation Regulations Part 71.33, and states in part:

> **FAR *71.33 Class A airspace areas.***
> *(a) That airspace of the United States, including that airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States, from 18,000 feet MSL to and*

[27] See attachment 18 - Flight Operations Manual (Flight Deck Decorum and PED Reference)
[28] See attachment 16 - Northwest Communication Procedures

including FL 600 excluding the states of Alaska and Hawaii, Santa Barbara Island, Farallon Island, and the airspace south of latitude 25°04'00" North.
(b) That airspace of the State of Alaska, including that airspace overlying the waters within 12 nautical miles of the coast, from 18,000 feet MSL to and including FL 600 but not including the airspace less than 1,500 feet above the surface of the earth and the Alaska Peninsula west of longitude 160°00'00" West.

Flights conducted within Class A airspace have specific equipment and operational requirements as defined by the FARs:

FAR 91.135 Operations in Class A airspace.
Except as provided in paragraph (d) of this section, each person operating an aircraft in Class A airspace must conduct that operation under instrument flight rules (IFR) and in compliance with the following:
(a) Clearance. Operations may be conducted only under an ATC clearance received prior to entering the airspace.
(b) Communications. Unless otherwise authorized by ATC, each aircraft operating in Class A airspace must be equipped with a two-way radio capable of communicating with ATC on a frequency assigned by ATC. Each pilot must maintain two-way radio communications with ATC while operating in Class A airspace.
(c) Transponder requirement. Unless otherwise authorized by ATC, no person may operate an aircraft within Class A airspace unless that aircraft is equipped with the applicable equipment specified in Sec. 91.215.
(d) ATC authorizations. An operator may deviate from any provision of this section under the provisions of an ATC authorization issued by the ATC facility having jurisdiction of the airspace concerned. In the case of an inoperative transponder, ATC may immediately approve an operation within a Class A airspace area allowing flight to continue, if desired, to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made, or both. Requests for deviation from any provision of this section must be submitted in writing, at least 4 days before the proposed operation. ATC may authorize a deviation on a continuing basis or for an individual flight.

6.2 IFR Communications

The Northwest Flight 188 flight plan was filed and operated under Federal Aviation Regulations Instrument Flight Rules (IFR), which required communications to be maintained between an aircraft and ATC.

14 CFR 91.183 states in part:

FAR 91.183 IFR communications.
Unless otherwise authorized by ATC, the pilot in command of each aircraft operated under IFR in controlled airspace must ensure that a continuous watch is maintained on the appropriate frequency and must report the following as soon as possible:

(a) The time and altitude of passing each designated reporting point, or the reporting points specified by ATC, except that while the aircraft is under radar control, only the passing of those reporting points specifically requested by ATC need be reported;
(b) Any unforecast weather conditions encountered; and
(c) Any other information relating to the safety of flight.

6.3 Company Communication Requirements

6.3.1 Flight Watch

Northwest Airlines required each flight to maintain communications capability with the company. The Northwest /Delta Flight Operations Manual (FOM), "Company Communications", page 6-41, dated October 2, 2009, states in part:

Flight Watch
Communications between the airplane and the company must be possible at all time to comply with FAR flight Watch requirements. Enroute communications is maintained through ACARS, Atlanta Radio, or Major World Air Route Area (MWARA), ARINC VHF/HF networks, and SATCOM.

Whenever the engines are running, the First Officer shall maintain Flight Watch requirements by:
- *Ensuring the proper operation of ACARS (no "NO COMM" msg) or*
- *Selection of the proper VHF/HF frequency with a successful SELCAL check or*
- *Selection of the proper VHF/HF frequency and maintaining a listening watch.*

6.3.2 VHF Monitoring

Normal radio frequency setup on the A320 Radio Management Panel (RMP) was to have the ATC frequency tuned in the #1 RMP and the #2 RMP tuned to the universal emergency frequency (121.50 MHz). The Northwest /Delta Flight Operations Manual (FOM), "Company Communications", page 6-45, dated October 2, 2009, states in part:

VHF Monitoring
In general, when a VHF radio is not being used for ATC or company communications, monitor the universal emergency frequency (121.50 MHz).

The captain stated that he did have the #2 radio set to 121.50 MHz, and "believes" he was monitoring it.[29] According to ATC transcripts, the crew was not communicating with ATC for about an hour and 17 minutes. Both pilots stated they heard other flights communicating over the cockpit speakers.

[29] See attachment 1 - Interview Summaries

6.3.3 Company Position Reports[30]

Northwest Airlines required flight crews to send various reports to the company during flight operations. These reports included a departure report, takeoff delay report, en route report, maintenance report, gate assignment report, on the ground report, and arrival report. Except for the on the ground report, all company reports were to be sent through ACARS, with voice communications as a backup. Enroute positions reports were required every hour and a half for INS/IRS[31] equipped aircraft. Northwest Communications Manual, page 400.1, dated October 11, 2002 states in part:

> ***En Route Reports***
> *The following en route reports are required:*
> *- Every 1:30 for INS/IRS equipped aircraft.*
> *- Every hour for aircraft without ACARS or when ACARS is inoperative.*
> *- When requested by Flight Dispatch.*
> *- When significant turbulence is encountered or the lack of forecast turbulence. (Meteorology uses these reports to update the TP forecast.)*
> *- When the EON changes by more than 5 minutes.*
> *- When the planned fuel on arrival changes significantly.*
> *- When the route of flight is changed.*
> *Include the following information in the report:*
> *- Aircraft number,*
> *- Position*
> *- Time*
> *- Altitude*
> *- Destination ETA if 10 minute or greater change*
> *- SAT (N/A for DC-9)*
> *- Wind (if INS/IRS equipped)*
> *- Turbulence Code*
> *Example: "Flight 123, aircraft 5501, over BIL 1653Z, flight level 330, ETA SEA 1835, minus 42, winds 300°/120 knots, code 2."*

The A320 fleet operated by Northwest Airlines was equipped with an Air Data Inertial Reference System (ADIRS). According to Delta Air Lines and Northwest Airlines, they had no record of a position report sent by the pilots of NWA188.

7.0 A320 Communications

7.1 Types of Onboard Communications[32]

The Airbus A320 aircraft is equipped with several communication systems which facilitate VHF (Very High Frequency) and HF (High Frequency) radio communication. These systems are accessed through the Radio Management Panels (RMP) and Audio Control Panels (ACP) located on the center pedestal in the cockpit.

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[30] See attachment 22 - Northwest Communications Manual
[31] INS/IRS – Inertial navigation system/inertial reference system.
[32] See attachment 7 - Airbus Radio Communication Units

Two RMPs are located on the pedestal, one next to each pilot. The RMP is used for selecting a desired radio for the purpose of viewing and changing the active and standby frequencies, and transferring the standby frequency to the active. Each RMP contains the switching controls for the communication radios. Either RMP can tune any of the three, VHF radios. The selected radio is indicated by a green light to the left of the radio key.

A rotary selector located on the RMP is used to select the desired radio frequency. Two liquid crystal display (LCD) windows on each RMP provide a visual presentation of the ACTIVE frequency on the left and the standby (STBY/CRS) frequency on the right. To make the standby frequency the active frequency, the pilot must push the transfer key located between the two LCD windows.

In normal operation, the radios are used in the following manner:

VHF1
• ATC ground, ramp control for aircraft movement, tower, departure, approach, and center.
VHF2
• Local gate radio, ATIS, clearance delivery and to monitor the emergency frequency 121.5.
VHF3
• ACARS.

Note: VHF3 can also be tuned and used as an additional communication radio. Selection and tuning are performed through the MCDU. This option is used when the ACARS is inoperative.

7.1.1 Aircraft Communications Addressing and Reporting System (ACARS)

ACARS is a communications system providing a data link between the aircraft and a ground-based communication network. Information is sent as a digital signal and can be transmitted over VHF radio, HF radio, or via satellite, depending on aircraft equipment. On aircraft only equipment with VHF ACARS link, there are gaps in coverage over ocean areas and some remote land masses. Various companies provide data communications networks throughout the world. The specific VHF frequency for datalink operations is determined by the company that provides the ground network for the geographic region. The system allows both manual and automatic communications. Events such as OUT, OFF, ON, and IN times are downlinked automatically as they occur.

ACARS messages sent via dispatch are distributed through a VHF ground network to ensure aircraft receipt. Frequency tuning and addressing of these messages are performed automatically by computers. All messages delivered to and from the aircraft perform verification between the aircraft and the ground network to ensure the message is delivered. This indicates that the message was received by the aircraft, but does not ensure it was read by the crew. Northwest Airbus A320's display a flashing ACARS MSG or ACARS CALL on the upper ECAM (E/WD)[33] when an dispatch message is received. [34] The ACARS system incorporates the memo

[33] E/WD – Engine Warning Display
[34] Reference NWA A319 A320 AOM Vol. II page 23.15.30

display on the E/WD display to alert the crew of the ACARS status. The following messages may be displayed:[35]

ACARS CALL
An ACARS message has been received that requests a voice communication on a specific radio frequency. The VOICE GO AHEAD advisory appears on ACARS.

ACARS MSG
An ACARS message has been received. The MESSAGE WAITING, LOAD REVISION, or GATE REVISION advisory appears on ACARS.

ACARS STBY
Indicates that ACARS is unable to communicate with the data-communication service provider. The NO COMMUNICATION advisory appears on ACARS.

VHF 3 VOICE
An ACARS message has been received that requests a voice communication on a specific radio frequency. The VOICE GO AHEAD advisory appears on ACARS.

SELCAL
A SELCAL can be received when the appropriate frequency is selected. "CALL" illuminates in the corresponding key, accompanied by a buzzer. VHF1, VHF2, VHF3, HF 1, and HF2 (if installed) can receive SELCALs.

Unless noted otherwise, there is no aural alert associated with these message displays on Northwest A320 airplanes.

7.1.2 Selective Calling (SELCAL)

Selective Calling (SELCAL) is a coded set of tones that are sent over HF or VHF radio waves that are picked up by a decoder in the aircraft that alerts the crew by a chime and/or a light that someone wants to speak to them on their voice radio. To send and receive a SELCAL alert requires that the same specific frequency be tuned on the ground and in the aircraft. It also requires that the code sent must match the code that is set in the aircraft decoder and is normally unique to that aircraft. SELCAL requires the aircraft to be in range of the ground station just as voice transmissions do. While HF can cover long distances, VHF is dependent upon line-of-sight to receive and is normally used with VHF station networks. Whether the SELCAL decoder

[35] Reference NWA A319 A320 AOM Vol. II page 23.15.49

in the airplane is connected to the HF or VHF radios or both, is up to the operator. On Northwest A320 airplanes, VHF1, VHF2, VHF3, VHF 1, and HF2 (if installed) can receive SELCALs. When a SELCAL is received, "CALL" illuminates in the corresponding key, accompanied by a buzzer. The SELCAL buzzer can only be silenced by pushing the reset key on the ACP.

If wired for it, SELCAL is available for use in the voice mode only. If it is desired to get the crews attention when it's in the ACARS mode and a message is received, then a chime can be wired up to ring upon message receipt.

7.2 Communications Aural Alerts

NTSB investigators spoke with software vendors and Airbus Industries to learn about the aural alerting capability of the Airbus aircraft for ACARS messages received by the airplane. The software upgrade, and extent of complexity of the upgrade, would depend on the type of communication unit installed. Additionally, any aural alerting would require an upgrade to the Flight Warning Computer (FWC).[36] The Flight Warning Computers (FWC), working with data received from the System Data Acquisition Concentrators (SDAC), were capable of alerting the crew of nearly 300 abnormal conditions on the ECAM display screens. These conditions were classified as Class 1 ECAM failure messages and, were divided into two categories: Warnings and Cautions. In addition, failure messages were automatically prioritized and displayed based on the severity of the condition. The system was also capable of alerting the crew of abnormal conditions that were not severe enough to be categorized as warnings or cautions. These were classified as advisories.

According to Northwest Airlines, their A320 airplanes did not have an aural ACARS message alert enabled on their aircraft. A software upgrade, purchased through the vendor (Honeywell), would be required to enable an ACARS chime for crew alerting.

8.0 Dispatch Actions[37]

All Northwest dispatchers were located in the Delta Operations Control Center in Atlanta, Georgia. There were about ten domestic dispatchers on duty at the time of the incident and they were centrally located in the same room as the chief dispatcher and ATC coordinator. Northwest Airlines dispatch became aware of loss of communication with Northwest flight 188 when the chief dispatcher received a call from Minneapolis Center at about 0030Z listing NWA188 as NORDO (no radio contact). According to the chief dispatcher, all calls regarding NORDO aircraft were routed through the chief dispatcher's desk, and that all Air Route Traffic Control Centers (ARTCC) had the direct phone number for the Northwest Airlines chief dispatcher. The chief dispatcher sent NWA188 an ACARS text message requesting that they contact Minneapolis Center. The chief dispatcher copied the message to the dispatcher for Northwest 188, who was receiving a "competency check" from another dispatcher during that time. The dispatcher checked his computer monitor and noticed that the flight was about 30 miles southwest of Sioux Falls, South Dakota and level at 37,000 (FL370). The dispatcher stated

[36] Reference NWA A319 A320 AOM Vol. II page 31.10.12
[37] See attachment 1 - Interview Summaries

he had no idea that NWA188 had flown through Denver Center as a NORDO until he was notified by the chief dispatcher and the aircraft was about "40 minutes from MSP." About 10 minutes later the dispatcher received a copy of another ACARS text message sent to Northwest 188. The dispatcher stated he saw the flight fly past the SKETR intersection[38] on the arrival route at FL370 and became "concerned" about NWA188 and its close proximity to MSP. The dispatcher contacted the chief dispatcher, who resent several additional ACARS text to the aircraft. According to ACARS logs provided by Northwest Airlines, eight total ACARS messages were sent by dispatch to the aircraft between the times of 0032Z and 0111Z.[39] None of the messages were rejected by the aircraft's computer.[40] The chief dispatcher attempted to contact NWA188 via the two company frequencies utilized by Northwest Airlines. He stated that he made eight unsuccessful attempts through the SELCAL (selective call) system to contact the flight.

The dispatcher stated that he became concerned about the fuel state of the aircraft as it overflew MSP, and sent computer "queries" to the aircraft computer via ACARS[41]. These messages returned information about the aircraft, including current position, closest fix, GMT (Greenwich Mean Time), current altitude, static air temperature, wind, and fuel remaining onboard. According to ACARS logs provided by Northwest Airlines, four "queries" were sent to the aircraft between about 0109Z and 0159Z.

The dispatcher stated that he observed the chief dispatcher and Delta security coordinator on a conference line with the Domestic Events Network (DEN) and Minneapolis Center. The dispatcher stated that a short time later, he was advised that NWA188 was back in contact with ATC. At approximately 0125Z, the dispatcher received an ACARS message from NWA188 that read "WE R NOW INBOUND". According to ACARS logs provided by Northwest Airlines, the dispatcher sent one final fuel "query" at about 0159Z (approximately eight minutes before the aircraft landed) and this indicated 7,600 pounds of fuel onboard.[42] The dispatcher called the ATC traffic manager in the MSP control tower and asked that he "protect Northwest 188 from any ATC initiated go-around." The dispatcher stated that he received a call from the Northwest Flight Operations office, and a chief pilot asked that he send a message to Northwest 188 and ask the crew to remain in the cockpit after the aircraft arrived at the gate. At approximately 0208Z, the dispatcher sent that message to NWA188, but received no response.[43]

On the day of the incident, the dispatcher for NWA188 worked "26-28" flights. He stated that the merger of the dispatch offices of Northwest and Delta Air Lines had gone "smoothly". He also added that there were no formal procedures in the dispatch manual regarding the communication procedures for NORDO aircraft.

[38] See attachment 4 - Arrival Chart
[39] See attachment 3 - ACARS Messages
[40] ACARS messages that are not received by the aircraft get a "no response" reject notice routed through ARINC facilities in Annapolis, MD and are copied to the dispatcher who sent the message.
[41] According to Northwest Airlines, this "query" feature is not operational between dispatch and Delta aircraft.
[42] See attachment 3 - Aircraft Communications Addressing and Reporting System (ACARS)
[43] See attachment 3 - Aircraft Communications Addressing and Reporting System (ACARS)

9.0 Aural and Visual Alerts

The following table, constructed by NTSB investigators, lists the various aural and visual alerts onboard Northwest A320 aircraft, similar to the incident aircraft, from cruise altitude to arrival of the last waypoint entered in the FMC. The table is based upon the filed ATC flight plan and information entered into the FMC as presented in the NWA188 flight crew's interviews. References to the Northwest Aircraft Operating Manual (AOM, Volume II) are provided.

Visual and Aural Alerts During NW188 NORDO

Phase of Flight	Aural Alerts	Visual Alerts

Cruise (with inbound ACARS messages from Dispatch)	None	1. Flight plan scrolling to the next waypoint on MCDU[44] (passive visual, not an "alert"). 2. ACARS MSG or ACARS CALL pulses in green on the memo display of the upper ECAM.[45] 3. The MESSAGE WAITING advisory appears on the MCDU scratchpad.[46] 4. ENTER DEST DATA advisory in MCDU scratchpad[47] Vertical "MCDU MENU" enunciator alert (in white) on right side of both MCDUs.[48]
Top of Descent	None	1. "DECELERATE" annunciates on the top portion of C/O and F/O's PFD.[49] [50]
Arrival[51]	None[52]	1. LAT DISCONT AHEAD in MCDU scratchpad.[53] 2. Vertical "MCDU MENU" annunciator alert(in white) on right side of both MCDUs. 3. NAV to HDG lateral mode reversion on each pilot's Flight Mode Enunciator (FMA).[54] MCDU Flight Plan page will show "PPOS" followed by a "F-PLN DISCONTINUITY" and dashes for the remaining waypoints.[55]

The flight crew stated in both interviews that they had their headsets off and cockpit speakers on during cruise flight. The Northwest Airlines AOM Volume II, page 23.10.8 states in part:

[44]MCDU - Multi-function Control and Display Unit. Reference NWA AOM (Aircraft Operating Manual) Vol. II page 34.36.3.
[45] Reference NWA A319 A320 AOM Vol. II page 23.15.30
[46] Reference NWA A319 A320 AOM Vol. II page 23.15.30
[47] ENTER DEST DATA – Message to crew requiring landing data information to be entered when the aircraft is within 180 nautical miles of the destination. Reference NWA AOM Vol II page 34.36.101.
[48] Reference NWA A319 A320 AOM Vol. II page 34.30.1
[49] PFD - Primary Flight Display
[50] Reference NWA A319 A320 AOM Vol. II page 34.36.100. The aircraft is still in cruise or climb phase beyond Top of Descent and in speed auto control.
[51] With no anticipated runway entered in the flight management computer (FMC)
[52] Reference NWA A319 A320 AOM Vol. II page 22.10.105. A triple click aural warning (cricket) is only generated in the event of a landing capability downgrade, not a lateral mode reversion (1/2 second and 3 clicks).
[53] Reference NWA A319 A320 AOM Vol. II page 34.36.102. The aircraft is within 30 seconds of a lateral discontinuity. LAT DISCONT AHEAD – Lateral discontinuity in the flight plan is approaching.
[54] Reference NWA A319 A320 AOM Vol. II page 22.10.59, 60. The aircraft enters a flight plan discontinuity in managed NAV (reverts to HDG)
[55] Note: PPOS – Present Position. F-PLN DISCONTINUITY – There is no more flight plan information for lateral navigation with. The triple click (cricket) sound does not alert following a vertical mode reversion (i.e. NAV to HDG).

The flight deck is equipped with two voice communication loudspeakers. Located on each pilot's forward instrument panel, each speaker's volume can be individually controlled by the associated LOUD SPEAKER volume knob.
***Note:** The LOUD SPEAKER volume control knob does not control/affect the volume of any aural warnings or alerts.*

Further, even if the cockpit speakers were turned off, all aural cautions and alerts would still be heard.[56] Northwest Airlines aircraft do not have an aural alert system activated to alert the crew of incoming ACARS messages.

10.0 Merger Issues[57]

On April 14, 2008, Delta Air Lines announced their intention to merge their operations with Northwest Airlines. A joint contract was agreed upon between the two pilot groups on June 24, 2008, and on September 22, 2008 the Federal Aviation Administration (FAA) approved Delta's plan for interim operations and a Single Operating Certificate transition. On October 29, 2008, Northwest Airlines and its subsidiaries became wholly-owned subsidiaries of Delta Airlines with plans to be fully integrated toward the end of 2010. As of December 31, 2008, the combined airline had a total of 84,306 full-time equivalent employees. Approximately 42% of these employees were represented by unions, including 11,040 pilots. On January 7, 2009, the National Mediation Board (NMB) ruled that Delta and Northwest constituted a single transportation system for representation purposes under the Railway Labor Act.

Shortly after the FAA approval, the FAA Principal Operations Inspector (POI) for each airline created a Joint Transition Team (JTT) to oversee the integration of flight operations, using research from the recent USAirways/America West merger as a foundation. In January of 2009, the two airlines created an "A" team (analysis) to develop a plan to integrate each airline's Flight Operation's Manual (FOM), procedures and philosophies. This team was staffed with Delta and Northwest pilots, instructors, management pilots, and representatives from the Airline Pilots Association (ALPA). The group looked at impact changes from both carriers on training and flight operations, focusing on differences and similarities of the various phases of flight, and adopted a "best practices" approach. They decided to break down the integration into phases, roughly matching the different phases of flight.

Phase one was introduced in February of 2009 and focused on pushback, climb and cruise items since, according to the Northwest POI, it presented the fewest differences and allowed the pilots to "test the water" on the evolvement of the process with the least amount of change. For each phase introduction, pilots received manual revisions and an overview of the changes approximately three weeks prior to implementation. For phase one, Northwest pilots received a new revised AOM (Aircraft Operating Manual) Volume I in March, 2009. Pilots were also required to participate in "distributed training" for each phase change in the form of computer based training (CBT) modules. Phase one implementation went into effect on April 1, 2009, with each subsequent phase of integration occurring 2 months later. At the time of the incident

[56] Reference Northwest AOM Vol. II, page 23.20.11.
[57] Reference attachment 1 - Interview Summaries

flight (Northwest 188), the airline was in phase four of its integration. According to the Northwest POI, phase four was the largest phase in regards to change, with many of the changes occurring in the Flight Operations Manual (approximately 142 items). He also stated that, although it was not planned, 75 percent of the changes in the integration of the two airline flight operations occurred on the Northwest side, while 25 percent of the changes occurred on the Delta side.[58]

The FAA conducted regular line observation of flight crews for both airlines. According to the FAA, after a month and a half into each phase, Northwest Airlines would brief the FAA on their view of the operational changes. The Northwest POI stated that from April 1-Septmenber 30, 2009, there were 10 Element Performance Inspections (EPI) performed which dealt with 88 separate activities, asked 1356 questions, and 3.9 percent of the questions documented "minor items not done correctly (i.e. Pilot said something wrong on a checklist, got out of sequence on a flow, etc). The preceding six months, there were 1574 questions asked, and 1.7 percent negative response was received. According to the Northwest POI, the increase in negative responses was due to changes in the way the flight deck was being managed. Based on his analysis of the ASAP reports, the Northwest POI did not have any specific concerns about the line operations at Northwest, but did concede that "change is difficult" for the Northwest pilots and that Northwest philosophy was different than Delta.[59]

11.0 Post Event Actions

11.1 FAA Actions

In response to the events surrounding NWA188, the FAA issued an emergency revocation of the certificates of both pilots, citing violations associated with 14 CFR 91.13.[60] Both pilots have filed appeals of their certificate revocation.

11.2 Company Response[61]

On October 23, 2009, in response to the Northwest 188 event, the Delta Senior Vice President of Flight Operations sent a letter to both pilot groups entitled "Safety Focus and Back to Basics". There were four summary points made in the letter:

1. *Threats to our operation are continuous and change throughout each flight and each phase of our operation. The important point is to develop a plan of action to mitigate those threats once you identify them.*
2. *Expand your team when making decisions. This includes using your dispatcher, the duty pilot, cabin crew, ground personnel, maintenance, ATC, UPMC/Mayo Clinic and your Chief Pilot. After gathering all applicable information and perspectives, the final decision rest with the Captain.*

[58] See attachment 1 - Interview Summaries
[59] See attachment 1 - Interview Summaries
[60] See attachment 13 – Federal Aviation Regulations
[61] See attachment 6 - Company Response to Incident

3. *Complacency – don't let your guard down. The clear, VFR day can set you up for an onset of complacency because "I've seen this a thousand times before."*
4. *Finally, if in doubt, slow down or stop the operation and sort things out.*

On November 13, 2009, the Northwest POI received a letter from the Northwest Airlines Managing Director Flight Procedures, Training and Standards outlining the corrective actions and error mitigation efforts on the part of Northwest Airlines. A summary of the actions were included in the letter:

- *Flight Ops Director Briefing*
  - *Participated in Director Briefing on October 22, 2009*
  - *Confirmed tentative plan of action for immediate and long term mitigation.*
- *Immediate written communication via "All Pilot Letter"*
  - *"Back to Basics refocus on safety bullet point provided to Chief Pilots, Line Check Pilots, and Training Instructors focusing on four main areas:*
    - *If in doubt, slow down or stop the operation*
    - *Threat and error management*
    - *Team expansion for quality decision making*
    - *Undetected complacency – don't let your guard*
- *Real Life Examples*
  - *Provided to chief Pilots, Line Check Pilots and Training Instructors*
  - *Pulled from de-identified ASAP events*
  - *Phase of Flight oriented*
  - *Bullet points provided for discussion*
  - *Informational packet detailing events*
- *General Bulletin (Delta – N) and EFOC (Delta – S)*
  - *Published Sunday, October 25, 2009 on E-Crew, and NWA email*
- *Chief Pilot Notification and Base Plan*
  - *Conference call held Friday, October 23, 2009 and briefed corrective plan of action*
  - *Chief Pilots highly visible in crew lounges beginning Monday, October 26, 2009*
  - *Available everyday to answer questions and discuss safety focus with crews*
- *Line Check Pilot Meetings*
  - *MSP and SLC emphasis on events and safety focus*
- *Expanded and Enhanced LOR*
  - *Slated to start November 1, 2009*
  - *Increased observations*

- *Targeted discussion points of recent events emphasizing corrective measures*

F. List of Attachments

Attachment 1: Interview Summaries
Attachment 2: A320 Operating Procedures
Attachment 3: Aircraft Communications Addressing and Reporting System (ACARS)
Attachment 4: Arrival Charts
Attachment 5: Assistant Chief Pilot Statement
Attachment 6: Company Response to Incident
Attachment 7: Airbus Radio Communication Units
Attachment 8: Captain Training Summary
Attachment 9: Chief Dispatcher Statement
Attachment 10: Crew Flight Times
Attachment 11: Dispatch Manual
Attachment 12: Delta/Northwest 2008 10K
Attachment 13: Federal Aviation Regulations
Attachment 14: First Officer Training Summary
Attachment 15: Northwest 188 Flight Papers
Attachment 16: Northwest Communication Procedures
Attachment 17: Northwest Flight Operations Manual (Headset Reference)
Attachment 18: Northwest Flight Operations Manual (Flight Deck Decorum and PED References)
Attachment 19: Operating Procedures (Pilot Flying and Monitoring Procedures)
Attachment 20: Pilot Deviation Report
Attachment 21: Standard Operating Procedures
Attachment 22: Northwest Communications Procedures

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