NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

July 19, 2011

OPERATIONAL FACTORS/HUMAN PERFORMANCE SPECIALIST REPORT TO THE U.S. ACCREDITED REPRESENTATIVE

DCA10RA092

CONTENTS

A. ACCIDENT

Operator:	United Parcel Service (UPS) Flight 6
Location:	Dubai, United Arab Emirates
Date:	September 3, 2010
Airplane:	Boeing 747-400

B. NATIONAL TRANSPORTATION SAFETY BOARD (NTSB) AND TECHNICAL ADVISORS

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C. SUMMARY

On September 3, 2010 at about 8:10 pm local time (1610 UTC)[1], UPS Flight 6, a Boeing 747-400AF (N571UP), crashed while attempting an emergency landing at Dubai International Airport (DXB), Dubai, United Arab Emirates (UAE). The flight had departed from Dubai approximately 45-minutes earlier enroute to Cologne, Germany, and returned after the crew declared an emergency and reported smoke and fire. The airplane impacted inside an Emirati army post, approximately 9 miles from Dubai's international airport. The two flight crew members were fatally injured, there were no ground injuries, and the airplane was destroyed by impact and fire. The investigation is being led by the UAE General Civil Aviation Authority (GCAA).

[1] Coordinated Universal Time (UTC), also known as GMT or Greenwich Mean Time (Z).

D. DETAILS OF THE INVESTIGATION

On September 6, 2010, the Operations/Human Performance group (Group) was formed on scene in Dubai, United Arab Emirates (UAE) at approximately 0930 local time. Initial walk through of the accident site was conducted under the direction of the General Civil Aviation Authorities (GCAA). The group reconvened off-site for an organizational meeting. The Group returned on-site to assist the GCAA in cockpit identification, wreckage documentation and recorder location. The Group participated in a formal debrief by the U.S. Accredited Representative and the GCAA Investigator in Charge (IIC). The day's on-scene activities concluded at approximately 1800 local.

On September 7, 2010, the Group departed Dubai by vehicle to Abu Dhabi with Mr. Khalid Al Raisi, GCAA Accident Investigator, where it reconvened at the GCAA office for Air Traffic Control (ATC).[2] The Group was given a tour of the UAE Center facility by Mike Dolbey, Senior Air Traffic Control Officer. The Group then was escorted to a secure room and allowed to observe the UAE Center radar returns of UPS flight 6, as well as listen to the available recorded data. The Bahrain Audio transcript for frequency 131.12 covering the Bahrain East and UAE Land Line conversations was received.

The Group then traveled by vehicle to the GCAA investigative offices of Mr. Al Raisi where interviews were conducted with the three Bahrain controllers who assisted UPS flight 6. A progress report was received by Mr. Raymond Bagshaw, ATS (Air Traffic Safety) Inspector for the GCAA followed by a return trip to Dubai.

The Group members met with Captain Charles Burton of the Dubai Air Wing, and received a written statement for one of the Captains on "Dubai One", the flight that assisted UPS6 by relaying ATC messages to the accident aircraft. Activities for the group concluded at approximately 1800 local.

On September 8, 2010, the Group convened a progress meeting at 1000 local to discuss previous activities. A division of workload was distributed amongst the group for creation of the Field Notes. The NTSB Human Performance investigator coordinated with the US consulates office in Dubai regarding flight crew autopsy and toxicology procedures, while coordinating the same services with the UPS team.

At approximately 1400 local, the Group conducted an interview with one of the Captains of "Dubai One". Group activities concluded at approximately 1800 local.

On September 9, 2010, the Group had a progress meeting at 0800 to finalize the Field Notes and exchange all data between group members. The NTSB Human Performance investigator attempted to make additional contact with the local coroner regarding autopsies and toxicology reports, and awaited further coordination upon return to the United States. This concluded the on-scene phase of the investigation.

[2] See section 8.1 Air Traffic Control for additional information.

From September 13 through September 14, 2010, the Group conducted additional interviews and participated in an observational study at the UPS Training Facility in Anchorage, Alaska, (ANC) on September 13, 2010. The purpose of the study was to familiarize the Group with checklists and procedures related to smoke and fire scenarios that may occur in-flight. The simulator used for the observations as an FAA certified level D B747-400 simulator. Three pilots who were type rated, current and qualified on the B747-400 participated in this study. In addition there was a simulator instructor and four observers from the Group.

On Tuesday September 14, 2010, the investigators were provided a familiarization of a UPS Boeing 747-400 freighter (Aircraft #576; see figure 1) at about 1315 ADT. A walk-around of the aircraft, under the guidance of a UPS Check Airman, was conducted around the exterior of the aircraft prior to the Group traveling to Louisville, KY.

Figure 1: Familiarization of UPS Boeing 747

Photo documentation of the main cargo deck and the smoke detection system was performed. The Group was also provided a tour of the cockpit and supernumerary areas of the 747. Included was a familiarization of the 747 emergency equipment and its location, including the crew oxygen masks and smoke goggles, and main deck firefighting equipment (see figure 2).

Figure 2: Main Deck Emergency Equipment

From September 15 through September 16, 2010, the Group conducted additional interviews at the UPS Global Operations Center in Louisville, Kentucky.

On November 17, 2010, the Group participated in a flight test of a UPS B747-400 and documented, in flight, the audio/sound differences when positioning the oxygen mask system to various settings (normal, 100%, emergency) with and without the smoke goggles vent on. They also documented, on ground, the donning and accessibility of emergency equipment within the cockpit to flight crew members, and, in flight, the pack system logic as displayed on the FDR and in AHM data.

On December 1, 2010, the Group traveled to Seattle, Washington, to document crew procedures and the aural and visual alerts/messages that occur during pack failure and main deck fire events in a Boeing 747-400 simulator. The Group also documented how crew performance was affected by modifying the font size of crew checklists and various lighting configurations by removing outside visual references, and during single pilot operations. Investigators tested the range of the crew oxygen mask hose lines. A pilot exiting his/her flight deck seat while donning the crew oxygen mask cannot reach the emergency portable oxygen bottle (full-face mask and oxygen bottle located behind the left cockpit jumpseat) without removing their crew oxygen mask (see figure 3).

Figure 3: O2 mask with hose fully extended

Figure 4: Cockpit Portable Oxygen

From October, 2010, to January, 2011, the Group conducted additional follow-up interviews with UPS and FAA personnel, as well as next of kin interviews. B747-400 and UPS documents were collected during this period, and all receivable documentation was provided to the GCAA.

E. FOLLOW-UP ACTIVITIES

1.0 Anchorage Simulator Observations

The Group participated in an observational study at the UPS Training Facility in ANC on September 13, 2010. The purpose of the study was to familiarize the group with checklists and procedures related to smoke and fire scenarios that may occur in-flight. The simulator used for the observations as an FAA certified level D B747-400 simulator. Three pilots who were type rated, current and qualified on the B747-400 participated in this study. In addition there was a simulator instructor and 4 observers from the operations/human performance group.

1.1 Simulator Session #1 set up:

Altitude: FL320
Location: 148 NM from ANC
Heading: 180 degrees away from ANC (heading of about 240)
Weather: clear skies, unlimited visibility, winds calm, night
Pilot flying (PF): first officer/pilot #2; Pilot monitoring (PM): captain/pilot #1

1.1.1 Scenario #1a: FIRE MN DK FWD warning followed by smoke in the cockpit within 30 seconds of warning.

1.1.1.1 Summary of observations[3]

Prior to beginning the scenario, the flight crew checked oxygen mask and smoke goggles per UPS procedures. Pilot #2 stated that most pilot do not know about the valve on the oxygen mask that must be activated to clear the goggles of smoke. The pilots and observers were briefed on the UPS initial B747-400 simulator session 6 which focused on the smoke, fire and fumes checklist.

The scenario began as the flight crew reached their top of climb after departing ANC. The flight crew received a “fire main deck forward” warning. The first officer remained as the pilot flying and the captain called for the fire main deck checklist. No emergency was declared and no turn was initiated. The FIRE MN DK FWD checklist was begun at about 1:32 (1 minute and 32 seconds into the scenario). When pilot #1 removed his oxygen mask from its container, the cord was tangled and delayed donning. Two minutes and 15 seconds into the scenario, an emergency was declared with ATC (air traffic control). The flight was cleared to descend to FL250 and initiated a right turn toward ANC. Although “smoke” was declared by the instructor, it was not heard by the flight crew and no acknowledgement was made. When the main deck cargo fire arm switch was armed, packs 2 and 3 were automatically turned to ‘off’. It was unclear to the observers who was designated the PF because pilot #1 switched the altitude in the mode control panel. The flight crew was again informed that the cockpit was full of smoke at 4:18 into the scenario. The flight crew donned smoke goggles. It took about 16 seconds for the crew to don their smoke goggles. The flight crew descended to FL100. At time 5:30, the flight crew was unable to see their instruments due to smoke in the cockpit. This was simulated by failing the

[3] Times noted in observations were based upon elapsed time from the beginning of the scenario..

displays and covering the backup display. The captain pulled the smoke handle (see figures 5 through 8); however, no checklist was used to make this decision.

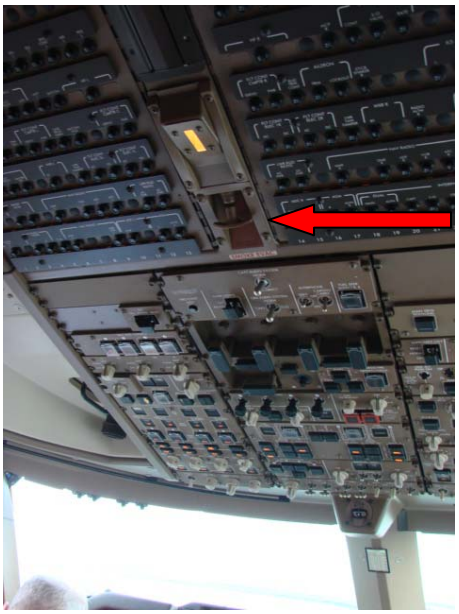


Figure 5: Smoke Evacuation Handle

Figure 6: Smoke Evacuation Handle (pulled)

Figure 7: Smoke Evacuation Handle

Figure 8: Smoke Evacuation Port (cockpit ceiling)

At time 8:20, the captain began the smoke or fumes removal checklist. The flight crew received a "terrain" warning at about 4800 feet but recovered by initiating a climb to 7000 feet. The instructor used flight freeze at 11:55.

1.1.1.2 Summary of debrief

The pilots involved in the exercise indicted that with the smoke goggles donned, it was difficult to find the switch to clear the goggles of smoke (see figures 9 and 10) and one stated “it was “awkward”.

Figure 9: Smoke vent valve selector (closed)

Figure 10: Smoke vent valve selector (open)

The pilots did not believe they would have thought to clear the goggles if they had not practiced it before the scenario. Pilot #1 stated that it was a misconception that the goggles should fit snuggly. He said they were designed to be loose so that the goggles could be cleared of smoke. The instructor informed the crew that they should have completed the smoke fire and fumes checklist prior to completing the smoke removal checklist. Asked who would be in charge of communicating with ATC, both pilots indicated that the PM would do this.

If this was a single pilot operation, pilot #2 stated that the situation would have been “mind boggling” and he would have foregone the checklist. He also believed it would have been difficult to fly the approach without being able to see the instruments and having specific headings and altitudes. Pilot #1 said it would have been very difficult and that one person needed to be dedicated to remove the smoke. He indicated that he would have considered a controlled crash in the water if he was in a situation where he could not see his instruments.

Pilot #2 indicated that with the smoke goggles donned, he could not see the standby compass. He said the image was distorted and he would have gotten his flashlight to improve visibility of the compass. Figures 11 and 12 show how close a pilot could get to the instrument panel with the oxygen mask and goggles donned.

Figure 11: Closest position to the MCP

Figure 12: Closest position to the FMS

Pilot #1 stated that not having a live mic could be an issue. He said if he did not hit the lower rocker (the "push to talk" switch on the audio panel; see figure 13), pilot #2 could not hear him. It was difficult to do this when holding the checklist.

Figure 13: "Push to Talk" switch

One person indicted that the Boeing 747 manual states to consider landing anywhere. One person also stated that pilot suggestions and recommendations for changes usually go into the "trash can".

The instructor who participated stated that he believed the smoke fire and fumes checklist to be the most complicated checklist and the scenario presented would have been a lot for any crew to do. He said the checklist had been redefined since flight safety. He stated that the crew donned the mask during initial training but it was not a scenario in subsequent training.

The pilots in the exercise did not know about preflight maintenance of O2. Regarding the different oxygen levels of the oxygen mask (see figure 10), "Normal" was a mix of ambient air and oxygen and the higher you get, the more O2 that was introduced, "100%" was 100% oxygen and "emergency" was positive pressure and 100% oxygen.

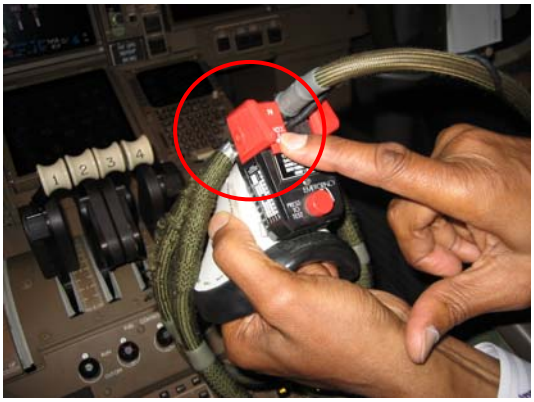


Figure 14: 100% Selector Switch on Oxygen Mask

In addition, investigators noted that the instructor did not use a headset during the scenarios.

1.1.2 Scenario #1b: Understanding Pack Logic.

1.1.2.1 Summary of observations

When the main deck's cargo fire arm switch was armed, packs 2 and 3 were shut off. If pack 1 was turned off, pack 3 came back on as long as the pack 3 switch was still in the "norm" position. Page 8-10 of the smoke, fire, or fumes checklist stated to turn the pack 2 and 3 selectors to off. If this was completed and pack 1 failed without the crew recognizing this, pack 3 would not come back on. If the pilot turned pack 3 selector back to "norm", the system logic was reset and pack 3 would turn back on. The system logic did not reset when the pack 2 selector was turned back to "norm". The instructor stated that pack 2 did not have a dump valve; only packs 1 and 3 had a dump valve.

1.1.3 Scenario #1c: Donning Oxygen Mask and Goggles While Wearing a Headset.

1.1.3.1 Summary of observations

It took approximately 28 seconds for the crew to don both the oxygen mask and smoke goggles. It took an additional 6 seconds for the crew to establish crew communications. The scenario was run two times and both times the headset was knocked off when donning the oxygen mask (see figure 15).

Figure 15: Headset location after donning mask

Pilot #2 also indicated that to don the oxygen mask with the headset on, the pilot would have to move the boom of the headset to get the right seal on the mask. With the mask on, the crew could communicate using the rocker switch on the audio panel or on the control yoke.

1.2 Simulator Session #2 set up:

Altitude: FL320
Location: 140 NM from Hong Kong
Heading: 180 degrees away from Hong Kong
Weather: clear skies, unlimited visibility, winds calm, night
PF: first officer/pilot #1; PM: captain/pilot #3

1.2.1 Scenario #2a: FIRE MN DK FWD warning and heavy smoke introduced to the cockpit such that instruments cannot be seen. About 10 minutes into the scenario, the crew will be informed that smoke and fire severe and immediate landing must be performed.

1.2.1.1 Summary of observations

The flight crew received the fire main deck forward warning about 40 seconds into the scenario. Pilot #3 called for the fire main deck checklist about 1:35. At 1:50, smoke was reported to the crew. Oxygen masks were donned by both crewmembers by 2:03 and communication checks were completed by 2:20. At 2:40, pilot #3 indicated that the checklist would be started and then declared an emergency with ATC at 2:50. ATC gave the crew a right turn to heading 240. At 3:29, the fire main deck checklist was started. Pilot #3 had a difficult time finding some of the switches. Pilot #3 turned the pack switches to off however there was no EICAS (Engine Instrument and Crew Alerting System) message to indicate they were off and the switches should be moved. At 5:24, the smoke became so severe that the pilots could no longer see their instruments. At 7:21, pilot #3 requested that ATC keep the flight over water. Pilot #3 called for the smoke, fire or fumes checklist at 8:28. He stopped the checklist and asked that ATC call out his altitude in 1000’ increments. ATC cleared the flight to FL100. ATC gave the flight a descent

to 4000 feet. Pilot #3 adjusted the altitude window. Pilot #3 resumed the checklist at 10:10. The smoke removal checklist was started at 13:00 due to pilot #3 distractions with ATC communications. ATC delayed communications due to simulation that airplane was out of frequency range. At 14:30, the crew decided to ditch the airplane. The smoke removal checklist was interrupted numerous times because of ATC communications, including frequency changes, and altitude and heading clearances. The PM/PF duties seemed to go back and forth. The flight crew prepared for a ditching.

1.2.1.2 Summary of debrief

Pilot #3 stated that the smoke, fire or fumes checklist had lots of branches and was long. He said using the goggles and mask made it more difficult. He said it was tough to plan it out and rely on ATC for headings and altitudes; he did not know where he was. He said it was the worst of all situations to have no heading and altitude. Pilot #3 believed about 20 minutes had passed when completing the scenario. Pilot #3 indicated it was frustrating when ATC would not respond to his requests because he needed the information now.

During the continuation of the Smoke, Fire or Fumes checklist, Pilot #3 did not wait the 2 minutes required between the selection of Pack 2 off and Pack 3 off.

The pilots indicated that the PM normally changed the altitude in the window.

Pilot #3 said if smoke was severe he would turn off the packs and pull the smoke handle to see if it would get better. The pilots stated that if the smoke handle was pulled open, it could be closed again.

Pilot #3 did not notice whether the pack 1 went offline during the scenario.

Both pilots indicated that they thought they were much closer to Hong Kong then they were. The instructor stated that they were about 140 miles from Hong Kong when the scenario started but they flew farther away as they were making their turn.

Pilot #3 received his initial training on the B747-400 about 2 years ago.

If there was no first officer available, pilot #3 thought he would get down low and probably stop performing the checklist. He said with pilot #1 flying the airplane, he lost track of time. He said it took time to get to each checklist.

Pilot #3 said his peripheral vision was limited with the goggles on and he had to look right at the switch.

1.2.2 Scenario #2b: run through the smoke, fire or fumes checklist to completion.

1.2.2.1 Summary of observations

The crew received a main deck fire mid warning. Pilot #3 was the PM and pilot #1 was the PF. At time 0:35, pilot #3 declared an emergency with ATC. At time 1:20, pilot #3 called for the main deck fire mid checklist. At time 2:00, the checklist had not been started. The fire main deck checklist was completed at 4:30. At time 4:40, pilot #3 called for the smoke, fire or fumes checklist. There was no challenge/response when checklist was run. At time 10:10, pilot #3 began the smoke removal checklist. At time 11:22, pilot #3 pulled the smoke handle. After the handle was already pulled, pilot #3 said "unless you have a better idea". PF stopped the PM from reading the checklist to set 5000 feet in the altitude window. The smoke, fire and fumes checklist was completed at 14:24.

1.2.2.2 Summary of debrief

Pilot #3 said that with the smoke goggles on, he really wanted to make sure that he was moving the right switch and he would take time to confirm the right switch.

2.0 SDF Flight Tests

See Attachment 36 "UPS6 Flight Test Results."

3.0 SEA Smoke Simulator Testing

See Attachment 35 "SEA Smoke Simulator Results."

F. FACTUAL INFORMATION

4.0 History of Flight

On September 3, 2010, UPS flight 6 (UPS6), a Boeing 747-400AF, departed Dubai International Airport (DXB) on a scheduled cargo flight to Cologne (CGN), Germany. Twenty two minutes into the flight, level at 32,000 feet, the flight crew advised Bahrain Air Traffic Control (BAH-C) that the fire warning systems for the cargo compartments indicated an onboard main deck fire. The crew declared an emergency and requested a return to DXB as soon as possible. The crew further informed BAH-C that there was smoke in the cockpit and that the ability to view the primary flight instruments and radio frequency selection controls had become degraded. Due to the obscured visibility in the cockpit, the crew stayed on the BAH-C frequency for the duration of the return flight back to Dubai. Remaining on the BAH-C frequency heading East into the Emirates Flight Information Region (FIR) 1 required relay aircraft to communicate with the emergency aircraft by proxy for the Air Traffic Control (ATC) in Bahrain and the United Arab Emirates ATC (UAE-C).

As the aircraft approached DXB runway 12 left (RW12L), the aircraft overflew the DXB northern boundary at 4500 ft at a speed of 340 knots. Following the airport over flight, BAH-C, through a relay aircraft, advised the flight crew that Sharjah Airport (SHJ) was available to the airplane's left about 10 miles away. The aircraft reduced speed, and entered a shallow

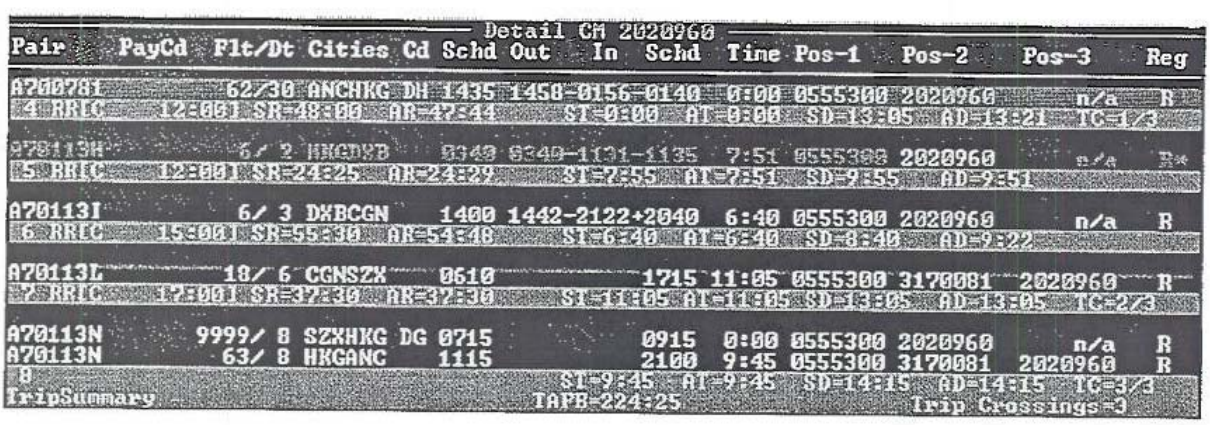
descending right turn to the south of Dubai Airport before radar contact was lost. The aircraft crashed 9nm south of DXB on a military installation.

5.0 Flight Crew Information

The accident flight crew consisted of a captain and a first officer. There were no passengers or occupants of the aircraft jumpseats.

5.1 Trip Information[4]

Both the Captain and F/O began the pairing from their crew base in Anchorage, Alaska (ANC) on August 30, 2010, by jumpseating on UPS flight 62 from ANC to Hong Kong (HKG) via Seoul Incheon Airport (ICN). While on a layover in HKG for 47:44 hours (8/31 – 9/2), they stayed at the Hyatt Regency, Hong Kong, Sha Tin. Following the layover in HKG, both crewmembers operated UPS flight 6 from HKG-DXB on September 02, 2010. The flight time for HKG to DXB was 7 hours and 51 minutes, and according to UPS records, the crew was on duty for 9 hours and 51 minutes. Both crewmembers had a 24:29 hour layover in DXB at the Fairmont Dubai, Sheikz Zayed Road. The crew was scheduled to operate UPS flight 6 on September 3, 2010 from DXB to Cologne, Germany (CGN), followed by a 55 hour rest period.



Detail CH 2020960

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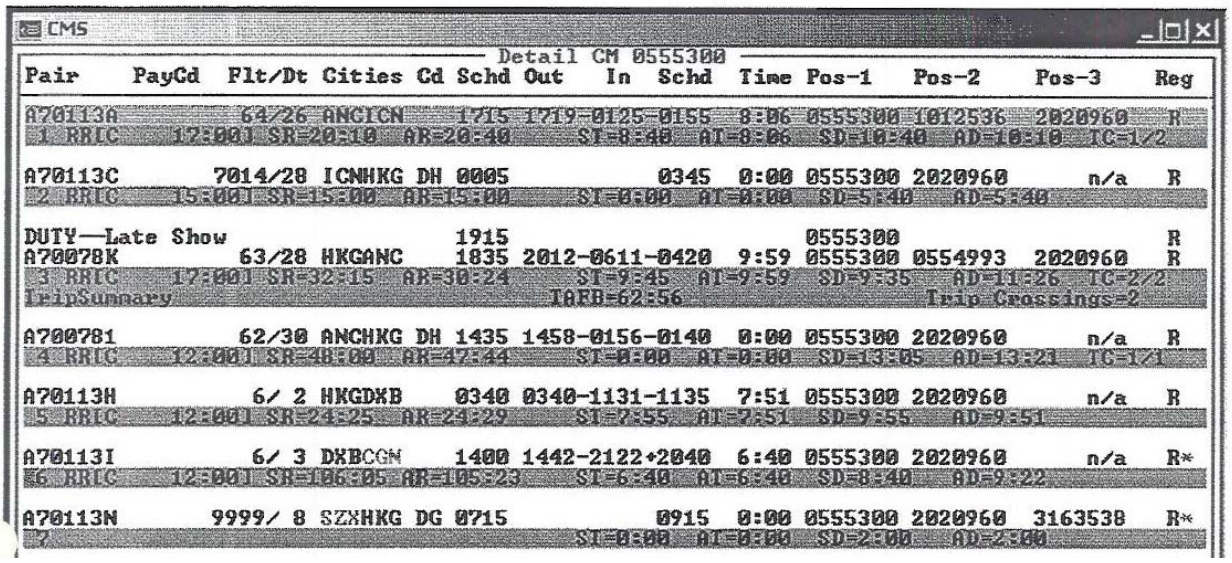
[4] See Attachment 12 - UPS6 Crew Flight Times.



5.2 The Captain

The Captain was 48 years old and his date of hire with UPS was July 10, 1995. He had flown for several commuter airlines, and previous to UPS was furloughed from USAirways. A search of FAA records indicated that he had no accidents, incidents, or violations in aviation and no record of any investigations pending.

5.2.1 The Captain's Pilot Certification Record[5]

FAA records of the captain indicated the following:

Private Pilot – Airplane Single Engine Land certificate issued July 10, 1981.

Private Pilot – Airplane Single Engine and Multiengine Land certificate issued June 11, 1982.

Commercial Pilot – Airplane Single and Multi Engine Land Instrument certificate issued April 19, 1983.

Flight Instructor – Airplane Single Engine, Valid only when accompanied by pilot certificate 282648474, expires 08/31/1987 certificate issued August 23, 1985.

Flight Instructor – Airplane Single & Multi Engine, Valid only when accompanied by pilot certificate 282648474, exp. 05/31/1988 certificate issued May 18, 1986.

Flight Instructor – Airplane Single & Multi Engine Instrument Airplane, Valid only when accompanied by pilot certificate 282648474 certificate issued June 21, 1987.

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

Notice of Disapproval – ATP (BE-99), VOR Approach Unsatisfactory, Failed to use correct Radial, issued February 17, 1988.[6]

Airline Transport Pilot – Airplane Multiengine Land, Commercial Privileges: Airplane Single Engine Land, issued February 19, 1988.

Flight Engineer – Turbojet Powered, "This certificate is Subject to the Provisions of Exemption 4901" issued September 14, 1989.

Flight Engineer – Turbojet Powered issued September 29, 1989.

Airline Transport Pilot – Airplane Multiengine Land B-747, Commercial Privileges Airplane Single Engine Land, B-747 Circling Approach-VMC Only issued April 11, 2005.

Airline Transport Pilot – Airplane Multiengine Land A310 B-747, Commercial Privileges Airplane Single Engine Land, A-310/B-747 Circ. Apch. -VMC Only issued November 27, 2007.

Airline Transport Pilot – Airplane Multiengine Land A310; B-747-400; B-747, Commercial Privileges Airplane Single Engine Land, English Proficient; A-310; B-747-400; B-747 Circ. Apch. -VMC Only issued November 7, 2009.

5.2.2 The Captain's Pilot Certificates and Ratings Held at Time of the Event[7]

AIRLINE TRANSPORT PILOT (issued November 7, 2009)
Airplane Multiengine Land A310; B-747-400; B-747, Commercial Privileges Airplane Single Engine Land, English Proficient; A-310; B-747-400; B-747 Circ. Apch. -VMC Only.

FLIGHT ENGINEER (issued September 29, 1989)
Turbojet Powered

MEDICAL CERTIFICATE FIRST CLASS issued March 3, 2010
Limitations: None

5.2.3 The Captain's Training and Proficiency Checks Completed[8]

Initial Type Rating B747-400: April 11, 2005
Last recurrent Proficiency Check: November 7, 2009
Last recurrent ground training: November 1, 2009
Last Line Check in B747-400: December 2, 2009 (ANC-SDF)

[6] Areas found unsatisfactory on examination and noted on FAA Form 8060-5 (4-82) were: VOR Approach unsatisfactory; Failed to use correct radial.
[7] Pilot Certification Records were provided by the Federal Aviation Administration.
[8] Training and Proficiency records provided by UPS. See Attachment 14 - UPS6 Crew Training Records.

5.2.4 The Captain's Flight Times[9]

The accident Captain's flight times:

Total pilot flying time	11,200 hours
Total Pilot-In-Command (PIC) time	2,350 hours
Total B747-400 flying time	366.8 hours
Total B747-400 PIC time	366.8 hours
Total flying time last 24 hours	0 hours
Total Flying time last 7 days	9.9 hours
Total flying time last 30 days	50.1 hours
Total flying time last 60 days	77.7 hours
Total flying time last 180 days	209.7 hours
Total flying time last 12 months	370.7 hours

5.3 The First Officer

The First Officer was 38 years old and was hired by UPS June 20, 2006. He was a former Marine Corps reservist, and previously flew for Chautauqua Airlines. A search of FAA records indicated that he had no accidents, incidents, or violations in aviation and no record of any investigations pending.

5.3.1 The First Officer's Pilot Certification Record [10]

FAA records of the first officer indicated that:

Private Pilot – Airplane Single Engine Land certificate issued March 21, 2000.

Private Pilot – Airplane Single Engine Land Instrument Airplane certificate issued June 7, 2000.

Private Pilot – Airplane Single and Multiengine Land Instrument Airplane; Airplane Multiengine Land Limited to VFR certificate issued 08/10/2000.

Notice Of Disapproval – Commercial Pilot (AMEL, INSTA) (PA-44); Area of operations 4 and 8. Area of Operations 1 and 9 Not Tested; First Failure issued September 26, 2000.[11]

Commercial Pilot – Airplane Multiengine Land Instrument Airplane; Private Pilot Privileges Airplane Single Engine Land certificate issued October 8, 2000.

Commercial Pilot – Airplane Single and Multiengine Land Instrument Airplane certificate issued October 16, 2000.
Flight Instructor – Airplane Single Engine, "Valid only when accompanied by pilot certificate

[9] Flight times based upon information provided on the Captain's Medical Application and information provided by UPS.
[10] Pilot Certification Record was provided by the Federal Aviation Administration.
[11] Areas of Operations 1 and 9 include normal takeoffs, landing and go-arounds, and multi-engine operations. Source: FAA-S-8081-12A Commercial Pilot Practical Test Standards for Airplane.

No. 399709614", expires 12/31/02 certificate issued December 17, 2000.
Flight Instructor – Airplane Single Engine, "Valid only when accompanied by pilot certificate No. 399709614", expires 12/31/02 certificate issued December 28, 2000.
Notice of Disapproval – Flight Instructor (INSTA) (C-172); Area of Operations 5 and 8; Area of Operations 2, 3, and 4 Not Tested issued January 8, 2001.[12]
Flight Instructor – Airplane Single Engine Instrument Airplane, "Valid only when accompanied by pilot certificate No. 399709614", expires 01/31/03 certificate issued January 16, 2001.
Flight Instructor – Airplane Single Engine and Multiengine Instrument Airplane, "Valid only when accompanied by pilot certificate No. 399709614", expires 12/31/03 issued December 6, 2001. Renewed December 4, 2003, December 30, 2005, December 18, 2007, and December 14, 2009.
Airline Transport Pilot – Airplane Multiengine Land EMB-145; Commercial Privileges Airplane Single Engine Land issued May 19, 2004.
Airline Transport Pilot – Airplane Multiengine Land B-757, B-767, EMB-145; Commercial Privileges Airplane Single Engine Land, B-757, B-767 Circ. Apch. – VMC Only issued August 18, 2006.
Airline Transport Pilot – Airplane Multiengine Land B-747-4, B-757, B-767, EMB-145; Commercial Privileges Airplane Single Engine Land; B-747-4, B-757, B-767 Circ. Apch. – VMC Only issued June 24, 2010.

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

AIRLINE TRANSPORT PILOT (issued June 6, 2010)
Airplane Multiengine Land B-747-4, B-757, B-767, EMB-145; Commercial Privileges Airplane Single Engine Land; B-747-4, B-757, B-767 Circ. Apch. – VMC Only.

FLIGHT INSTRUCTOR (issued December 14, 2009)
Airplane Single Engine and Multiengine Instrument Airplane

MEDICAL CERTIFICATE SECOND CLASS (issued May 4, 2009).
Limitations: None.

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

Last Proficiency check on B747-400: June 24, 2010
Last recurrent ground training: June 20, 2010

5.3.4 The F/O's Flight Times[15]

The accident First Officer's flight times:

[12] Areas of Operations 5 and 8 include Air Traffic Control Clearances and Procedures, and Instrument Approach Procedures. Source: FAA-S-8081-9A Flight Instructor Practical Test Standards for Instrument Airplane
[13] Pilot Certification Records were provided by the Federal Aviation Administration.
[14] Training and Proficiency records were provided by UPS. See Attachment 14 - UPS6 Crew Training Records.
[15] Flight times based upon information provided on the F/O's Medical Application and information provided by UPS, unless otherwise noted.

Total pilot flying time	5,549 hours
Total PIC time	1,590 hours[16]
Total second in command (SIC) time	1,355.3 hours
Total flying time in B747-400	77.4 hours
Total B747-400 second-in-command (SIC) time	77.4 hours
Total flying time last 24 hours	0 hours
Total Flying time last 7 days	9.9 hours
Total flying time last 30 days	25.9 hours
Total flying time last 60 days	77.4 hours
Total flying time last 180 days	130.2 hours
Total flying time last 12 months	243.3 hours

[16] PIC time derived from previous carrier (Chautauqua Airlines) flight times and resume.

6.0 Weight and Balance

6.1 Limitations[17]

STRUCTURAL DESIGN LIMITATIONS

MAXIMUM WEIGHTS

(AFM) Maximum weight limitations are listed in the table below.

MAXIMUM WEIGHT LIMITATIONS (1000 POUNDS)		
Maximum Taxi Weight	878.0 **(Freighter)**	873.0 **(BCF)**
Maximum Takeoff Weight	875.0 **(Freighter)**	870.0 **(BCF)**
Maximum Inflight Weight, Landing Flaps	670.0	
Maximum Landing Weight	652.0	
Maximum Zero Fuel Weight	610.0	
Minimum Flight Weight	361.2 **(Freighter)**	367.5 **(BCF)**

(AFM) The maximum takeoff weight at brake release and the maximum landing weight are the lesser of maximum structural weight limits, performance limits or noise limits.

Refer to airport analysis for maximum permissible operating weights for specific runways, weather conditions and abnormal aircraft configurations. Takeoff weight may be further restricted by the Minimum Equipment List (MEL), Dispatch Maintenance Procedures (DMP) and/or Configuration Deviation List (CDL).

(AFM) Maximum weight limits may be further limited by center of gravity limits, fuel density and fuel loading limits in this section or atmospheric pressure deviations below standard.

(AFM) Approved tires that are capable of at least 235 MPH true ground speed must be installed in order to utilize the maximum structural and performance-limited takeoff weights.

The following information for UPS flight 6 was obtained from UPS dispatch release information:[18]

Basic Operating Weight	352,000 lbs
Passenger Weight	0 lbs
Baggage & Cargo	228,076 lbs
Zero Fuel Weight	580,076 lbs
Fuel	193,693 lbs
Ramp Weight	773,769 lbs
Maximum Ramp Weight	878,000 lbs
Taxi Fuel Burn	2,700 lbs
Takeoff Weight	771,069 lbs

[17] Source: UPS B747-400 Aircraft Operating Manual (AOM), Chapter 1, page 12.
[18] See Attachment 39 - UPS6 Flight Paperwork.

Maximum Takeoff Weight (UPS6)	801,100lbs. (Landing Limit)
Maximum Certificated Takeoff Weight	875,000 lbs.
Estimated fuel burn to accident site	128,800 lbs
Estimated weight at impact	752,269 lbs
Maximum landing weight	652,000 lbs.

7.0 Accident Airplane

7.1 Airplane Description[19]

The accident airplane was a Boeing 747-44AF, registration number N571UP, serial number 35668. It was manufactured in 2007 and received its airworthiness certificate on September 26, 2007. It was certificated on October 5, 2007, and registered to United Parcel Service in Louisville, Kentucky. The airplane was powered by four General Electric CF6-80C2-B5FG01 engines.

The airplane was listed in the UPS Operations Specifications (Certificate Number: IPXA097B) under section D085 – "Airplane Listing".[20]

7.2 B747 Accident History[21]

The first flight of a B747 series aircraft occurred in 1969. There were over 1421 aircraft produced, and production of the B747 series is ongoing. There have been 42 hull loss accidents recorded for the B747 resulting in 2852 fatalities, with 3 non-fatal occurrences resulting in subsequent write-off of the aircraft.

The last hull loss of a B747 was a write-off of a Cargo B Airlines B747-228F (Registration OO-CBA, serial number 24158) following a tailstrike on takeoff from runway 25R Brussel-Zaventem Airport, Belgium (BRU/EBBR) on October 27, 2008.

The last fatal B747 accident occurred on July 7, 2008, when a cargo B747-209BSF (Registration N714CK, serial number 22446), operated by Centurion Air Cargo and leased from Kalitta Air, crashed after takeoff 5 miles from Bogota-Eldorado Airport (BOG) enroute to Miami International Airport (MIA/KMIA). The airplane impacted a farm field, broke up and caught fire. The farm was demolished in the crash, killing three people inside. There were no crew fatalities.

[19] Source: http://registry.faa.gov/aircraftinquiry/NNum_Results.aspx?NNumbertxt=N571UP.
[20] Reference: UPS Operations Specifications, page D085-2, dated March 05, 2010.
[21] Source: Flight Safety Foundation, http://aviation-safety.net/database/type/type-general.php?type=104.

8.0 Air Traffic Control and Weather

8.1 Air Traffic Control

8.1.1 Filed Flight Plan[22]

OMDB RANBI N571 BALUS UL768 OTILA UR219 MODAD B544 ALE UB402 NISAP UM861 BUK UL602 BUDOP UL850 LALIN UL604 DEMAB T842 RUNER T858 KOPAG KOPAG1C EDDK

8.1.2 Overview of GCAA Air Navigation Center (ANC)

On September 7, 2010, group members traveled to visit the UAE ATC facility that maintained communications with UPS6. It was an enroute center located in Abu Dhabi, UAE. Radar coverage was from the surface to unlimited (except for individual approach controls that extended from 14,500 feet to unlimited).

They had 60 active controllers and expected to have 76 by the end of the year. Controllers worked a 10 day cycle; the normal work schedule was 6 days on and 4 days off. Controllers were on position 75-80% of the 8 hour day. They had a total of 5 crews with a supervisor and deputy supervisor.

The center had 1800 movements per day; it was 600 movements per day about 13 years ago.

Supervisors were required to plug into an active sector solo for 12 hours per month to remain current. There were 6 radar feeds into the facility.

Each controller had an Emergency Training Program requirement once a year referred to as the Emergency Continuation Program. It consisted of lecture and simulator work.

Staff used a "Planner" who was trained to assist another controller during emergencies.

New hire experience requirements was 4 years of prior controller experience, a 3 month training period, and 2 ½ months "on the job training" on the floor with another controller.

8.2 Weather

8.2.1 Dubai Weather

The accident occurred at approximately 1610Z. The most current OMDB[23] reported weather at the time of the accident was a 1600Z surface observation that reported winds from 240 degrees at 4 knots, temperature 36 degrees C (Celsius) and dew point 26 degrees C, and no significant clouds or weather. The most current METARs and TAFs[24] at the time of the accident were as follows:

[22] See Attachment 39 - UPS6 Flight Paperwork

[23] OMDB is the International Civil Aviation Organization (ICAO) code for Dubai International Airport.

[24] METAR is the international standard code format for hourly surface weather observations which is analogous to the SA coding currently used in the US. The acronym roughly translates from French as *Aviation Routine Weather*

METAR OMDB 031200Z 30012KT 8000 NSC 37/27 Q100, NOSIG
METAR OMDB 031300Z 31011KT 290V350 8000 NSC 37/27 Q0999 NOSIG
METAR OMDB 031400Z 30010KT 8080 NSC 36/26 Q0999 NOSIG
AAXX 03154 41194 41958 03206 10352 20281 39993 49999 70600 333 59013
METAR OMDB 031500Z 32006KT 290V030 8000 NSC 35/28 Q0999 NOSIG

Note - *Accident occurred at about 1610Z*
METAR OMDB 031600Z 24004KT 8000 NSC 36/27 Q1000 NOSIG

METAR OMDB 031700Z 2-004KT 8000 NSC 35/29 Q1000 NOSIG
AAXX 03184 41194 11958 02204 10345 20289 30000 40005 60001 70500 333 10438 59014
METAR OMDB 031800Z 22004KT 8000 NSC 35/29 Q1000 NOSIG
METAR OMDB 031900Z 21004KT 170V290 8000 NSC 34/29 Q1000 NOSIG

TAF OMDB 031106Z 0312/0418 32012KT 8000 NSC
BECMG 0316/0318 12005KT
PROB30 0400/0404 2500 BR
BECMG 0407/0409 34012KT
BECMG 0416/0418 12005KT=

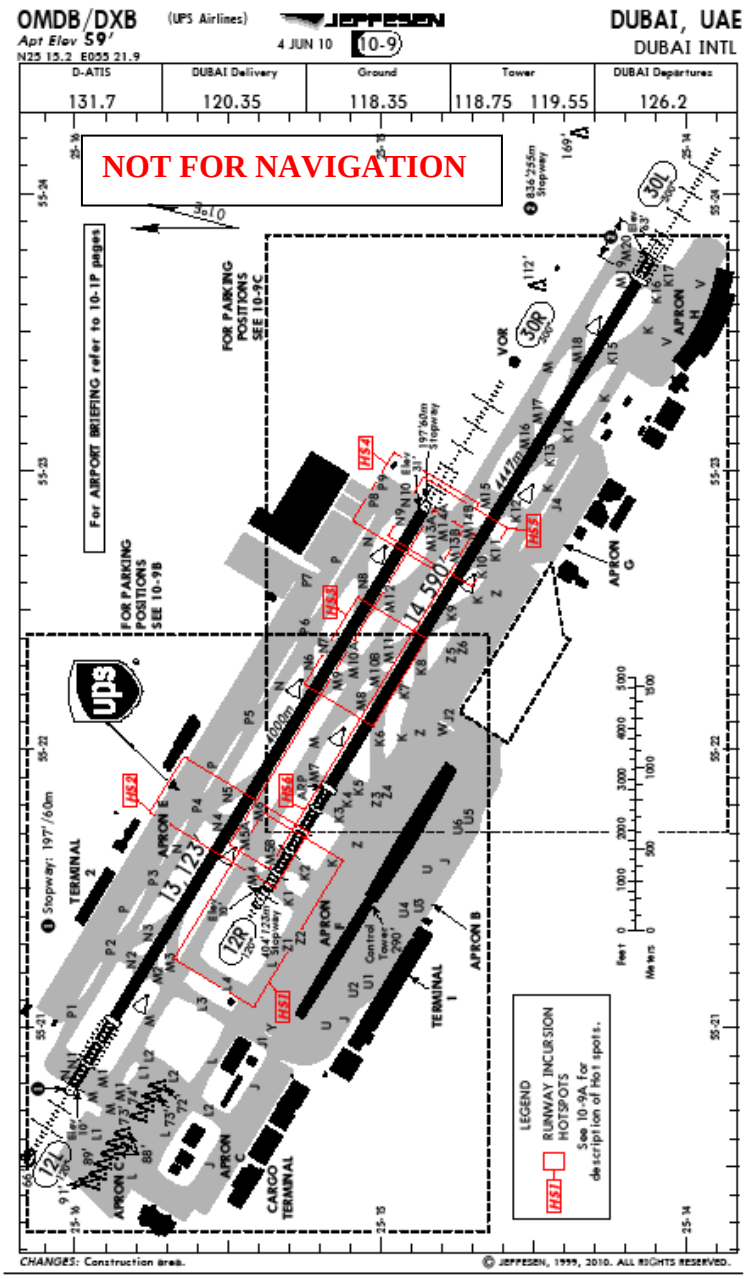
9.0 Aerodrome Information

Dubai International Airport is located in the United Arab Emirates. The opening of the Cargo Mega Terminal in 2008 increased the capacity to 2.5 million tons. According to Airport Council International's (ACI) figures the Dubai Airports Cargo ranks fourth worldwide in terms of international freight traffic. Dubai is serviced by over 130 airlines flying to more than 220 destinations across six continents.[25]

Report . SPECI is merely the code name given to METAR formatted products which are issued on a special non-routine basis as dictated by changing meteorological conditions. The **SPECI** acronym roughly translates as *Aviation Selected Special Weather Report* . TAF is the international standard code format for terminal forecasts issued for airports. The acronym translates to *Terminal Aerodrome Forecast* , and is analogous to the terminal forecast (FT) coding format currently used in the US.

[25] Source: http://www.dubaiairport.com/en/media-centre/facts-figures/Pages/factsheets-reports-statistics.aspx?id=13.

9.1 Dubai International Airport (DXB) [26]



[26] See Attachment 7 - Navigational Charts.

OMDB/DXB

JEPPESEN

4 JUN 10 (10-9A)

DUBAI, UAE

DUBAI INTL

ADDITIONAL RUNWAY INFORMATION

RWY			USABLE LENGTHS — LANDING BEYOND — Threshold	Glide Slope	TAKE-OFF	WIDTH
12L 30R	HIRL (60m) CL (15m) HIALS-II SFL TDZ REIL ❶	RVR	11,811' 3600m	10,778' 3285m	❷	197' 60m
				11,969' 3648m	❸	

❶ PAPI (angle 3.0°)

❷ TORA RWY 12L:

From rwy head	13,123' (4000m)
twy M2/N2 int	10,630' (3240m)
twy M3/N3 int	9826' (2995m)
twy M5/N4 int	7349' (2240m)
twy M6/N5 int	6529' (1990m)

❸ TORA RWY 30R:

From rwy head	13,123' (4000m)
twy M12/N8 int	11,188' (3410m)
twy M10/N7 int	9957' (3035m)
twy M9/N6 int	9170' (2795m)

12R 30L	HIRL (60m) CL (15m) HIALS SFL TDZ REIL ❹	RVR	12,237' 3730m	11,265' 3434m	❺	197' 60m
	HIRL (60m) CL (15m) HIALS-II SFL TDZ REIL ❹	RVR	14,157' 4315m	13,062' 3982m	❻	

❹ HSTIL, PAPI (angle 3.0°)

❺ TORA RWY 12R:

From rwy head	14,157' (4315m)
twy K2/M5 int	13,550' (4130m)
twy K3 int	12,139' (3700m)
twy K4/M7 int	11,844' (3610m)
twy K5 int	11,516' (3510m)
twy K6 int	10,285' (3135m)
twy K7/M10 int	9400' (2865m)
twy K8/M11 int	8645' (2635m)
twy K10/M13 int	6480' (1975m)

❻ TORA RWY 30L:

From rwy head	14,590' (4447m)
twy K15 int	12,500' (3810m)
twy M18 int	12,139' (3700m)
twy K14/M17 int	10,860' (3310m)
twy K13/M16 int	10,203' (3110m)
twy K12/M15 int	8957' (2730m)
twy K11/M14 int	8120' (2475m)
twy K9 int	6463' (1970m)

NOT FOR NAVIGATION

RUNWAY INCURSION HOT SPOTS

(For information only, not to be construed as ATC instructions.)

HS1 Confusion of TWYs M4 & L4 - There have been several RWY incursions on to RWY 12R at TWY M4 due to the confusion between the two when taxiing westbound on TWY M.

HS2 N4 crossing North to South - Hot Spot area with history of RWY incursions. Pilots are to exercise caution when crossing RWY 12L for DEP RWY 12R.

HS3 TWYs M10 & M11 - Several RWY incursions.
TWY M11 permanently closed in 12 direction.
TWY M10 - ARR ACFT shall not plan to cross RWY 12R as it blocks the primary Rapid Exit TWY for RWY 12L.
TWY M11 stopbar shall be lit to ensure ACFT vacating RWY 12L via TWY M9 do not head straight onto RWY 12R (when stopbar is on associated CL lights are de-energized).

HS4 RWY Holding Points M13A & M14A - Pilots are to be alert when given conditional clearances and to positively identify TFC BFR entering RWY 30R.

HS5 RWY Holding Points M13B & M14B - Hot Spot area with history of RWY incursions. Pilots are to exercise caution when crossing RWY 30R for DEP RWY 30L

HS6 Confusion of TWY M with both RWYs 12 & 30 direction - Pilots are warned not to confuse TWY M with RWY 12R after crossing RWY 12L via TWY N4 and TWY M5 for DEP RWY 12R. Pilots are warned not to confuse TWY M with RWY 30R after crossing RWY 30L via TWY K10 and TWY M13 or TWY K11 for DEP RWY 30R.

JAR-OPS

TAKE-OFF ❶

All Rwys

LVP must be in force ❷

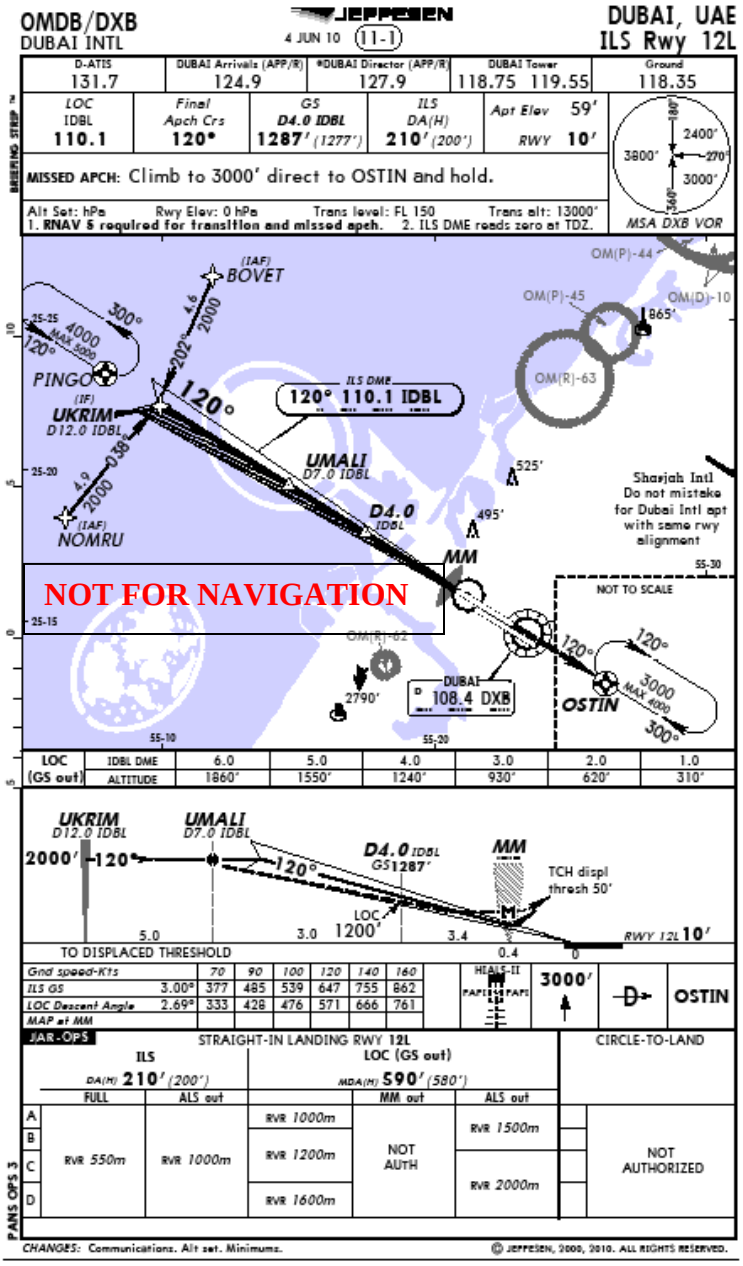
	RL, CL & mult. RVR req	RL & CL	RCLM (DAY only) or RL	RCLM (DAY only) or RL	NIL (DAY only)
A	125m	150m	250m	400m	500m
B					
C					
D	150m	200m	300m		

❶ Operators applying U.S. Ops Specs: CL required below 300m.

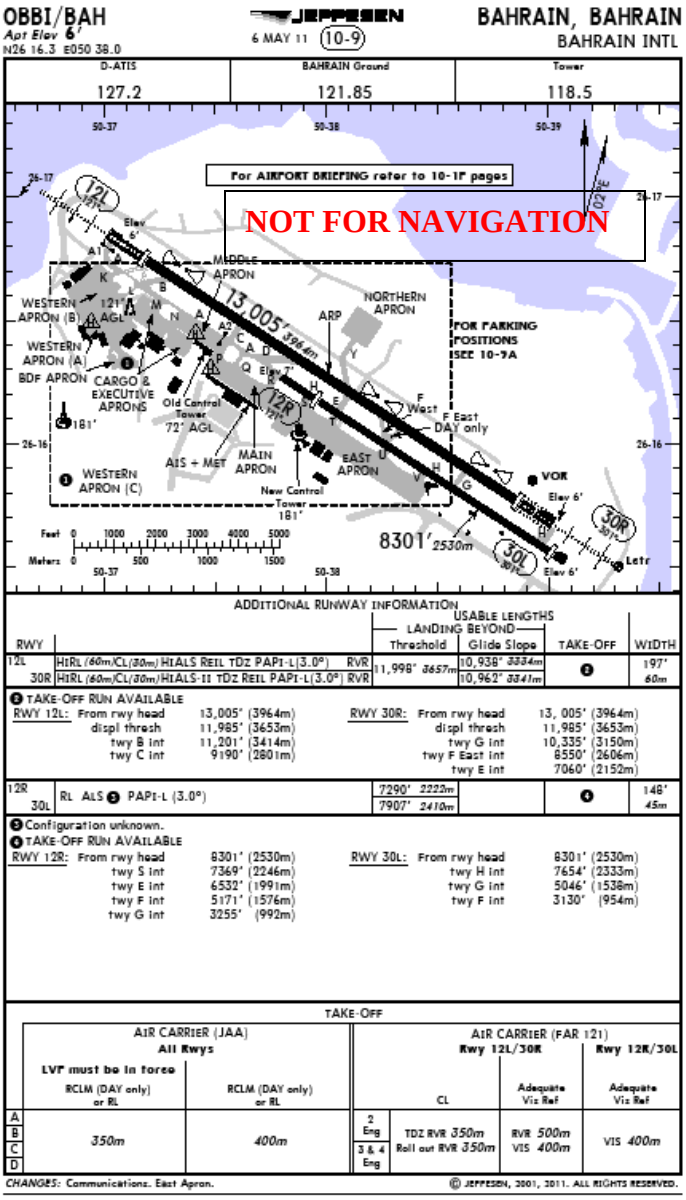
❷ For low visibility departures all RVR transmissometers of departure rwy shall be serviceable. If reported meteorological VIS>150m TDZ RVR not required.

CHANGES: Minimums.

9.2 ILS (Instrument Landing System) for Runway 12L



9.3 Bahrain International Airport



ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS LANDING BEYOND Threshold	Glide Slope	TAKE-OFF	WIDTH
12L	HIRL (60m/CL/30m) HIALS REIL TDZ PAPI-L(3.0°) RVR	11,998' 3657m	10,938' 3334m	❷	197' 60m
30R	HIRL (60m/CL/30m) HIALS-II TDZ REIL PAPI-L(3.0°) RVR		10,962' 3341m		

❷ TAKE-OFF RUN AVAILABLE

RWY 12L: From rwy head 13,005' (3964m); displ thresh 11,985' (3653m); twy B int 11,201' (3414m); twy C int 9190' (2801m)

RWY 30R: From rwy head 13, 005' (3964m); displ thresh 11,985' (3653m); twy G int 10,335' (3150m); twy F East int 8550' (2606m); twy E int 7060' (2152m)

12R 30L	RL ALS ❸ PAPI-L (3.0°)	7290' 2222m 7907' 2410m		❹	148' 45m

❸ Configuration unknown.

❹ TAKE-OFF RUN AVAILABLE

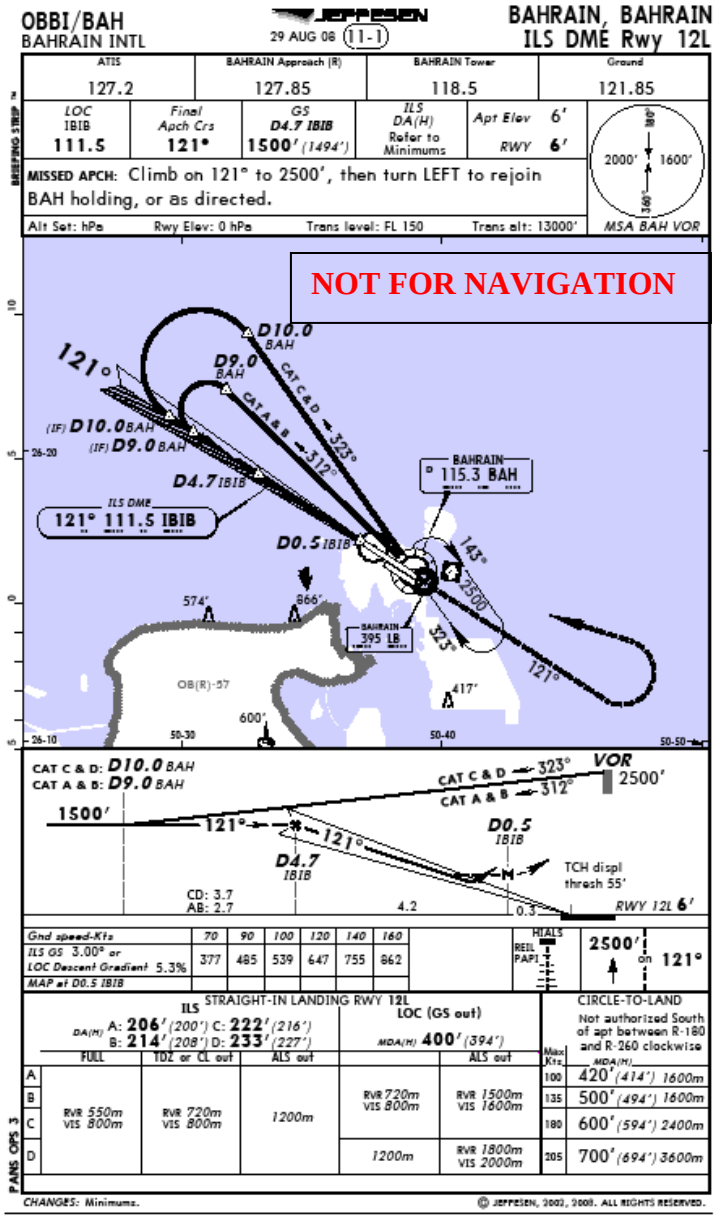
RWY 12R: From rwy head 8301' (2530m); twy S int 7369' (2246m); twy E int 6532' (1991m); twy F int 5171' (1576m); twy G int 3255' (992m)

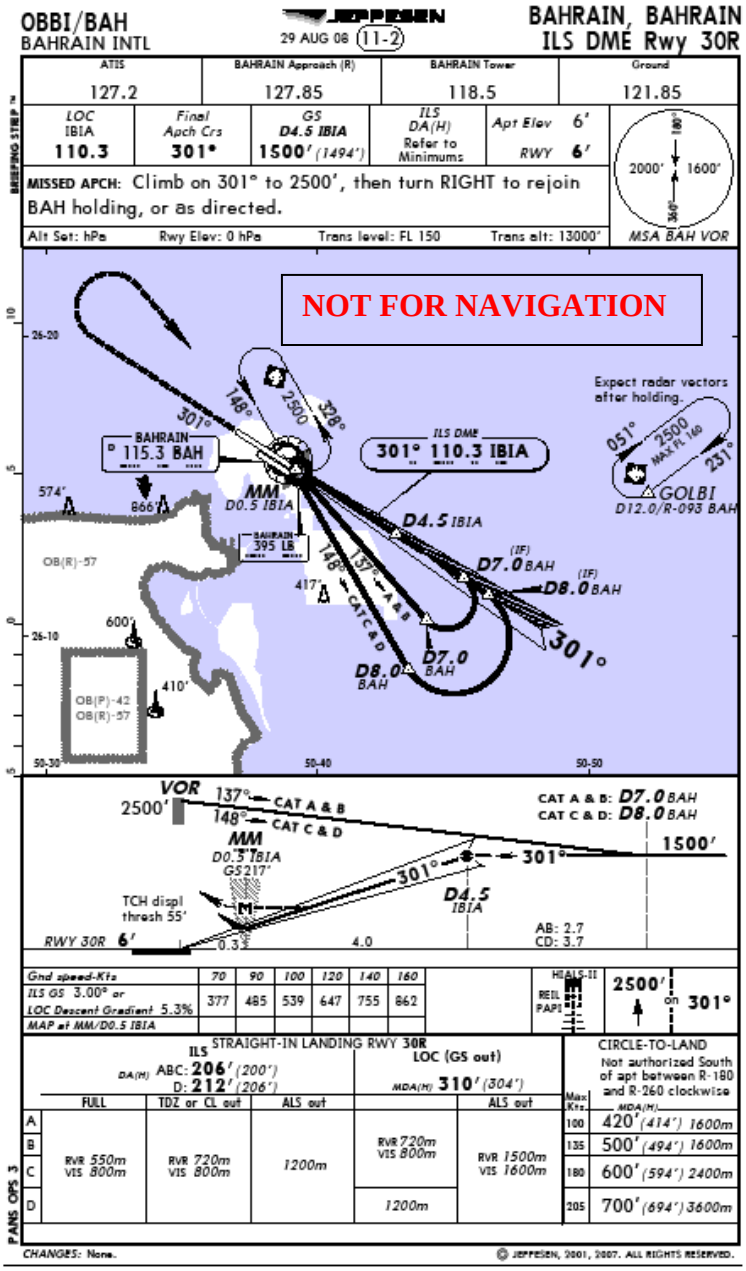
RWY 30L: From rwy head 8301' (2530m); twy H int 7654' (2333m); twy G int 5046' (1538m); twy F int 3130' (954m)

TAKE-OFF

	AIR CARRIER (JAA) All Rwys LVP must be in force RCLM (DAY only) or RL	AIR CARRIER (JAA) All Rwys RCLM (DAY only) or RL	AIR CARRIER (FAR 121) Rwy 12L/30R CL		AIR CARRIER (FAR 121) Rwy 12L/30R Adequate Vis Ref	AIR CARRIER (FAR 121) Rwy 12R/30L Adequate Vis Ref
A	350m	400m	2 Eng	TDZ RVR 350m Roll out RVR 350m	RVR 500m VIS 400m	VIS 400m
B						
C			3 & 4 Eng			
D						

CHANGES: Communications. East Apron.


OBBI/BAH
BAHRAIN INTL
29 AUG 08 (11-1)
BAHRAIN, BAHRAIN
ILS DME Rwy 12L
ATIS 127.2
BAHRAIN Approach (R) 127.85
BAHRAIN Tower 118.5
Ground 121.85
LOC IBIB 111.5
Final Apch Crs 121°
GS D4.7 IBIB 1500' (1494')
ILS DA(H) Refer to Minimums
Apt Elev 6'
RWY 6'
MISSED APCH: Climb on 121° to 2500', then turn LEFT to rejoin BAH holding, or as directed.
Alt Set: hPa
Rwy Elev: 0 hPa
Trans level: FL 150
Trans alt: 13000'
MSA BAH VOR
2000'
1600'
NOT FOR NAVIGATION
D10.0 BAH
D9.0 BAH
121°
CAT C & D 323°
CAT A & B 312°
(IF) D10.0 BAH
(IF) D9.0 BAH
D4.7 IBIB
ILS DME
121° 111.5 IBIB
BAHRAIN
115.3 BAH
D0.5 IBIB
145°
2500'
323°
121°
574'
866'
BAHRAIN
395 LB
417'
600'
OB(R)-57
CAT C & D: D10.0 BAH
CAT A & B: D9.0 BAH
1500'
VOR
2500'
D0.5 IBIB
D4.7 IBIB
TCH displ thresh 55'
CD: 3.7
AB: 2.7
4.2
0.3
RWY 12L 6'
Gnd speed-Kts 70 90 100 120 140 160
ILS GS 3.00° or LOC Descent Gradient 5.3%
377 485 539 647 755 862
MAP at D0.5 IBIB
HIALS
REIL
PAPI
2500' on 121°
STRAIGHT-IN LANDING RWY 12L
ILS
LOC (GS out)
DA(H) A: 206' (200') C: 222' (216')
B: 214' (208') D: 233' (227')
MDA(H) 400' (394')
FULL
TDZ or CL out
ALS out
ALS out
A
B
C
D
RVR 550m VIS 800m
RVR 720m VIS 800m
1200m
RVR 720m VIS 800m
RVR 1500m VIS 1600m
1200m
RVR 1800m VIS 2000m
CIRCLE-TO-LAND
Not authorized South of apt between R-180 and R-260 clockwise
Max Kts
MDA(H)
100 420' (414') 1600m
135 500' (494') 1600m
180 600' (594') 2400m
205 700' (694') 3600m
PANS OPS 3
CHANGES: Minimums.
© JEPPESEN, 2002, 2008. ALL RIGHTS RESERVED.



10.0 Company Overview[27]

United Parcel Service (UPS) corporate headquarters are located in Atlanta, Georgia, and its flight operations are based in Louisville, Kentucky. UPS employs 408,00 worldwide, (340,000 U.S., 68,000 international), and, according to its February 2010 Securities Exchange Commission 10K filing, employs about 2800 pilots who are represented by the Independent Pilots Association. The company most recently earned $49.6 billion in revenue for the year 2010.

[27] Source: UPS website.

UPS operated 218 aircraft[28] from the following air hubs:

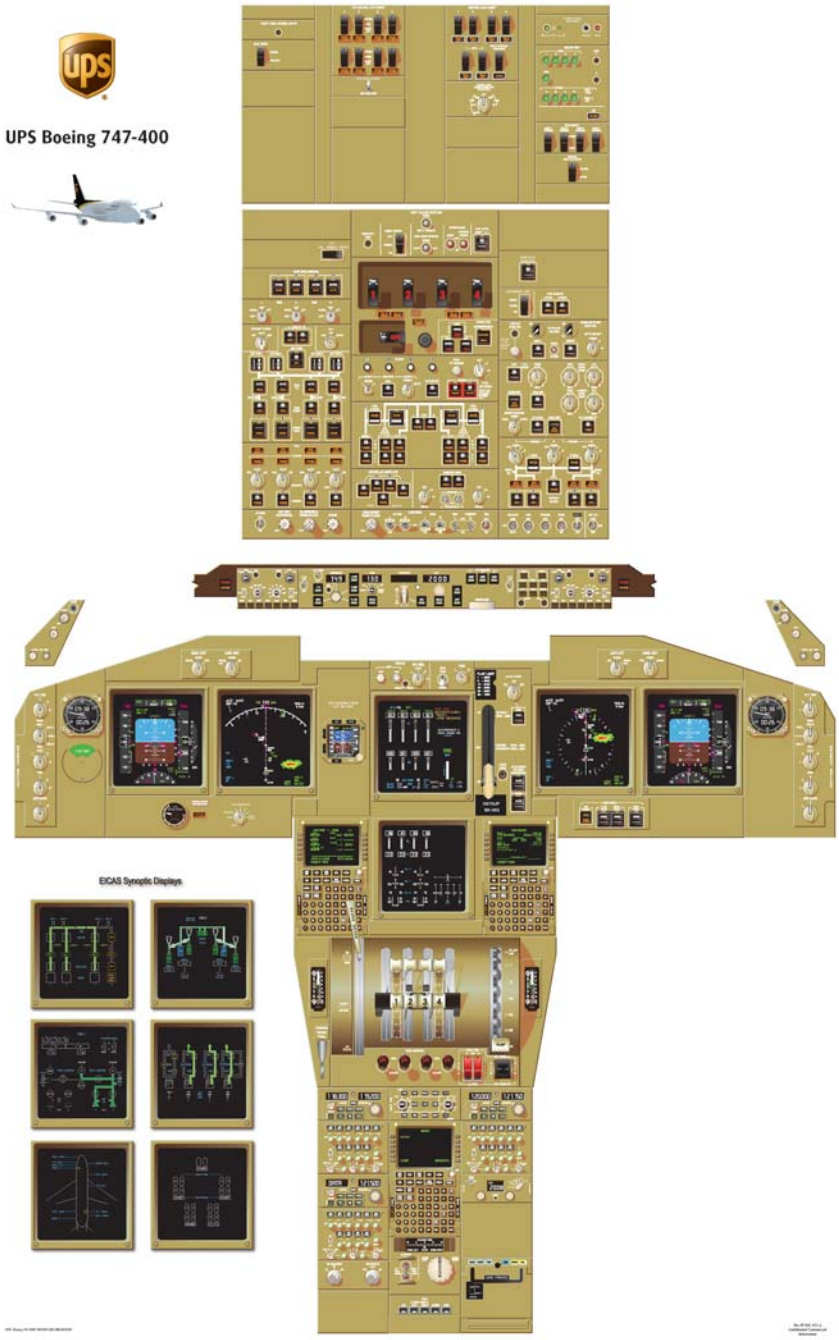
> **United States:** Louisville, Ky. (Main US Air Hub); Philadelphia, Pa.; Dallas, Texas; Ontario, Calif.; Rockford, Ill.; Columbia, S.C.
> **Europe:** Cologne/Bonn, Germany
> **Asia Pacific:** Shanghai; Shenzhen; Hong Kong
> **Latin America and Caribbean:** Miami, Fla., USA
> **Canada:** Hamilton, Ontario

According to UPS, the company operated 942 domestic flight segments, and 815 international flight segments. The sole UPS flight crew base for the B747-400 was located in Anchorage, Alaska (ANC). Both accident flight crewmembers were based in ANC.

[28] Breakdown of aircraft types operated by UPS: B747-400F (10), B747-400BCF (2), B757-200 (75), B767-300 (34), MD-11 (38), A300-600 (53).

11.0 B747-400 Systems

11.1 Cockpit Layout



11.2 UPS Boeing 747-400F Communications System Details[29]

The communication system on the Boeing 747-400F consisted of the following:

- Radio communication system
- Cockpit voice recorder system
- Interphone communication system
- SATCOM communication system
- ATC data communication system
- Company data communication system

11.2.1 Radio communication system

The radio communication system has multiple avenues to facilitate aircraft to ground communications. The primary source to the pilot for ground voice communications is through any one of three VHF (very high frequency) radios installed on the aircraft. Alternate voice communication sources are any one of two HF (high frequency) radios, Selective Calling (SELCAL) and Satellite Communications (SATCOM).

There is also a means to transmit data (non-voice) between the aircraft and ground facilities. The primary source of data transmission is through the Aircraft Communication Addressing and Reporting System (ACARS).

Another unique feature of data transmission available is an Airplane Health Management (AHM) system that would collect performance, fault and alert information onboard the aircraft in real time and relay that information to the UPS ground operations via the ACARS system.

11.2.2 VHF Radio Communications

There are three VHF radios designated as VHF L(eft), C(enter), R(ight) and two HF radios designated as HF L(eft), R(ight). Any VHF or HF radio can be controlled by any of the three radio tuning panels. The audio control panels control voice transmission and receiver monitoring. VHF L, VHF C, or VHF R can be configured for voice or ACARS data communication. VHF radios are equipped with 8.33 kHz channel spacing. Pilot control of the 3 VHF radios and 2 HF radios was enabled through the radio tuning panels and the audio control panels.

Each pilot (Captain and First Officer) has his/her own radio tuning panel and audio control panel, and both are located on the aft aisle stand in the cockpit between both pilots. In addition, each observer's station has its own audio control panel located near the observer's oxygen mask box.

11.2.3 Radio Tuning Panel

[29] Section 11 includes information from systems manuals, operating manuals (provided by Boeing and UPS) as well as from interviews with UPS pilots, instructors and check airmen.

The three radio tuning panels are used to tune the VHF and HF radio frequencies. The panels are designated left (Captain's), center (typically used for ACARS data), and right (First Officer's), and are normally configured to control the respective VHF and HF radios (left tuning panel controls left VHF radio, etc). If a radio tuning panel fails, it can be disconnected from the communication radios using the off switch. An offside tuning indicator light (located between the active and standby frequency windows) on each radio tuning panel indicates one of the following conditions when illuminated:

- The radio tuning panel is configured to control a radio that was normally controlled by another radio tuning panel (e.g. if the left tuning panel were configured to control the right VHF radio)
- A communication radio not normally associated with that radio tuning panel is selected and the radio can also be tuned by another radio tuning panel. (e.g. if more than one tuning panel is configured to control the same radio, the offside tuning indicator will illuminate on all the affected tuning panels)

Frequencies are tuned with a rotary knob and displayed in the right side "Standby" window. When the pilot wishes to make that frequency usable, the center ⟺ button is pushed to make that frequency "active" and available to transmit and receive on. When ACARS is selected in the CDU for data transmission over the VHF radio, that particular radio tuning panel will show "DATA" in the active window.

NOTE: If the center radio is configured with DATA in the active window, and the ⟺ button is selected to transfer out of DATA mode, the DATA LINK would be lost (if neither SATCOM nor HF are available).

When one of the two HF frequencies is selected, the HF SENS knob is available to adjust the sensitivity of the respective HF receiver. The AM switch will set amplitude modulation of USB (upper side band) mode for the selected HF radio.

11.2.4 Audio Control Panel

The audio control panels are used to control radio and interphone communication systems. Navigation receiver audio can also be monitored. The captain, first officer, and first observer audio control panels are installed on the aft aisle stand. The second observer audio control panel is installed on the sidewall panel. Microphones are keyed by pushing the desired audio control panel transmitter select switch (MIC CALL) and then selecting one of the following:

- The MIC position of a control wheel switch (the bottom rocker position on the yolk switch)
- The R/T position of an audio control panel Push-to-Talk (PTT) switch (see above)
- The PTT (push to talk) position of a hand microphone switch

Note: The R/T switch on the audio control panel also is used to transmit via cockpit interphone when pushed to the INT position. The switch is spring-loaded to the center (off) position. There is no “hot” microphone feature for the UPS B747-400F (except for the signal to the CVR).

When the MIC CALL switch is pressed, a white light illuminates for the selected transmitter, and any other MIC light that was previously illuminated will extinguish. This action will also select that receiver audio on, if not previously selected on manually, and the volume level can be adjusted as required (the button does not have to be pushed in to gain volume access for a selected transmitter). Additional receivers can be monitored by pushing in the volume knob for the associated receiver and rotating the knob to the desired level.

Radio systems are monitored using headphones or speakers (adjusted through the speaker volume control knob). An oxygen mask microphone is enabled and the boom microphone disabled, when the oxygen mask left stowage door is opened. The oxygen mask microphone is

disabled and the boom microphone enabled, when the left oxygen mask stowage box door was closed and the RESET/TEST switch on the stowage box is pushed.

11.2.5 Microphones

There are three different microphones available to each pilot for transmissions on selected radios; the hand-held microphone, the boom microphone on the headset, and the oxygen mask microphone. Activation of the hand-held PTT, a control wheel microphone/interphone or audio control panel mic/interphone switch transmits on the system selected for use at that station.

11.2.6 Stuck Mic Protection

On the ground, any VHF radio transmitting for longer than 35 seconds is disabled following annunciation of a warning beep. The radio is re-enabled when the microphone switch for that radio is released.

11.2.7 Emergency Frequency 121.50

A unique feature of the audio control panel will automatically select a VHF radio for monitoring, when the emergency frequency 121.50 is tuned and placed in the “active” window on the radio tuning panel. With 121.50 in an active frequency, the VHF radio is automatically selected to be monitored regardless which radio transmitter is selected. Additionally, interviews with UPS pilots indicate that a preset volume was provided at a lower setting, and that the volume of a radio set to 121.50 could not be reduced to zero.

11.2.8 Aircraft Communication Addressing and Reporting System (ACARS)

ACARS data and voice modes provide automatic and manual means to transmit and receive operational, maintenance, and administrative information between the airplane and a ground station. ACARS is operational when electrical power is established and is accessed by selecting the ACARS prompt on the CDU main menu.

ACARS communicates through VHF L/C/R or SATCOM and/or HF L/R. If ACARS is not available due to lost communication, information to be transmitted is stored, and then transmitted automatically when communication was regained. VHF L/C/R or HF L/R data mode can be selected and deselected by pushing the frequency transfer switch on the radio tuning panel. The VHF or HF radio is in data mode when the word DATA is displayed in the radio tuning panel active frequency window.

When a VHF L/C/R or HF L/R standby frequency is transferred to the active window, DATA is displayed in the standby window. If a new frequency was subsequently selected in the standby window, DATA is replaced by the new frequency. DATA can be returned to the standby window by selecting a frequency higher or lower than the allowable VHF or HF frequency range. When a VHF radio is in data mode, it is not available for voice communications. HF datalink operation is inhibited on the ground. When an HF radio is in data mode during flight, the opposite side HF radio is available for voice communications. Voice transmission on the opposite side will

preempt any HF datalink operation in progress.[30] HF datalink will resumes after a short period following completion of the voice transmission. The VHF or HF radios can be returned to voice communication mode by transferring a voice frequency into the active frequency window.

11.2.9 High Frequency (HF)

To use an HF radio, HF L or HF R is selected on the associated RTP and the desired HF frequency is put in the active frequency window. For normal HF communications, USB mode is used. USB mode is active if the AM switch is not selected (green flowbar extinguished). The HF SENS control can be set as desired for the HF radio being used. One feature peculiar to HF radios is that the antenna must be tuned to the desired frequency before transmitting. Antenna tuning is accomplished by selecting the desired frequency and keying the microphone momentarily (approximately one second). While the antenna is being tuned, a steady or intermittent tone may be heard through the audio system. This may take up to seven seconds, but generally happens very quickly. When the tone is no longer heard, the radio is ready to transmit.
HF L or HF R can be configured for voice or ACARS data communication. The two HF radios share a common antenna. An HF voice transmission disables the opposite side HF radio during transmission. Simultaneous use of both HF radios is limited to receive only. HF radio sensitivity can be adjusted using any radio tuning panel with the receiver selected. Sensitivity control is rendered inoperative by radio tuning panel failure or by pushing the OFF switch.

When an HF transmitter is keyed after a frequency change, the antenna tunes while a continuous or intermittent tone may be heard through the audio system. A tone lasting longer than 7 seconds indicates failure of the system to tune. Data is stored in memory for the last 100 tuned frequencies. Stored frequencies may tune quickly and a tone may not be noticeable.

11.2.10 Satellite Communications (SATCOM)

ACARS uses the SATCOM system when the airplane is beyond VHF communication range. Switching between VHF and SATCOM is automatic. ACARS data is controlled through the control display units (CDUs). The SATCOM system also provides voice communications. Voice transmission is controlled using the CDUs and audio control panels. Calls could be initiated using the CDU. The SATCOM CDU control pages display by selecting SAT on the MENU page.

One SATCOM transceiver (with three channels) is installed on the B747-400. Two channels may be used for voice communications while the third is reserved for data communications. SATCOM is essentially a link into the ground based telephone system using a satellite relay. Selection of SATCOM for data communications is automatic. If VHF radio is not available for data communications, the aircraft Communications Management Unit (CMU) will automatically select SATCOM for data communications.

[30] Both the L and R HF radios share a common antenna. Both radios cannot be used simultaneously for transmitting, but can be used simultaneously for independent receiving.

11.2.11 Selective Calling (SELCAL)

The SELCAL system monitors the VHF and HF radios. When the system receives a call from a ground station, the respective radio CALL light illuminates and a chime sounds. The CALL light is reset by selecting the respective transmitter selector, or by transmitting on that radio.

In addition to providing greater communications range, the HF radios also support SELCAL. To use HF SELCAL, the crew must accomplish a SELCAL check on the first contact with a ground station. The SELCAL check consists of the crew notifying the ground station of the aircraft four letter SELCAL code (located on a placard on the forward instrument panel) and the ground station sending a SELCAL signal to the aircraft. The SELCAL check is successful if the SELCAL aural signal sounds and the appropriate HF CALL light illuminates on each audio control panel. The CALL light is reset by selecting the associated MIC switch or activating the PTT if the MIC switch is already selected. If the SELCAL check was successful, the crew is not required to monitor the HF radios. If communication with the aircraft is necessary, the ground station would SELCAL the aircraft, notifying the flight crew to establish voice communications with the ground station.

11.2.12 Flight Interphone

Communication between the two crew members when the oxygen masks are donned can be conducted via the flight interphone system. Since there is no "hot" mic function on the UPS B747-400, pilots must communicate (through the microphone in their oxygen mask) by pressing the INT position on the control yoke or the INT position on the audio control panel, and listening to each other via the cockpit overhead speakers.[31]

11.2.13 UPS Standard Operating Procedures (SOPS) for Radio Panel Setup and Communications

11.2.13.1 Radio Panel Setups

The following information was based upon input from UPS B747-400 Check Airmen, guidelines defined in the UPS IOE Instructor's Guide, and the UPS Aircraft Operating Manual (AOM).

According to the UPS AOM, below are the checklist items for preflighting the Captain's, Center and First Officer's audio control panels:

LEFT RADIO TUNING PANEL . . . . . SET
Verify OFF light extinguished.
Verify Offside Tuning light extinguished.
Check HF radios in accordance with AOM, Chapter 4 procedures. Do not operate HF radios during or near fueling operations.
CENTER RADIO TUNING PANEL . . . . . SET
Verify OFF light extinguished.
Verify VHF C selected and DATA displayed in ACTIVE frequency display.

[31] The CVR indicates that the UPS flight 006 crew did not use the interphone system to communicate with each other during the accident flight. Please refer to the CVR group report for additional information.

RIGHT RADIO TUNING PANEL . . . . . SET
Verify OFF light extinguished.
Verify Offside Tuning light extinguished.

In normal B747-400 UPS operations, the flight crew would use the VHF L for all ATC (air traffic control) communications, the VHF R set with 121.50 as the active frequency and the standby frequency on VHF R tuned to a future frequency as a reminder (for instance, after receipt of the ATC pre-departure clearance in which a ATC departure frequency was given, the pilots would tune that frequency in on the standby). VHF C would always be used for ACARS data communications.

The Captain's radio tuning panel would have VHF L selected (with the green light illuminated) with the ATC frequencies tuned, and the MIC selected to VHF L to transmit to ATC. The First Officer would have had VHF R (with the green light illuminated) with 121.50 dialed in the active window. Additionally, he would have had the MIC selected to VHF L so as to monitor ATC communications from his audio control panel.

Typically for UPS B747-400F operations, the VHF C is used for ACARS and would display DATA on the center radio tuning panel.

The SATCOM system could be used to dial any conventional phone number; however, UPS policy is that SATCOM may never be used for personal phone calls due to its high cost. SATCOM is not normally used for ATC voice communications. However, the flight crew could establish voice contact with ATC facilities using SATCOM if necessary. An ATC facility directory with phone numbers is included in the SATCOM CDU pages. SATCOM could also be used to contact Flight Control, Maintenance Control or other company facilities if necessary.

11.3 Flight Crew Oxygen[32]

Flight crewmember oxygen masks such as those on UPS6 have two purposes. First, during a cabin depressurization event, the mask provides supplemental oxygen to protect pilots from the effects of hypoxia.[33] The second purpose of the mask is to provide protective breathing at 100 percent oxygen during a smoke, fire or fumes event.

14 Code of Federal Regulations (CFR) Part 25.1429 states:

> "Protective breathing equipment.
> (a) Fixed (stationary, or built in) protective breathing equipment must be installed for the use of the flight crew, and at least one portable protective breathing equipment shall be

[32] Source: Boeing 747 Flight Crew Operations Manual, pages 1.40.09 through 1.40.12, and Boeing 747-400 Aircraft Maintenance Manual (AMM).

[33] According to the Federal Aviation Administration's *Pilot's Handbook of Aeronautical Knowledge*, FAA-H-8083-25A, Chapter 16, "Aeromedical Factors," hypoxia means "reduced oxygen," or "not enough oxygen." Although any tissue will die if deprived of oxygen for a period of time, the brain is particularly vulnerable to oxygen deprivation; any reduction in mental function while flying can result in life-threatening errors. Symptoms of hypoxia commonly include headache, decreased reaction time, impaired judgment, euphoria, visual impairment, and drowsiness.

located at or near the flight deck for use by a flight crewmember. In addition, portable protective breathing equipment must be installed for the use of appropriate crewmembers for fighting fires in compartments accessible in flight other than the flight deck. This includes isolated compartments and upper and lower lobe galleys, in which crewmember occupancy is permitted during flight. Equipment must be installed for the maximum number of crewmembers expected to be in the area during any operation.
(b) For protective breathing equipment required by paragraph (a) of this section or by the applicable Operating Regulations:
(1) The equipment must be designed to protect the appropriate crewmember from smoke, carbon dioxide, and other harmful gases while on flight deck duty or while combating fires.
(2) The equipment must include—
(i) Masks covering the eyes, nose and mouth, or
(ii) Masks covering the nose and mouth, plus accessory equipment to cover the eyes.
(3) Equipment, including portable equipment, must allow communication with other crewmembers while in use. Equipment available at flight crew assigned duty stations must also enable the flight crew to use radio equipment.
(4) The part of the equipment protecting the eyes shall not cause any appreciable adverse effect on vision and must allow corrective glasses to be worn.
(5) The equipment must supply protective oxygen of 15 minutes duration per crewmember at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD. The equipment and system must be designed to prevent any inward leakage to the inside of the device and prevent any outward leakage causing significant increase in the oxygen content of the local ambient atmosphere. If a demand oxygen system is used, a supply of 300 liters of free oxygen at 70[deg] F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. If a continuous flow open circuit protective breathing system is used, a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70[deg] F. and 760 mm. Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. Continuous flow systems must not increase the ambient oxygen content of the local atmosphere above that of demand systems. BTPD refers to body temperature conditions (that is, 37[deg] C., at ambient pressure, dry).”

11.3.1 Oxygen Supply Requirements

11.3.1.1 Supplemental Breathing Requirements

14 CFR Part 121.333(b) states in part:

> *“Crewmembers.* When operating at flight altitudes above 10,000 feet, the certificate holder shall supply enough oxygen to comply with §121.329, but not less than a two-hour supply for each flight crewmember on flight deck duty. The required two hours supply is that quantity of oxygen necessary for a constant rate of descent from the airplane's maximum certificated operating altitude to 10,000 feet in ten minutes and followed by 110 minutes at 10,000 feet. The oxygen required in the event of cabin pressurization failure by §121.337

may be included in determining the supply required for flight crewmembers on flight deck duty."

11.3.1.1.1.1 UPS Minimum O2 Requirements[34]

Chapter 5.2 of the UPS AOM provides information on the minimum oxygen dispatch pressures for the B747-400F and B747-400BCF. With the exception of flights over route L888 in China and South Pacific from the U.S. west coast to Hawaii and Hawaii to Australia and Asia[35], the tables provided minimum dispatch oxygen pressures for flight crew and supernumeraries for domestic and international operations.

For the B747-400F, the minimum oxygen dispatch pressures are as follows:

CREW OXYGEN		
Number of Crew	120 Mins (PSI)	180 Mins (PSI)
2	480	671
3	662	922
4	825	1200

SUPERNUMERARY OXYGEN (Aircraft With Diluter-Demand Masks Installed)		
Number of Supernumeraries	120 Mins (PSI)	180 Mins (PSI)
2	480	671
3	662	922
4	875	1200

SUPERNUMERARY OXYGEN (Aircraft With Passenger-Type Masks Installed)		
Number of Supernumeraries	120 Mins (PSI)	180 Mins (PSI)
4	400	540

[36]

For UPS6, the minimum oxygen pressure was 480 PSI.[37] The following note and assumptions to the above values are made:

[34] See Attachment 46 - UPS B747-400 Minimum O2 Requirements.
[35] According to the UPS AOM, route L888 over China and South Pacific from the U.S. west coast to Hawaii and Hawaii to Australia and Asia would require 180 minutes of oxygen supply for flight crew and supernumeraries.
[36] Source: UPS AOM, Chapter 5.2, Page 3. See Attachment 46 - UPS B747-400 Minimum O2 Requirements.
[37] Pounds per square inch.

NOTE: If descent to an altitude below 25,000 feet is accomplished (and 100% oxygen is no longer required), each occupant should select the NORMAL/100% switch to NORMAL (Diluter-demand masks) in order to meet published oxygen duration requirements.

Data is based on the following assumptions:

- For crew system, published number of crewmembers.
- For supernumerary system, published number of supernumeraries plus Lav and Crew Rest.
- Regulators on 100% flow (Diluter-demand masks).
- Lavatory and crew rest oxygen is shut off when supernumeraries return to seats.
- Maintaining 25,000 feet.
- Pressure is average of 3 bottles (4 bottles for supernumerary system).
- Ambient temperature is 70°F.

[38]

11.3.2 Protective Breathing Requirements

14 CFR Part 121.337(b) states:

"*Pressurized and non-pressurized cabin airplanes.* Except as provided in paragraph (f) of this section, no person may operate an airplane unless protective breathing equipment meeting the requirements of this section is provided as follows:
(1) *General.* The equipment must protect the flight crew from the effects of smoke, carbon dioxide or other harmful gases or an oxygen deficient environment caused by other than an airplane depressurization while on flight deck duty and must protect crewmembers from the above effects while combating fires on board the airplane.
(2) The equipment must be inspected regularly in accordance with inspection guidelines and the inspection periods established by the equipment manufacturer to ensure its condition for continued serviceability and immediate readiness to perform its intended emergency purposes. The inspection periods may be changed upon a showing by the certificate holder that the changes would provide an equivalent level of safety.
(3) That part of the equipment protecting the eyes must not impair the wearer's vision to the extent that a crewmember's duties cannot be accomplished and must allow corrective glasses to be worn without impairment of vision or loss of the protection required by paragraph (b)(1) of this section.
(4) The equipment, while in use, must allow the flight crew to communicate using the airplane radio equipment and to communicate by interphone with each other while at their assigned duty stations. The equipment, while in use, must also allow crewmember interphone communications between each of two flight crewmember stations in the pilot compartment and at least one normal flight attendant station in each passenger compartment.
(5) The equipment, while in use, must allow any crewmember to use the airplane

[38] Source: UPS AOM, Chapter 5.2, Page 3. See Attachment 46 - UPS B747-400 Minimum O2 Requirements.

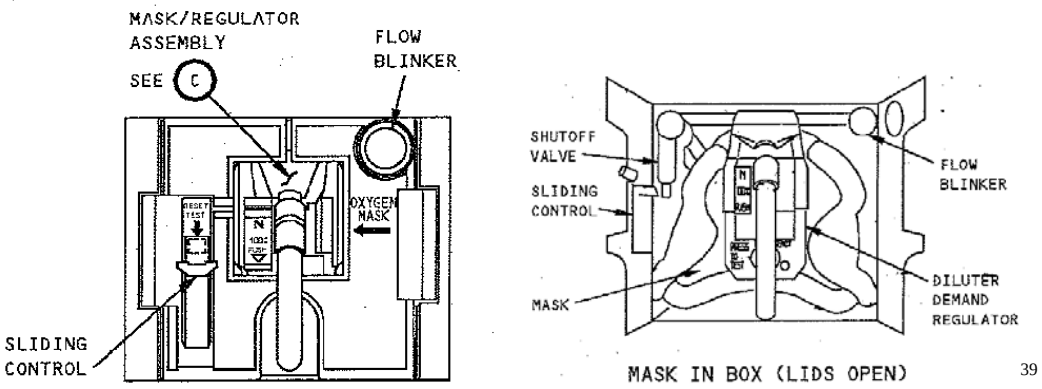
interphone system at any of the flight attendant stations referred to in paragraph (b)(4) of this section.
(6) The equipment may also be used to meet the supplemental oxygen requirements of this part provided it meets the oxygen equipment standards of Sec. 121.335 of this part.
(7) Protective breathing gas duration and supply system equipment requirements are as follows:
(i) The equipment must supply breathing gas for 15 minutes at a pressure altitude of 8,000 feet for the following:
(A) Flight crewmembers while performing flight deck duties; and
(B) Crewmembers while combating an in-flight fire.
(ii) The breathing gas system must be free from hazards in itself, in its method of operation, and in its effect upon other components.
(iii) For breathing gas systems other than chemical oxygen generators, there must be a means to allow the crew to readily determine, during the equipment preflight described in paragraph (c) of this section, that the gas supply is fully charged.
(iv) For each chemical oxygen generator, the supply system equipment must meet the requirements of Sec. 25.1450 (b) and (c) of this chapter.
(8) *Smoke and fume protection.* Protective breathing equipment with a fixed or portable breathing gas supply meeting the requirements of this section must be conveniently located on the flight deck and be easily accessible for immediate use by each required flight crewmember at his or her assigned duty station.
(9) *Fire combating.* Except for nontransport category airplanes type certificated after December 31, 1964, protective breathing equipment with a portable breathing gas supply meeting the requirements of this section must be easily accessible and conveniently located for immediate use by crewmembers in combating fires as follows:
(i) One PBE is required for each hand fire extinguisher located for use in a galley other than a galley located in a passenger, cargo, or crew compartment.
(ii) One on the flight deck, except that the Administrator may authorize another location for this PBE if special circumstances exist that make compliance impractical and the proposed deviation would provide an equivalent level of safety.
(iii) In each passenger compartment, one for each hand fire extinguisher required by Sec. 121.309 of this part, to be located within 3 feet of each required hand fire extinguisher, except that the Administrator may authorize a deviation allowing locations of PBE more than 3 feet from required hand fire extinguisher locations if special circumstances exist that make compliance impractical and if the proposed deviation provides an equivalent level of safety."

11.4 B747-400 Oxygen System

Two independent oxygen systems are provided, one for the flight crew and one for the supernumeraries. Portable oxygen cylinders are located in the supernumerary cabin for emergency use. Oxygen pressure displays on the EICAS STATUS page.

The flight crew oxygen system uses quick-donning diluter-demand masks located at each crew station. Oxygen flow is controlled by a regulator mounted on each mask. The Captain and First Officer's masks have automatic pressure breathing regulators.

11.4.1 Mask Stowage Box



[39]

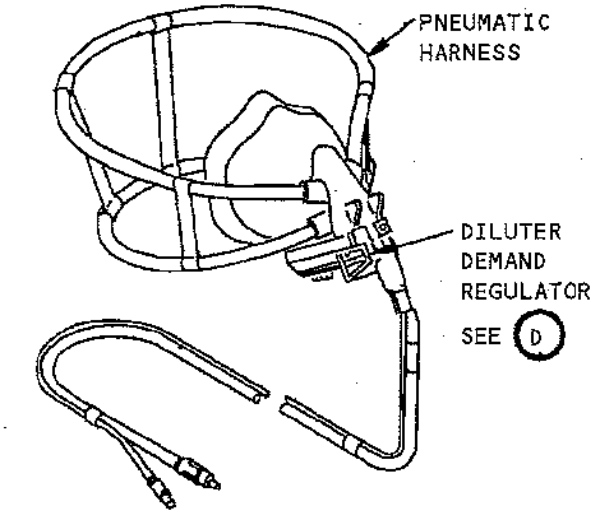
A mask stowage box is located at each crew station. The box provides stowage for the mask/regulator and controls flow of oxygen to the mask/regulator. The box contains a sliding control, a shutoff valve, left and right lids and a flow blinker. The sliding control automatically keeps the shutoff valve in the closed position when the mask/regulator is stowed and both lids are closed.

Holding the sliding control in TEST allows the mask/regulator to be tested when in the stowed position. The inner part of the sliding control has a white flag marked OXY-ON. The left lid controls the shutoff valve when the mask/regulator is removed from the box. The left lid also moves the sliding control's white flag to the exposed position when the mask/regulator is removed and the left lid is closed.

The flow blinker contains a yellow diaphragm and a black diaphragm. When oxygen flow occurs, the yellow diaphragm is pushed up against the black diaphragm causing a yellow cross to appear.

[39] Boeing AMM, Configuration 1, Page 5.

11.4.2 Mask Regulator Assembly



[40]

12.0 B747-400 Checklists

12.1 FAA 8900.1, Manuals, Procedures, and Checklists for 14CFR Parts 91K, 121, 125, and 135 (excerpts)[41]

This section FAA Order 8900 contains direction and guidance to be used by principal operations inspectors (POI) in the evaluation of flight manuals for Title 14 of the Code of Federal Regulation (14 CFR) part 121 and 135 operators. Part 121, § 121.141 requires that part 121 operators maintain a current flight manual for each aircraft used in their air transportation operations. Title 14 CFR part 135, § 135.81(c) requires that part 135 operators maintain a current flight manual (or the equivalent information for certain aircraft certified without a flight manual) for each aircraft used in their air transportation operations. 14 CFR part 91, § 91.9 requires that a flight manual (or the equivalent information for aircraft certified without a flight manual) be available in the aircraft for flightcrew personnel use and guidance during flight operations.

To satisfy the part 121 and 135 requirements, operators may use either the approved airplane flight manual (AFM) or the approved rotorcraft flight manual (RFM), as applicable, or they may develop, obtain approval for, and use a company flight manual (CFM). AFMs or RFMs (as applicable) are acceptable for satisfying the regulations in cases of small, simple aircraft. The Federal Aviation Administration (FAA)-preferred practice for all other aircraft, however, is for operators to develop a CFM which includes procedures specifically tailored to the operator's operations. Operators who operate multiple aircraft types usually find it efficient to collect policies, procedures, and guidance common to all aircraft in a single manual such as a flight operations policy manual (FOPM). In this case, the CFM contains only those policies, procedures, and guidance that apply to the operation of the specific aircraft. POIs shall use this section as guidance when evaluating an operator's AFMs, RFMs, or CFMs.

[40] Source: Boeing AMM, Configuration 1, Page 5.
[41] See Attachment 37: FAA Order 8900.1.

The procedures section of an AFM of complex aircraft is typically not suitable for flightcrew use in air transportation operations. The certification regulations only require that the procedures section of an AFM or RFM contain specific and detailed procedural information related to the unique characteristics of the aircraft. These manuals are not required to contain each and every procedure necessary to operate the aircraft. Most manufacturers of complex aircraft develop and have approved only those procedures necessary to certify the aircraft. The certification regulations do not require that procedural information be expressed in sequential, step-by-step format suitable for publication in a checklist. AFM procedural information may be supplied in narrative format. POIs must ensure that operators have rewritten such AFM procedures to make them suitable for flightcrew use in part 121 and 135 operations.

POIs should not construe procedures published in an AFM or RFM to be the only or best means of accomplishing a specific objective. Because AFM or RFM procedures are formulated primarily for aircraft certification purposes, POIs should encourage operators to develop procedures appropriate to revenue operations for inclusion in a CFM.

Procedural information included in a CFM must be presented in a step-by-step format. A procedural step in an AFM or RFM procedure must be included in the equivalent CFM procedure, unless the POI approves the deletion through the process described in subparagraph I that follows.

POIs may approve combined procedural steps. For example, an AFM or RFM procedure specifies a two-step procedure such as the following: Step 1—Smoke Goggles On, and Step 2—O2 Mask On. The POI could approve a one-step procedure such as the following: Step 1. Smoke Goggles and O2 Mask On. If there is a specific reason, however, for not combining the steps, the POI must not approve such combinations. For instance, if in the previous example, for some reason the smoke goggle has to be put in place before the O2 mask can be put into place, the two-step procedure should be retained.

POIs may approve an arrangement of procedural steps in a different sequence from the sequence in the AFM or RFM, and may approve the combination of similar procedures into a single procedure.

The POI will require the operator to present evidence that newly developed procedures are effective. This may be done by analysis, documentation, or validation tests. Tests may be conducted by the manufacturer, the operator, or another competent party (such as a contractor). The POI or a designated inspector qualified in the aircraft must evaluate the effectiveness of such tests.

When an operator proposes to modify a nonnormal or emergency procedure, the operator must show that the modified procedure does not adversely affect the airworthiness of the aircraft. The operator may establish the safety and effectiveness of proposed procedures by analysis, documentation, or validation tests.

POIs must contact the applicable Aircraft Evaluation Group (AEG) and obtain concurrence before approving deletion of an item or the rearrangement of items on these checklists. AEG concurrence may be expressed informally (by telephone). AEG concurrence is not required if the operator provides evidence that the AEG has already concurred with the identical procedure for another party (such as another operator or manufacturer).

Certain situations that either require or appear to require immediate action have proven to be a stimulus for evoking incorrect and inappropriate flightcrew actions. Therefore, immediate action items must be strictly limited to only those actions necessary to stabilize the situation.

POIs may approve an operator's proposal to replace immediate action items in an AFM or RFM procedure with challenge-do-verify (CDV) checklist procedures in a CFM, provided the operator shows compliance with the criteria in this paragraph and also demonstrates an equivalent level of safety through validation tests.

12.2 Fire Main Deck Checklist

12.2.1 Airplane Flight Manual (AFM) Version

F I R E

FIRE CARGO (Class C compartments)

If the EICAS message FIRE CARGO FWD/AFT is displayed, push the affected cargo fire extinguisher arming switch to ARMED and discharge the cargo fire bottles. Set the landing altitude selector between 8000 and 8500 feet.

FIRE MAIN DECK (Class E compartments)

Upon detection of fire or smoke on the main deck use the following procedure:

Oxygen masks and regulators - ON 100%
Smoke goggles (if required) - ON
Supernumerary oxygen switch (if required) - ON
Crew communications - ESTABLISH
ARM switch to main deck - Depress
DISCH/DEPRESS switch - Depress

Climb or descend, as required, to obtain 25,000 feet pressure altitude.

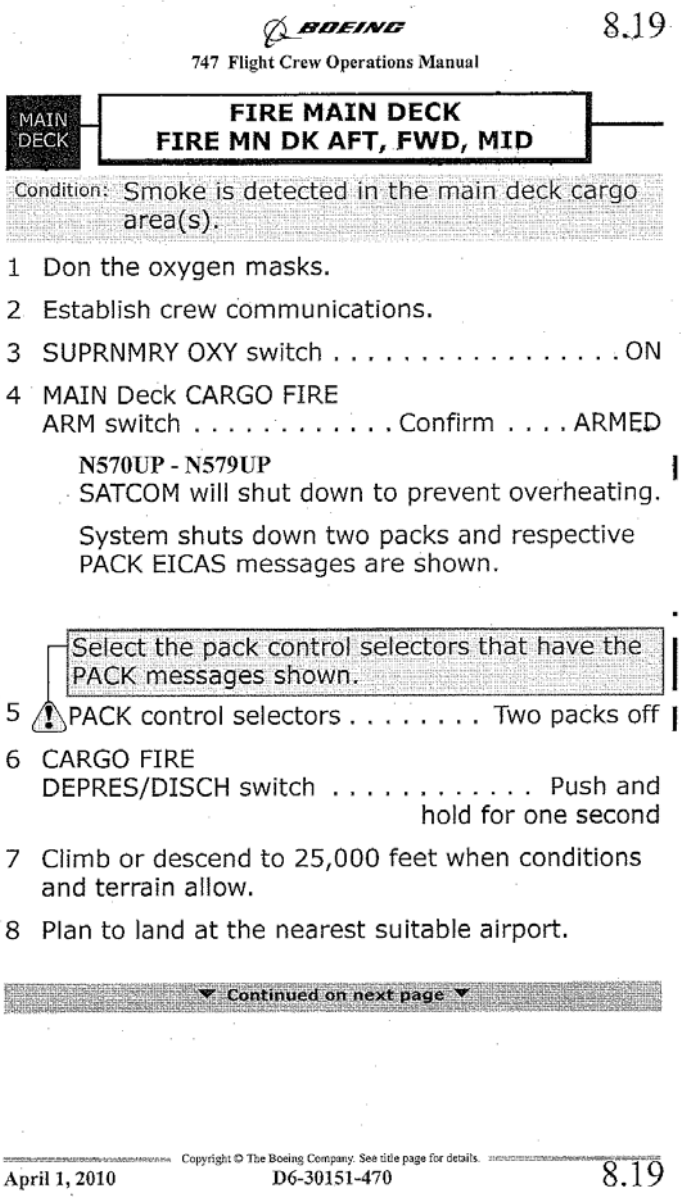
Land at the nearest suitable airport.

FIRE WHEEL WELL

If the EICAS message FIRE WHEEL WELL is displayed, move the landing gear lever to the down position at V_{LO} or lower.

If the landing gear must be retracted for airplane performance, the landing gear may be retracted 20 minutes after the FIRE WHEEL WELL message is no longer displayed.

12.2.2 Boeing Version



BOEING 8.19

747 Flight Crew Operations Manual

MAIN DECK

FIRE MAIN DECK
FIRE MN DK AFT, FWD, MID

Condition: Smoke is detected in the main deck cargo area(s).

1 Don the oxygen masks.

2 Establish crew communications.

3 SUPRNMRY OXY switch . . . . . ON

4 MAIN Deck CARGO FIRE ARM switch . . . . . Confirm . . . . ARMED

N570UP - N579UP
SATCOM will shut down to prevent overheating.

System shuts down two packs and respective PACK EICAS messages are shown.

Select the pack control selectors that have the PACK messages shown.

5 ⚠ PACK control selectors . . . . . Two packs off

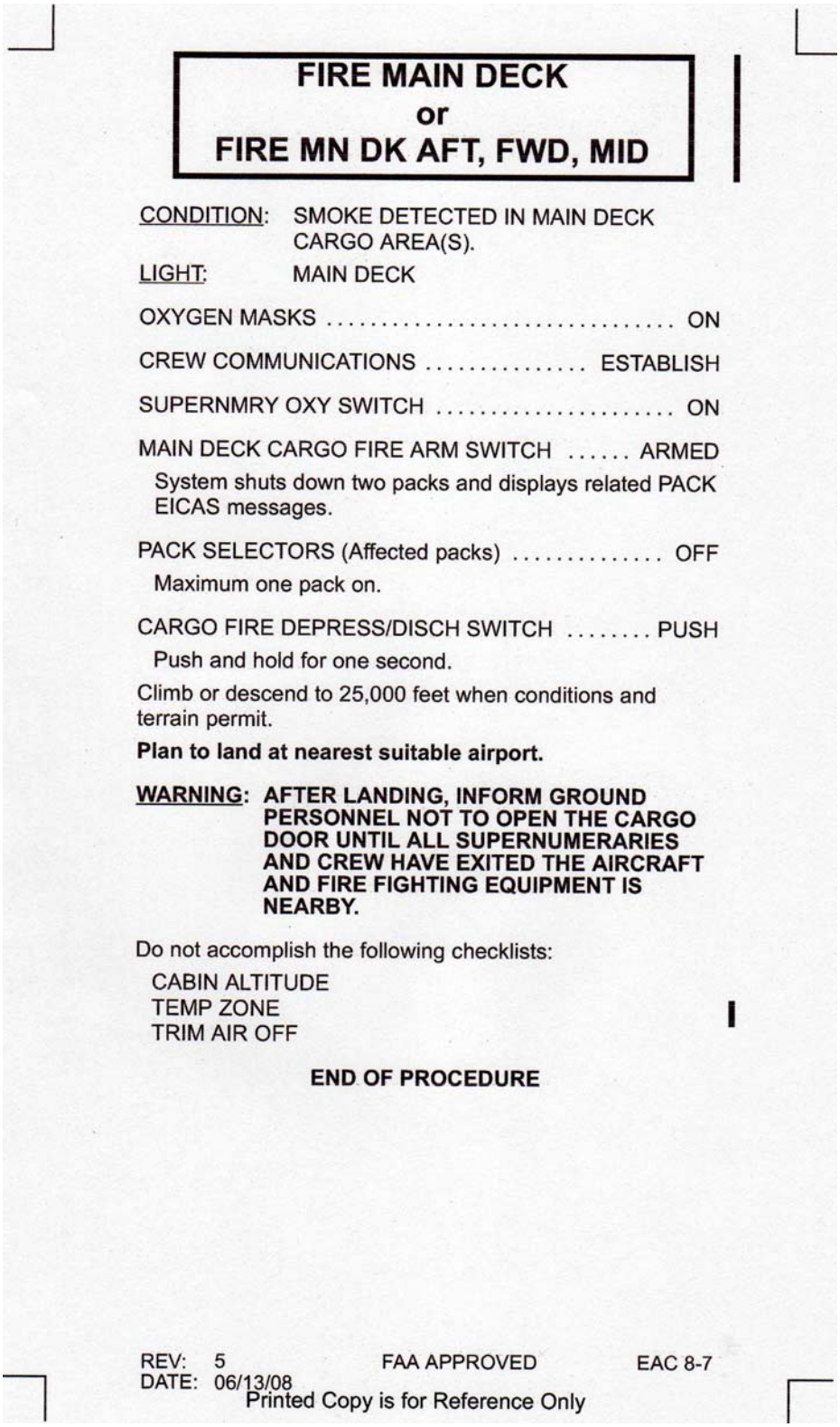
6 CARGO FIRE DEPRES/DISCH switch . . . . . Push and hold for one second

7 Climb or descend to 25,000 feet when conditions and terrain allow.

8 Plan to land at the nearest suitable airport.

Continued on next page

12.2.3 UPS Version



FIRE MAIN DECK
or
FIRE MN DK AFT, FWD, MID

CONDITION: SMOKE DETECTED IN MAIN DECK CARGO AREA(S).

LIGHT: MAIN DECK

OXYGEN MASKS ..... ON

CREW COMMUNICATIONS ..... ESTABLISH

SUPERNMRY OXY SWITCH ..... ON

MAIN DECK CARGO FIRE ARM SWITCH ..... ARMED

System shuts down two packs and displays related PACK EICAS messages.

PACK SELECTORS (Affected packs) ..... OFF

Maximum one pack on.

CARGO FIRE DEPRESS/DISCH SWITCH ..... PUSH

Push and hold for one second.

Climb or descend to 25,000 feet when conditions and terrain permit.

Plan to land at nearest suitable airport.

WARNING: AFTER LANDING, INFORM GROUND PERSONNEL NOT TO OPEN THE CARGO DOOR UNTIL ALL SUPERNUMERARIES AND CREW HAVE EXITED THE AIRCRAFT AND FIRE FIGHTING EQUIPMENT IS NEARBY.

Do not accomplish the following checklists:

CABIN ALTITUDE
TEMP ZONE
TRIM AIR OFF

END OF PROCEDURE

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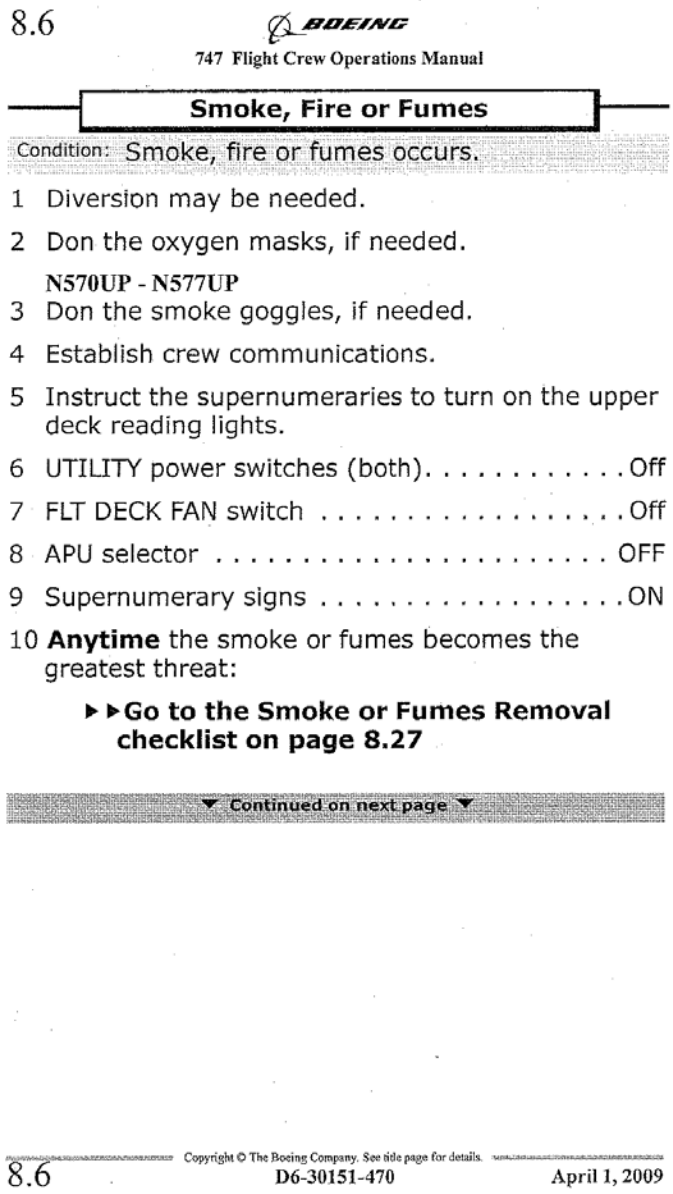
12.3 Smoke, Fire or Fumes Checklist

12.3.1 Boeing Version



8.6

747 Flight Crew Operations Manual

Smoke, Fire or Fumes

Condition: Smoke, fire or fumes occurs.

1 Diversion may be needed.

2 Don the oxygen masks, if needed.

N570UP - N577UP

3 Don the smoke goggles, if needed.

4 Establish crew communications.

5 Instruct the supernumeraries to turn on the upper deck reading lights.

6 UTILITY power switches (both). . . . . Off

7 FLT DECK FAN switch . . . . . Off

8 APU selector . . . . . OFF

9 Supernumerary signs . . . . . ON

10 **Anytime** the smoke or fumes becomes the greatest threat:

▶▶**Go to the Smoke or Fumes Removal checklist on page 8.27**

▼ Continued on next page ▼

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▼ Smoke, Fire or Fumes continued ▼

11 Choose one:

- Source of the smoke, fire or fumes **is** obvious **and can** be extinguished quickly:

  Isolate and extinguish the source of the smoke, fire or fumes.

  If possible, remove power from the affected equipment by switch or circuit breaker in the flight deck or upper deck.

  ▶▶**Go to step 12**

- Source of the smoke, fire or fumes is **not** obvious **or can not** be extinguished quickly:

  ▶▶**Go to step 13**

12 Choose one:

- Source **is** visually confirmed to be extinguished **and** smoke or fumes are **decreasing**:

  Continue the flight at the Captain's discretion.

  Restore unpowered items at the Captain's discretion.

  ▶▶**Go to step 24**

- Source **is not** visually confirmed extinguished **or** smoke or fumes **continue**:

  ▶▶**Go to step 13**

▼ Continued on next page ▼

▼ Smoke, Fire or Fumes continued ▼

13 Divert to the nearest suitable airport while continuing the checklist.

14 Consider an immediate landing if the smoke, fire or fumes situation becomes uncontrollable.

15 Do not delay landing in an attempt to complete the following steps.

16 ISLN valve switches (both) . . . . . Off

This isolates the left and right sides of the bleed air system.

17 PACK 2 control selector . . . . . OFF

18 **Wait** 2 minutes unless the smoke or fumes are increasing. This allows time for the smoke or fumes to clear.

19 Choose one:

◆Smoke or fumes **continue or are increasing**:

PACK 3 control selector . . . . . OFF

Wait 2 minutes unless the smoke or fumes are increasing. This allows time for the smoke or fumes to clear.

▸▸Go to step 20

◆Smoke or fumes are **decreasing**:

▸▸Go to step 24

▼ Continued on next page ▼

▼ Smoke, Fire or Fumes continued ▼

20 Choose one:

◆Smoke or fumes **continue or are increasing**:

PACK 3 control selector . . . . . .NORM

PACK 1 control selector . . . . . OFF

R ISLN valve switch . . . . . On

▶▶**Go to step 21**

◆Smoke or fumes are **decreasing**:

L ISLN valve switch . . . . . On

▶▶**Go to step 21**

21 PACK 2 control selector . . . . . .NORM

22 **Wait** 2 minutes unless the smoke or fumes are increasing. This allows time for the smoke or fumes to clear.

23 Choose one:

◆Smoke or fumes **continue or are increasing**:

ISLN valve switches (both) . . . . . On

PACK 1 control selector . . . . . .NORM

Consider an immediate landing.

▶▶**Go to step 24**

◆Smoke or fumes are **decreasing**:

▶▶**Go to step 24**

▼ Continued on next page ▼

▼ Smoke, Fire or Fumes continued ▼

24 Do **not** accomplish the following checklists:

N570UP - N577UP, N580UP, N581UP
CARGO DET AIR

ELEC UTIL BUS L, R

FUEL OVRD 2, 3 FWD

FUEL PRESS CTR L

FUEL PUMP 2, 3 FWD

TEMP ZONE

TRIM AIR OFF

▶▶Go to the Smoke or Fumes Removal checklist on page 8.27, if needed

■ ■ ■ ■

>BOTTLE LOW APU

Condition: The APU fire bottle pressure is low.

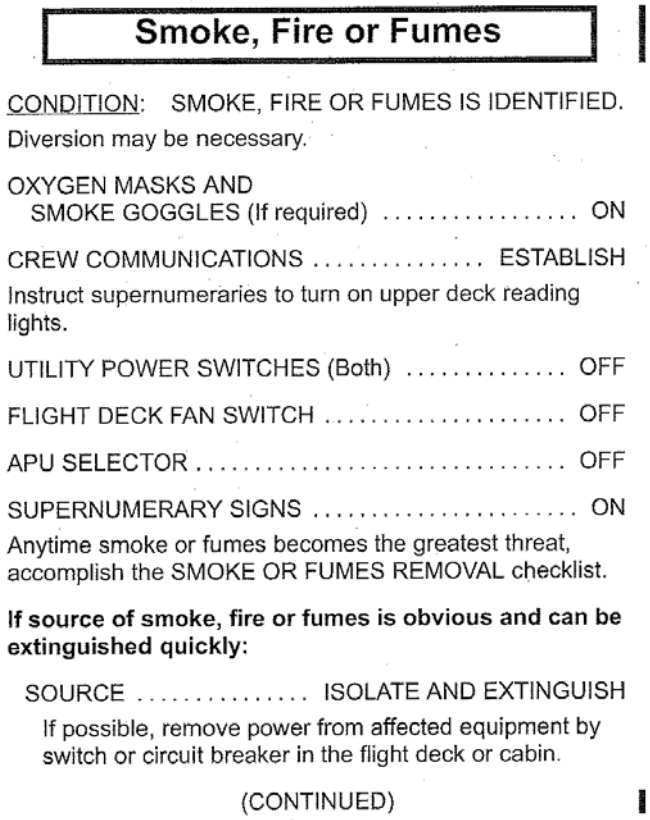
■ ■ ■ ■

>BTL LO L ENG A, B

Condition: The left wing fire bottle A or B pressure is low.

■ ■ ■ ■

12.3.2 UPS Version



Smoke, Fire or Fumes

CONDITION: SMOKE, FIRE OR FUMES IS IDENTIFIED.

Diversion may be necessary.

OXYGEN MASKS AND
SMOKE GOGGLES (If required) ..... ON

CREW COMMUNICATIONS ..... ESTABLISH

Instruct supernumeraries to turn on upper deck reading lights.

UTILITY POWER SWITCHES (Both) ..... OFF

FLIGHT DECK FAN SWITCH ..... OFF

APU SELECTOR ..... OFF

SUPERNUMERARY SIGNS ..... ON

Anytime smoke or fumes becomes the greatest threat, accomplish the SMOKE OR FUMES REMOVAL checklist.

If source of smoke, fire or fumes is obvious and can be extinguished quickly:

SOURCE ..... ISOLATE AND EXTINGUISH

If possible, remove power from affected equipment by switch or circuit breaker in the flight deck or cabin.

(CONTINUED)

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Smoke, Fire or Fumes (Cont'd)

If both of the following are true:

- The source is visually confirmed to be extinguished, and
- The smoke or fumes are decreasing.

Continue flight at the Captain's discretion.

Restore unpowered items at the Captain's discretion.

Accomplish SMOKE OR FUMES REMOVAL checklist if necessary.

END OF PROCEDURE

Initiate a diversion to the nearest suitable airport while continuing the checklist.

Consider an immediate landing if smoke, fire or fumes situation becomes uncontrollable.

WARNING: DO NOT DELAY LANDING IN AN ATTEMPT TO COMPLETE ALL OF THE FOLLOWING STEPS.

ISOLATION VALVE SWITCHES ..... OFF

PACK 2 SELECTOR ..... OFF

Wait two minutes unless smoke or fumes are increasing.

If smoke or fumes continue or are increasing:

PACK 3 SELECTOR ..... OFF

Wait two minutes unless smoke or fumes are increasing.

If smoke or fumes continue or are increasing:

PACK 3 SELECTOR ..... NORM

PACK 1 SELECTOR ..... OFF

RIGHT ISOLATION VALVE SWITCH ..... ON

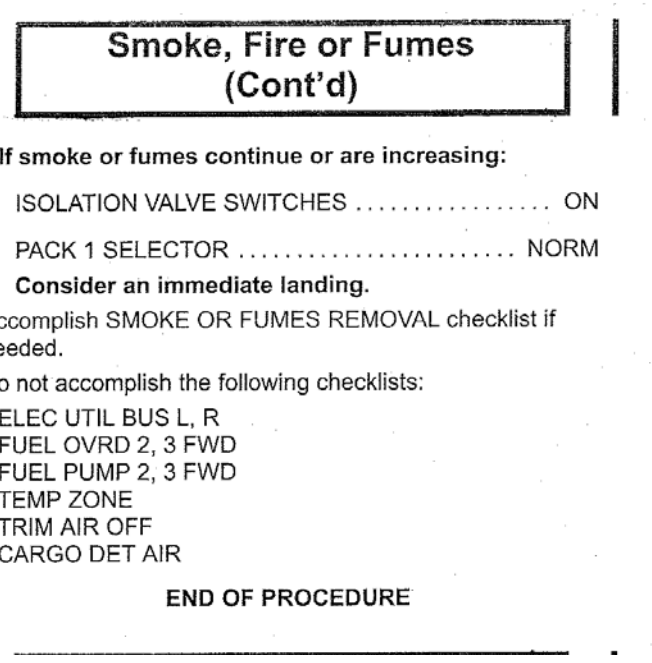
If smoke or fumes stop:

LEFT ISOLATION VALVE SWITCH ..... ON

PACK 2 SELECTOR ..... NORM

Wait two minutes unless smoke or fumes are increasing.

(CONTINUED)



Smoke, Fire or Fumes (Cont'd)

If smoke or fumes continue or are increasing:

ISOLATION VALVE SWITCHES ..... ON

PACK 1 SELECTOR ..... NORM

Consider an immediate landing.

Accomplish SMOKE OR FUMES REMOVAL checklist if needed.

Do not accomplish the following checklists:

ELEC UTIL BUS L, R
FUEL OVRD 2, 3 FWD
FUEL PUMP 2, 3 FWD
TEMP ZONE
TRIM AIR OFF
CARGO DET AIR

END OF PROCEDURE

12.3.2.1 UPS "Immediate Landing Required"

The UPS B747-400 AOM provides the following clarification of the phrase "Immediate Landing Required" found in the UPS "Smoke, Fire or Fumes" checklist:

IMMEDIATE LANDING REQUIRED

The SMOKE, FIRE OR FUMES non-normal checklist includes the phrase **"Consider an immediate landing"** under certain conditions. This phrase indicates that conditions have deteriorated and the risks associated with the approach, landing or post-landing are exceeded by the risk of the onboard situation. The crew shall proceed immediately to the nearest landing site.

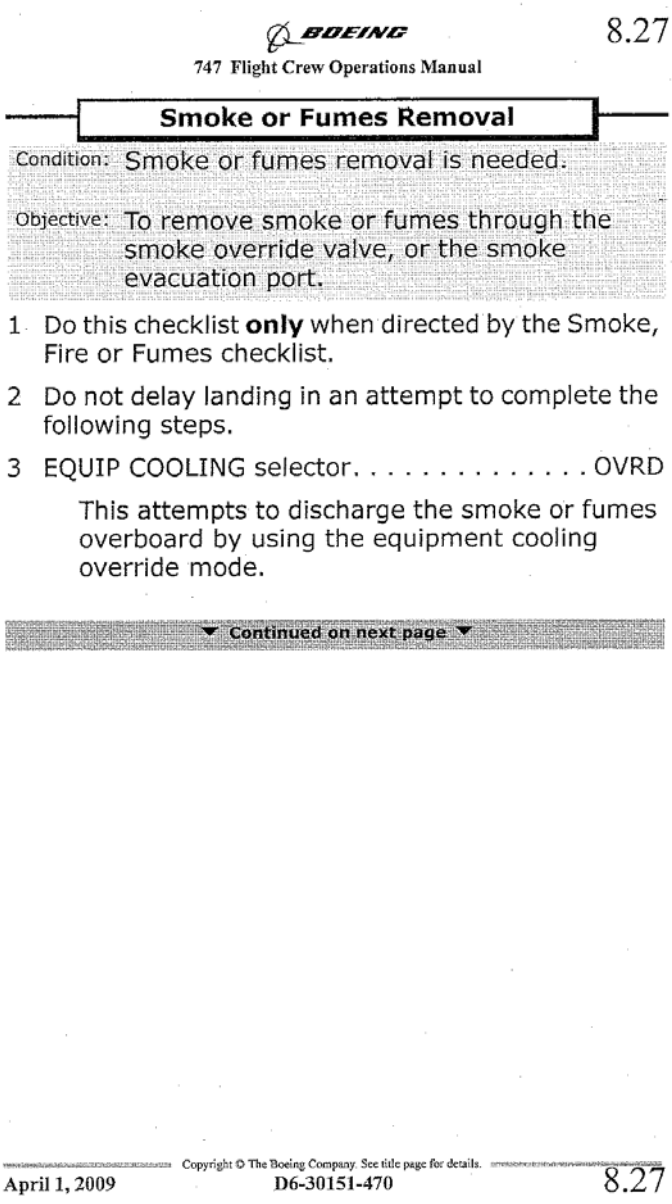
"Consider an immediate landing" implies an immediate diversion to a runway. However, the smoke, fire or fumes situation may be severe enough that the Captain should consider an overweight landing, a tailwind landing, an off-airport landing or ditching, as appropriate.

[42]

[42] Source: UPS B747-400 AOM, Chapter 2, INTRO 5. See also Attachment 45 - Safety of Flight Reference.

12.4 Smoke or Fumes Removal Checklist

12.4.1 Boeing Version



BOEING 8.27

747 Flight Crew Operations Manual

Smoke or Fumes Removal

Condition: Smoke or fumes removal is needed.

Objective: To remove smoke or fumes through the smoke override valve, or the smoke evacuation port.

1 Do this checklist **only** when directed by the Smoke, Fire or Fumes checklist.

2 Do not delay landing in an attempt to complete the following steps.

3 EQUIP COOLING selector. . . . . OVRD

This attempts to discharge the smoke or fumes overboard by using the equipment cooling override mode.

Continued on next page

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▼ Smoke or Fumes Removal continued ▼

4 Choose one:

- Smoke or fumes does **not** continue and is **not** severe:

  ▸▸**Go to the Smoke, Fire or Fumes checklist on page 8.6 and do the remaining steps**

  ■ ■ ■ ■

- Smoke or fumes **continues or** is **severe** and the smoke or fumes source is determined to be on the **flight deck**:

  Pull the smoke evacuation handle. Pulling the smoke evacuation handle when smoke or fumes source is not on the flight deck may bring the smoke or fumes into the flight deck.

  ▸▸**Go to the Smoke, Fire or Fumes checklist on page 8.6 and do the remaining steps**

  ■ ■ ■ ■

- Smoke or fumes **continues or** is **severe** and the smoke or fumes source is determined to be in the **cabin**:

  ▸▸**Go to step 5**

5 LDG ALT switch . . . . . MAN

▼ Continued on next page ▼

▼ Smoke or Fumes Removal continued ▼

6 LDG ALT selector . . . . . Set the landing altitude between 8000 and 8500 to command the cabin altitude to 8,000 feet.

7 EQUIP COOLING selector. . . . . .NORM

8 Start a descent. Level off at the lowest safe altitude or 8,500 feet, whichever is higher.

9 OUTFLOW VALVES MAN switches (both) . . . . .ON

10 OUTFLOW VALVES manual control . . . . . OPEN

11 Do **not** accomplish the following checklists:

CABIN ALT AUTO

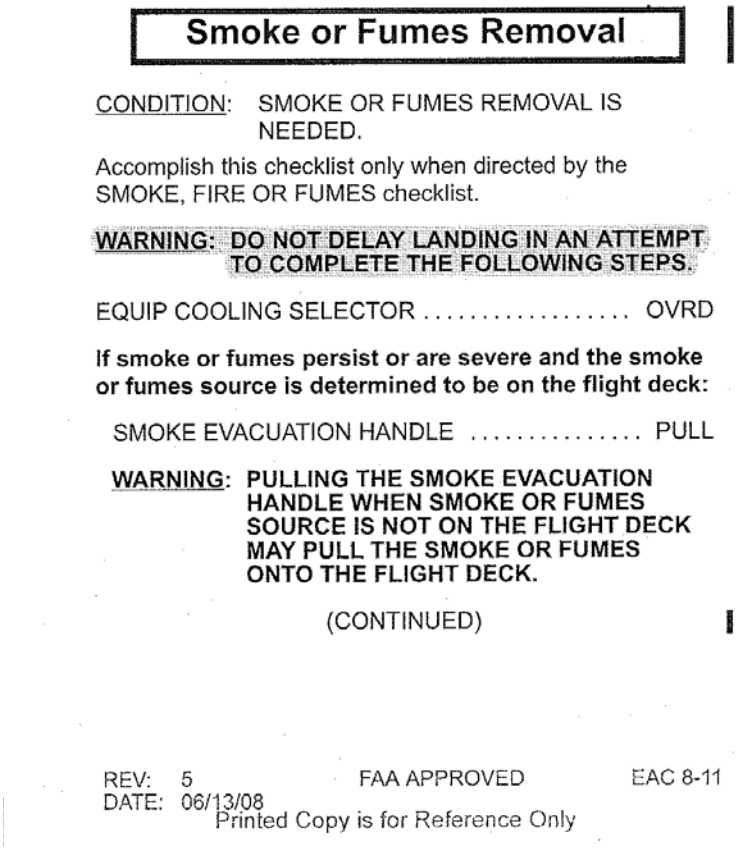
LANDING ALT

OUTFLOW VLV L, R

▸▸Go to the Smoke, Fire or Fumes checklist on page 8.6 and do the remaining steps

■ ■ ■ ■

12.4.2 UPS Version



Smoke or Fumes Removal

CONDITION: SMOKE OR FUMES REMOVAL IS NEEDED.

Accomplish this checklist only when directed by the SMOKE, FIRE OR FUMES checklist.

WARNING: DO NOT DELAY LANDING IN AN ATTEMPT TO COMPLETE THE FOLLOWING STEPS.

EQUIP COOLING SELECTOR ..... OVRD

If smoke or fumes persist or are severe and the smoke or fumes source is determined to be on the flight deck:

SMOKE EVACUATION HANDLE ..... PULL

WARNING: PULLING THE SMOKE EVACUATION HANDLE WHEN SMOKE OR FUMES SOURCE IS NOT ON THE FLIGHT DECK MAY PULL THE SMOKE OR FUMES ONTO THE FLIGHT DECK.

(CONTINUED)

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Smoke or Fumes Removal (Cont'd)

Return to SMOKE, FIRE OR FUMES checklist and complete remaining steps.

END OF PROCEDURE

If smoke or fumes is severe and the smoke or fumes source is determined to be on upper deck:

LDG ALT SWITCH ..... MAN

LDG ALT CONTROL ..... SET 8,000 - 8,500 FEET

Set landing altitude between 8,000 and 8,500 to command cabin altitude to 8,000 feet.

EQUIP COOLING SELECTOR ..... NORM

DESCENT ..... ACCOMPLISH

Level off at the lowest safe altitude or 8,500 feet, whichever is higher.

OUTFLOW VALVE MAN SWITCHES (Both) ..... ON

OUTFLOW VALVES MAN CONTROL ..... OPEN

Position outflow valves fully open to depressurize aircraft.

Do not accomplish the following checklists:

CABIN ALT AUTO
OUTFLOW VLV L, R

Return to SMOKE, FIRE OR FUMES checklist and complete remaining steps.

END OF PROCEDURE

13.0 UPS Non-normal Pilot Flying/Pilot Monitoring Duties

NON-NORMAL CHECKLIST ASSUMPTIONS

Non-normal checklists assume that the following conditions have been met prior to beginning any non-normal checklist:

- During engine start and prior to takeoff, the respective non-normal checklist must be accomplished if an EICAS Alert message is displayed. Upon completion of the checklist, the MEL must be consulted to determine if dispatch relief is available.
- System controls should be in the normal configuration for the phase of flight before the start of the non-normal checklist.
- Aural alerts should be silenced and the master caution/warning system reset by the flight crew as soon as the cause of the alert is recognized.
- The EMERGENCY position of the oxygen regulator must be used when needed to supply positive oxygen pressure in the masks and smoke goggles to evacuate contaminants. The 100% position of the regulator must be used when positive pressure is not needed, but contamination of flight deck air exists. The NORMAL position of the regulator must be used if prolonged use is needed and the situation allows. Normal boom microphone operation should be restored when oxygen use is no longer required.
- Indicator lights should be tested to verify suspected faults.

NON-NORMAL CHECKLIST PROCEDURES

Any crewmember detecting an emergency or abnormal condition shall immediately identify and verbally communicate the condition to the other crewmember(s).

When a non-normal condition is identified, the PF calls for the appropriate checklist when:

- Flight path is under control.
- Aircraft is not in a critical stage of flight (such as takeoff or landing).
- All Immediate Action items are complete.

In the event the First Officer is PF when a malfunction occurs, decisions regarding which checklist to accomplish and the designation of PF and PM, are subject to final determination by the Captain. The Captain should clearly designate which pilot will be the PF and which pilot will be the PM.

The overriding matter of importance at all times is that SOMEONE MUST FLY THE AIRCRAFT. As Pilot-in-Command, the Captain has ultimate responsibility and authority with regard to the safety and operation of the aircraft. The designated PF must devote constant attention to control and navigation of the aircraft with regard to terrain, weather, ATC and aircraft configuration. The PF participates in verification and completion of any checklist only after safety-of-flight is assured.

Execution of any checklist should not commence until the aircraft is at a safe altitude, airspeed and configuration, commensurate with the phase of flight. The minimum altitude after takeoff to initiate a checklist is 1,000 feet AFE, unless the Captain determines that a delay will jeopardize safety. Only a few situations require an immediate response (such as stall warning, GPWS pull-up or windshear warnings or a rejected takeoff). Time is usually available to assess the situation before corrective action is required. All actions should be coordinated with the Captain and performed in a deliberate and systematic manner. Under no circumstances is safety-of-flight to be compromised to accomplish any checklist or procedure.

14.0 UPS Policy on "Establishing Communications"

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moment is experienced during flap transition, (indicating a failure to automatically shut down an asymmetric flap situation) return the flap handle to the previous position.

Unusual events adversely affecting aircraft handling characteristics while airborne may continue to adversely affect aircraft handling characteristics during the landing ground roll. Aggressive differential braking and/or use of asymmetrical reverse thrust, in addition to other control inputs, may be required to maintain directional control.

Recall Checklists

After flight path control has been established, accomplish the immediate action item steps of the appropriate NNCs. The emphasis at this point should be on containment of the problem. Execution of NNC actions should only commence when the aircraft flight path and configuration have been properly established.

Accomplish all applicable NNCs prior to commencing final approach. Exercise common sense and caution when accomplishing multiple NNCs with differing direction. The intended course of action should be consistent with the damage assessment and handling evaluation.

Communications

Establish flight deck communications as soon as possible. This may require use of the flight deck interphone system or, in extreme cases of high noise levels, hand signals and gestures in order to communicate effectively.

Communications with the IRO or other crewmembers should be established as soon as the situation allows. All additional crewmembers should be utilized to the fullest extent possible.

Declare an emergency with ATC to ensure priority handling and emergency services upon landing. Formulate an initial plan of action and inform ATC. If possible, request a discrete radio frequency to minimize distractions and frequency changes. If unable to establish radio communication with ATC, squawk 7700 and proceed as circumstances dictate.

Communications with supernumeraries and company ground stations are important, but should be accomplished as time permits. If an immediate landing is required, inform the supernumeraries as soon as possible.

Damage Assessment and Aircraft Handling Evaluation

Unless circumstances such as imminent aircraft breakup or loss of control dictate otherwise, the crew should take time to assess the effects of the damage and/or conditions before attempting to land. Use caution when reducing airspeed to lower flaps. Make configuration and airspeed changes slowly until a damage and controllability assessment has been accomplished and it is certain that lower airspeeds can be safely used. In addition, limit bank angle to 15° and avoid large or rapid changes in engine thrust and/or airspeed. If possible, conduct this assessment and handling evaluation at an altitude that provides a safe margin for recovery should flight path control be inadvertently compromised. It is important for the

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G. ATTACHMENTS

Attachment 1: Interview Summaries
Attachment 2: Interview Summaries Addendum 1
Attachment 3: Dubai One Pilot Interview
Attachment 4: Interview Summaries Addendum 2
Attachment 5: Dubai One Pilot Statement
Attachment 6: ATC Transcripts
Attachment 7: Navigational Charts

Attachment 8: NTSB Form 6120
Attachment 9: UPS6 Block In Block Out Times
Attachment 10: Flight Crew Information
Attachment 11: N571UP Aircraft Routing
Attachment 12: UPS6 Crew Flight Times
Attachment 13: UPS6 PTRS Data
Attachment 14: UPS6 Crew Training Records
Attachment 15: UPS6 Pilot Certification Summary
Attachment 16: UPS6 Text Transmissions
Attachment 17: UPS B747-400 Initial Training Flow Chart
Attachment 18: UPS B747-400 Donning of O2 Masks
Attachment 19: UPS B747-400 AOM Supplemental O2 Description
Attachment 20: 1978 FAA CAMI Aircrew and Passenger Protective Breathing Equipment Studies
Attachment 21: Boeing 747 FCOM O2 Mask and Regulator Description
Attachment 22: January 31, 2011 UPS Flight Safety Bulletin
Attachment 23: UPS B747-400 AOM Amplified Checklist Reference
Attachment 24: UPS B747-400 Audio Control Panel
Attachment 25: UPS B747-400 Oxygen Systems
Attachment 26: UPS B747-400 Smoke or Fumes Removal Checklist
Attachment 27: UPS B747 Training Guide on Establishing Communications
Attachment 28: UPS Boeing 747-400 Cockpit Diagram
Attachment 29: UPS Emergency Equipment CBT Modules
Attachment 30: UPS O2 Mask CBT Modules
Attachment 31: Hypoxia Reference in FAA-H-8083-25A
Attachment 32: UPS Pilot Duties
Attachment 33: UPS 747-400 Full Flight Simulator Session Session 6
Attachment 34: Federal Express Conference Call
Attachment 35: SEA Smoke Simulator Results
Attachment 36: UPS6 Flight Test Results
Attachment 37: FAA Order 8900.1
Attachment 38: B747-400 Fire Main Deck Non-Normal Procedure
Attachment 39: UPS6 Flight Paperwork
Attachment 40: B747 Smoke or Fumes Removal QRH
Attachment 41: Boeing Non-normal Checklist Instructions
Attachment 42: FAA Oxygen Requirements Responses
Attachment 43: FAA Response to Fire Main Deck Checklist AFM Differences
Attachment 44: 2004 Smoke, Fire Fumes Initiative
Attachment 45: Safety of Flight Reference
Attachment 46: UPS B747-400 Minimum O2 Requirements

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