GENERAL CIVIL AVIATION INVESTIGATION

AIR ACCIDENT PRELIMINARY REPORT

BOEING 747-400F/N571UP

GCAA ACCIDENT REPORT N° 13/2010

GENERAL STATEMENT

Decree no. 10/2010 was issued by the Director General (DG/GCAA) establishing an Investigation Committee, accordingly the Air Accident Investigation Department (AAI) instituted an investigation pursuant to Artide 48 of the Civil Aviation Law no. 20 of 1991, Part VI, Chapter 3 of the Civil Aviation Regulations. This accident investigation is conducted by the General Civil Aviation Authority (GCAA) Air Accident Investigation Department in accordance with International Civil Aviation Organization (ICAO) Annex 13.

This Preliminary Accident Report contains the initial factual information of the investigation into an accident involving a Boeing 747-400F, registration N571UP, on the 3rd September 2010, near Dubai in the United Arab Emirates.

The information contained in this preliminary report is published to inform the aviation industry and the public of the general circumstances of the accident. Readers are cautioned that there is the possibility that new information may become available that alters this Preliminary Accident Report.

In accordance with ICAO Annex 13, the GCAA investigation team includes an Accredited Representative and Technical Advisors from the United States, as State of Manufacture and Design, State of Operator, and State of Registry. The Accredited Representative and advisors from the National Transportation Safety Board were joined by technically qualified advisors from the aircraft manufacturer, the Federal Aviation Administration (FAA), the operator, and the labour union representing the pilots.

GCAA Air Accident Investigation Department (AAI)

The Air Accident Investigation Department of the General Civil Aviation Authority (GCAA) is responsible for the investigation of civil accidents and incidents within and outside the UAE in accordance with Annex 13 to the ICAO Convention.

The purpose of the department is to enhance aviation safety by determining through investigation, the Findings and Significant Factors that lead to Safety Recommendations intended to prevent the reoccurrence of serious incidents or accidents - it is not to purpose of this activity to apportion blame or liability.

Contact Information
P.O.BOX: 6558
ABU DHABI - UNITED ARAB EMIRATES
TEL: +971 2 444 7666
FAX:+971 2 449 1599
E-mail: accid@gcaa.ae

CONTENTS:

ABBREVIATIONS/TERMINOLOGY

ACP	AUDIO CONTROL PANEL
AP	AUTOPILOT
ATC	AIR TRAFFIC CONTROL
BAH-C	BAHRAIN AIR TRAFFIC CONTROL
BALUS	WAYPOINT
CAPT	CAPTAIN
CET	CIVIL EVENING TWILIGHT
CGN	COLOGNE AIRPORT [IATA]
COPPI	WAYPOINT
CRM	COCKPIT RESOURCE MANAGEMENT
CVR	COCKPIT VOICE RECORDER
DFDR	DIGITAL FLIGHT DATA RECORDER
DME	DISTANCE MEASURING EQUIPMENT
DOH	DOHA INTERNATIONAL AIRPORT [IATA]
DXB	DUBAI INTERNATIONAL AIRPORT [IATA]
CAVOK	CEILING AND VISABILITY ARE OK
ECS	ENVIRONMENTAL CONTROL SYSTEM
FIR	FLIGHT INFORMATION REGION
FMS	FLIGHT MANAGEMENT SYSTEM
F/O	FIRST OFFICER/CO-PILOT
GMT	GREENWICH MEAN TIME
IATA	INTERNATIONAL AIR TRANSPORT ASSOCIATION
ICAO	INTERNATIONAL CIVIL AVIATION ORGANISATION
MMEL	MASTER MINIMUM EQUIPMENT LIST
MOM	MULTI OPERATOR MESSAGE
OMDB	DUBAI INTERNATIONAL AIRPORT [ICAO]
PACK	AIRCONDITIONING/PRECONDITIONED AIR
PF/PH	PILOT FLYING/PILOT HANDLING
PNF/PM	PILOT NON FLYING/PILOT MONITORING
RANBI	WAYPOINT
RW12L	RUNWAY 12 LEFT DXB
SHJ	SHARJAH INTERNATIONAL AIRPORT
TAF	TERMINAL AERODROME FORECAST
UAE-C	UNITED ARAB EMIRATES AIR TRAFFIC CONTROL CENTER
ZULU	REFER TO GMT (AVIATION)

PRELIMINARY REPORT BRIEFING NOTE

This report is to update the progress of the investigation, including previously issued safety recommendations, based on information established from the investigation to date and the feedback from the investigative teams working on this investigation.

The Cockpit Voice Recorder (CVR) and Digital Flight Data Recorder (DFDR) information is used to support the factual analysis for the safety recommendations, annotated excerpts of which are used as references in this report.

The Air Traffic Control communications are annotated where appropriate to support the factual information.

Technical teams working in support of the accident investigation analysis are continuing with the testing and support functions.

The investigation is ongoing. A further update will be provided in accordance with ICAO Annex 13.

AIR ACCIDENT SYNOPSIS

On September 3rd 2010 a Boeing 747-400F departed Dubai International Airport (DXB) on a scheduled cargo flight to Cologne (CGN), Germany.

22 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).

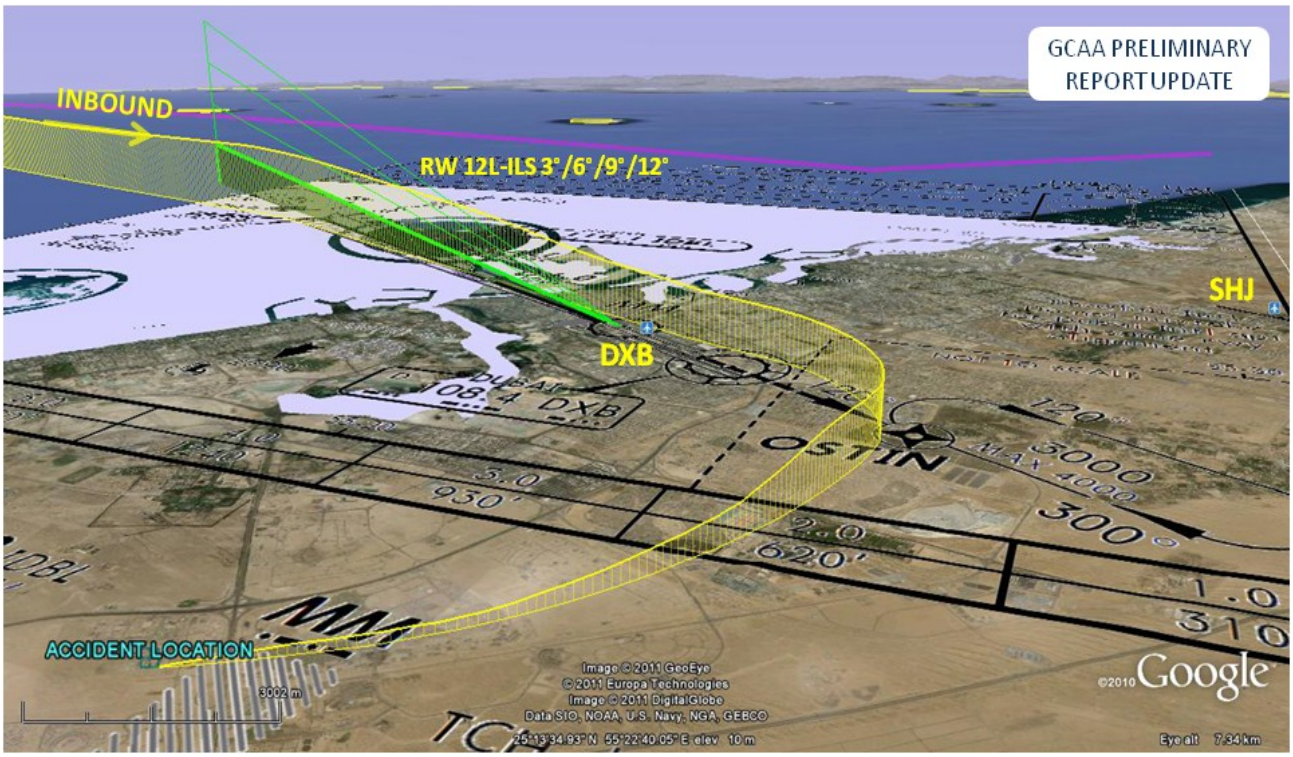
As the aircraft approached DXB runway 12 left (RW12L), the aircraft overflew the DXB northern boundary at 4500 ft and at a speed of 340 kts.

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.

Fig 1 below is an overview of the approach and over flight of DXB , the right hand descending turn and the accident location

FIG 1. OVER FLIGHT DXB RW12L, RH DESCENDING TURN, ACCIDENT LOCATION



TRACK DATA DRIVED FROM THE DIGITAL FLIGHT DATA RECORDER (DFDR)

ACCIDENT DETAILS SUMMARY	
OCCURANCE CATEGORY	ACCIDENT
DATE OF OCCURANCE	03 SEPT 2010
TIME OF OCCURANCE	15:41 UTC
LOCATION	9 NM STH DUBAI INTERNATIONAL AIRPORT
COUNTRY	UNITED ARAB EMIRATES
AIRCRAFT MANUFACTURER	BOEING COMMERCIAL AIRCRAFT
AIRCRAFT TYPE	BOEING 747-400F
REGISTRATION	N571UP
DAMAGE TO AIRCRAFT	DESTROYED
TYPE OF OPERATION	SCHEDULED CARGO
CREW	2
PAX	NIL
INJURIES	FATAL
DEPARTURE TIME	14:50 UTC
DEPARTURE POINT	DUBAI INTERNATIONAL AIRPORT, UAE (OMBD/DXB)
DESTINATION	KOLN-BONN (COLOGNE), GERMANY (EDDK/CGN)
REPORT STATUS	PRELIMINARY UPDATE

FIG 2. FLIGHTPATH FROM DUBAI - THE FIRE EVENT SEQUENCE AND THE RETURN TO DUBAI

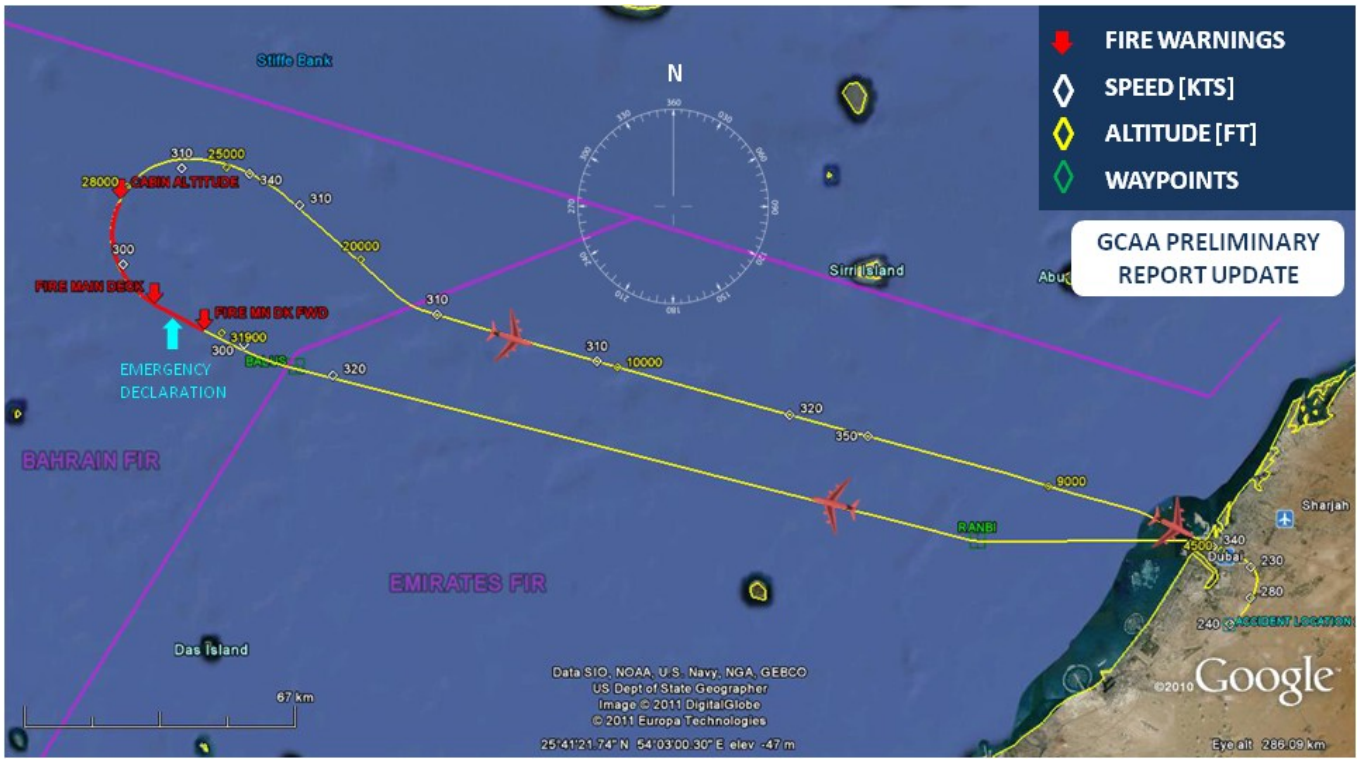
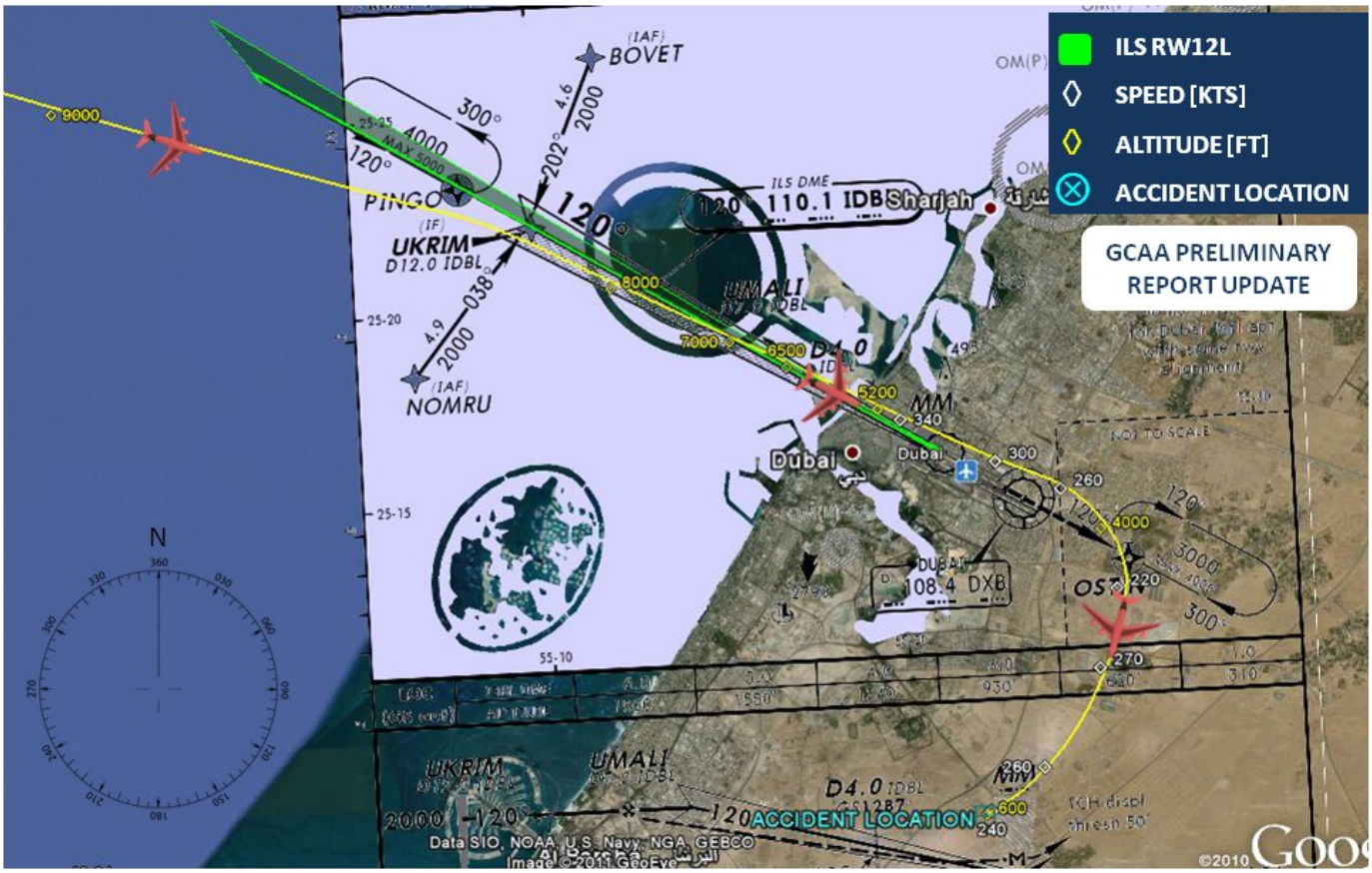


FIG 3 - FLIGHTPATH - MISSED APPROACH/OVER FLIGHT/ACCIDENT LOCATION, DXB RW12L APPROACH/RH TURN AND ACCIDENT LOCATION



FACTUAL INFORMATION

HISTORY OF THE FLIGHT

NOTE 1: ALL TIMES ARE UTC

BACKGROUND TO THE FLIGHT (ARRIVAL SECTOR HKG – DXB)

The operator of the accident flight is a scheduled cargo operator using Boeing 747-400F aircraft on a scheduled cargo service with a sector from Hong Kong (HKG) - Dubai (DXB) - Koln-Bonn, Cologne (CGN).

On September 3rd 2010, a Boeing 747-400F aircraft, registered N571UP, arrived from Hong Kong on a scheduled cargo service flight into DXB carrying among other items consignments of cargo that included lithium batteries.

There were no declared shipments of hazardous materials onboard the airplane. The package details for the cargo onboard the accident flight identified many of the shipments as lithium batteries and electronic equipment containing or packed with lithium batteries. The manifest indicated these shipments were distributed throughout the cargo decks, and not concentrated in any specific area. Further investigation into these items revealed that at least three of the shipments contained lithium ion battery packs that met the Class 9 hazardous material criteria. Accordingly, these shipments should have been shipped as regulated materials per ICAO Technical Instructions, and thus should have appeared on the cargo manifest. In addition to the many shipments of electronic devices and lithium batteries, the remainder of the cargo was general freight, which consisted largely of clothes, shoes, books, toys, lighting, transformers, solenoids, USB drives, circuitry, etc.

The aircraft was parked at the loading position, chocks on/block in at 11:35 UTC.

The inbound crew entered a logbook item for a PACK 1 fault which was reset on the inbound sector HKG-DXB.

TRANSIT TURNAROUND DXB/ LOADING OF CARGO IN DXB/ CARGO HANDLING SEQUENCE

Prior to the flight to Dubai, cargo was loaded into all positions in Hong Kong. Upon arriving in Dubai, the Unit Load Devices (ULD) in cargo positions 13L, 14L, 14R, 18L, 19L, and 20 were removed from the aircraft. Some of these ULD's were replaced with other out-bound ULD's. The following section describes the sequence of loading unloading.

The following cargo was removed from the inbound flight , as final destination cargo at Dubai, UAE: 14L, 18L, 19L, and 45 pieces of loose cargo located in Aft Bulk (AB). Additionally, approximately 2,770 lbs of cargo was transferred from the ULD in position 13L to the AB loose load position to establish the new AB cargo weight of 4,020 lbs. At this point, a bulge in the collapsible ULD in position 18R was identified by loaders working the aircraft. The bulge indicated that a load shift of packages occurred inside the ULD. According to the personnel at DXB, one package fell out of the ULD, from a height of approximately 5 feet. In order to remove the ULD in position 18R, the ULD in position 14R was removed and placed on the ramp. The ULD from position 18R was removed and transferred to the operations hub at DXB to be reconstructed. Following the reconstruction of the ULD from position 18R, the cargo loaders indicated that a ULD serviceability check was performed. New ULD's were loaded into positions 13L, 14L, 18L, and 19L. Along with these ULD's, the reconstructed ULD from position 18R and the ULD from position 14R were reloaded onto the aircraft into their respective positions.

NOTE 2

- THE FOLLOWING CHRONOLOGY OF THE HISTORY OF THE FLIGHT IS DERIVED FROM THE CVR/DFDR/ATC/AHM DATA AVAILABLE TO DATE.
- ALL DATA CONTAINED HEREIN IS PROVISIONAL AND SUBJECT TO CHANGE.
- GULF STANDARD TIME(GST) IS +4 HOURS AHEAD OF COORDINATED UNIVERSAL TIME (UTC)

DEPARTURE FROM DXB

The aircraft pushed back at 14:41 UTC, departing Dubai International Airport (DXB) at 14:51 UTC (18:51 GST local time) on a scheduled cargo service to Koln-Bonn, Cologne (CGN), Germany.

The aircraft was dispatched with no known technical limitations. The aircraft was dispatched with Master Minimum Equipment List (MMEL)[2] items which were not contributory to the accident.

The departure runway was runway 30 Right (RW30R) from DXB. The First Officer (F/O) was the Pilot Flying (PF)[3], the Captain was the Pilot Non Flying (PNF)[4] for the sector from DXB to CGN.

The aircraft was cleared for a RANBI2D departure from Dubai - which required a left hand turn after takeoff from DXB, heading west to towards the RANBI waypoint, then a right hand turn heading north/west overhead the RANBI waypoint towards the BALUS waypoint, which was on the Emirates FIR/Bahrain FIR boundary.

The take off and climb out from DXB was uneventful with the exception of a PACK 1 fault which was reset by the PNF at 14:55 UTC at 13,000 ft enroute to the BALUS waypoint.

ENROUTE DXB-CGN

15:11 UTC, Bahrain Air Traffic Control (BAH-C) confirmed the aircraft was in radar contact and cleared the flight crew to the next waypoint, COPPI. The crew acknowledged the BAH-C transmission as the aircraft was climbing to the designated cruise altitude of 32, 000 ft. Over head the BALUS waypoint the aircraft entered into the Bahrain Flight Information Region (FIR).

1 minute after passing the BALUS waypoint approaching the top of climb, there was the sound of an audible alarm on the CVR consistent with the fire bell alarm; this occurred at 15:12 UTC.

FIRE WARNING/EMERGENCY DECLARATION/SMOKE IN THE FLIGHT DECK

Following the fire bell annunciation, the CAPT assumed control of the aircraft as PF, and the F/O reverted to PNF while managing the fire warnings and cockpit checklists.

The CAPT advised BAH-C that there was a fire indication on the main deck of the aircraft. The crew informed BAH-C that they needed to land as soon as possible. BAH-C advised the crew that Doha International Airport (DOH) was at the aircraft's 10 o'clock position at 100 NM DME. DOH was the nearest airport at the time the emergency was declared, DXB was approximately 148 NM DME.

The CAPT elected to return to DXB, and following the request to land as soon as possible to BAH-C, the crew declared an emergency.

BAH-C acknowledged the request, cleared the aircraft for a series of right hand heading changes back to DXB onto a heading of 106° - the turns and remaining straight line distance to DXB totalled approximately 150 nm.

EMERGENCY DESCENT AND TURN BACK TO DUBAI

At approximately 15:14 UTC, the Auto Pilot (AP) disconnected, followed at 15:15 by a second audible alarm similar to the fire bell. At about this time the flight crew put on the oxygen masks and goggles. The crew experienced difficulties communicating via the intercom with the masks on, which interfered with the Cockpit Resource Management (CRM)[5].

Following the initiation of the turn back to DXB, having been cleared to 27,000 ft, the crew requested an expedited, immediate descent to 10,000 feet (ft).

Following ATC clearance, the flight crew initiated a rapid descent to 10,000 ft. BAH-C advised the crew that the aircraft was on a direct heading to DXB and cleared for landing on DXB runway 12 left (RW12L) at their discretion.

The Fire Main Deck checklist was activated. According to the system logic, the cabin began to depressurise, PACKS 2 and 3 shut down automatically, and PACK 2 and 3 positions were then manually selected to OFF on the overhead panel in accordance with the checklist instructions.[6/7/8]

Based on the DFDR data, at 15:15 UTC, PACK 1 shut down, with no corresponding discussion recorded on the CVR.

A short interval after the AP was disengaged, the CAPT informed the F/O that there was limited pitch control of the aircraft in the manual flying mode, the CAPT then requested the F/O to determine the cause of the pitch control anomaly.

The DFDR data indicates that there was a control column movement anomaly between the input by the crew on the control column forward and aft and the corresponding elevator movement: the elevator was not deflecting to the required range of travel relative to the control inputs.

During the turn back to DXB, the AP was re-engaged, and the aircraft descent was stabilised at 15:17 UTC.

At 15:17 UTC the CAPT told the F/O to pull the smoke evacuation handle[9]. This was not part of the Fire Main Deck Non-Normal checklist.

The CAPT informed BAH-C that the cockpit was 'full of smoke' and commented to the F/O about the inability to see the instruments.

The CAPT instructed the F/O to input DXB into the Flight Management System (FMS). The F/O acknowledged the request and commented about the increasing flight deck temperature. It was not clear from the CVR if the FMS was programmed for DXB, although the DFDR indicated that the ILS/VOR frequency was changed to 110.1 MHz which was the frequency for DXB RW12L.

Based on the information available to date, it is likely that less than 5 minutes after the fire indication on the main deck, smoke had entered the flight deck and intermittently degraded the visibility to the extent that the flight instruments could not effectively be monitored by the crew.

At approximately 15:19 UTC, during the emergency descent, at approximately 20,000 ft cabin altitude, the CAPT, as PF, declared a lack of oxygen supply.

Following a brief exchange between the CAPT and F/O regarding the need for oxygen, the CAPT transferred control of the aircraft to the F/O as PF. Portable oxygen is located on the flight deck and in the supernumerary area, aft of the flight crew's positions when seated.

At this point the recorded CVR is consistent with the CAPT leaving his seat, after which there is no further CVR information that indicates any further interaction from the CAPT for the remainder of the flight.

TRANSIT FROM THE BAHRAIN TO EMIRATES FIR

The normal procedural requirement of transiting into the Emirates FIR, inbound for DXB was a radio frequency change from BAH-C to UAE-C.

At 15:20 UTC, BAH-C advised the crew to contact UAE-C with a frequency change to 132.15. At approximately the same time, the PF transmitted 'mayday, mayday, mayday can you hear me?'.

The PF advised BAH-C that due to the smoke in the flight deck, the ability to view the cockpit instruments, the Flight Management System (FMS), Audio Control Panel (ACP) and radio frequency selection displays had been compromised.

At 15:21 UTC, the PF advised BAH-C that they would stay on the BAH-C frequency as it was not possible to see the radios. The PF elected to remain on the BAH-C radio frequency for the duration of the flight.

At approximately 15:22 UTC the aircraft entered the Emirates FIR heading east, tracking direct to the DXB RW12L intermediate approach fix. The aircraft was now out of effective VHF radio range with BAH-C. In order for the crew to communicate with BAH-C, Bahrain advised transiting aircraft that they would act as a communication relay between BAH-C and the emergency aircraft[10].

At 15:22 UTC, the F/O informed the relay aircraft that he was 'looking for some oxygen'. During this time, UAE-C transmitted to the A/C on the guard frequency 121.5. The PF did not transmit an acknowledgement on the guard frequency but did transmit on 121.5 at a later point. The relay aircraft confirmed to UAE-C that the emergency aircraft was transmitting on the BAH-C frequency.

Following the rapid descent to 10,000 ft the aircraft leveled off at the assigned altitude approximately 84NM from DXB.

At approximately 15:26 UTC, the PF requested immediate vectors to the nearest airport and advised he would need radar guidance due to difficulty viewing the instruments.

At around 15:33 UTC, approximately 26 NM from DXB, the aircraft descended to 9000 ft, followed by a further gradual descent as the aircraft approached DXB, inbound for RW12L. The speed of the aircraft was approximately 340 kts.

APPROACH TO DUBAI AND OVER FLIGHT OF DXB RW 12L

15:38 UTC, approximately 10NM from RW12L, BAH-C, through the relay aircraft, advised the crew the aircraft was too high and too fast and requested the PF to perform a 360° turn if able. The PF responded 'Negative'.

At this time the DFDR data indicated the gear lever was selected down, the speed brake lever moved toward extend and at approximately the same time there was a sound consistent with the flap handle movement; shortly afterward the PF indicated that the landing gear was not functioning.

The aircraft over flew the DXB northern airport boundary on a heading of 117°, the aircraft speed and altitude, based on the radar plots and DFDR information, was 340 kts at an altitude of 4500 ft and descending.

Following the over flight of DXB, on passing the south eastern end of RW12L, the aircraft was cleared direct to Sharjah Airport (SHJ) as an immediate alternate – SHJ was to the aircraft's left and the SHJ runway was a parallel vector. The relay pilot asked the PF if it was possible to perform a left hand turn. The PF responded requesting the heading to SHJ.

SHARJAH ALTERNATE/RIGHT HAND DESCENDING TURN

The PF was advised that SHJ was at 095° from the current position at 10 NM and that this left hand turn would position the aircraft on final approach for SHJ (RW30).

The PF acknowledged the heading change for SHJ. The PF selected 195° degrees on the Mode Control Panel (MCP), The AP disconnected at 15:40 UTC, the aircraft then entered a descending right hand turn at an altitude of 4000 ft as the speed gradually reduced to 240 kts until the impact.

Several Ground Proximity Warning System (GPWS)[11] caution messages were audible on the CVR indicating: Sink Rate, Too Low Terrain and Bank Angle warnings.

Radar contact was lost at approximately 15:41 UTC. The aircraft crashed 9nm south of DXB onto a military installation.

Note[1] : A Flight Information Region (FIR) is a region of airspace with specific dimensions, normally controlled by a specific ATC center.

Note[2] : The aircraft was dispatched with Master Minimum Equipment List (MMEL) items which were not contributory to the accident

Note[3]: Pilot Flying – PF: this is the handling pilot who, irrespective of hierarchical position on the aircraft, has the duty of flying the aircraft, both manually and using the autopilot.

Note[4]: **Pilot Not Flying – PNF**: this is the other handling pilot. who assists the PF by controlling the progress of the flight and immediately announcing any anomalies detected. He collaborates with the PF during all stages of the flight, carrying out any operations that are complementary to the flight, such as radio communication with ATC.

Note[5] : There is no hot-mic function in the B747-44AF. The push to talk switch on the Audio Control Panel (ACP) has to be moved or the mic/intercom switch on each pilot's control yoke depressed in order to communicate between the CAPT and F/O, ATC or other traffic. There is no hands free hot-mic function for the intercom– one hand has to used to push the respective switches to talk/transmit.

Note[6]: PACK: Air Conditioning - the PACK provides preconditioned air to the pressurised fuselage. There are 3 PACK's in the Boeing 747.

Note[7] : This check list was revised through a Boeing MOM in December 2010 advising operators that either air conditioning pack one or pack three must be operating to prevent excessive flight deck smoke accumulation during a main deck fire

Note[8]: When the Main Deck Cargo Fire Arm switch is depressed, PACK 2 and 3 shut down while PACK 1 continues to supply conditioned air to the upper deck. This provides a positive pressure differential between the upper deck and the rest of the airplane preventing smoke or fumes entering occupied areas.

Note[9] : Smoke Evacuation Handle – a handle immediately aft of the P5 overhead panel that when pulled opens a circular, manually displaced vent in the overhead fuselage section of the flight deck.

Note[10] : Communication relay is an intermediary aircraft used to relay VHF radio communication between an aircraft and Air Traffic Control.

Note[11] : GPWS - The Ground Proximity Warning System is a system designed to alert the crew if the aircraft is in close proximity to the ground, at an unusual bank angle, has a high rate of descent or a combination of all three parameters.

INJURIES TO PERSONS

INJURIES	CREW	PAX	OTHERS
FATAL	2	NIL	NIL
SERIOUS	NIL	NIL	NIL
MINOR/NONE	NIL	NIL	

PERSONNEL INFORMATION

CAPTAIN	
FLT CREW LICENSE	FAA AIRLINE TRANSPORT PILOT – AIRPLANE MULTIENGINE LAND
TOTAL TIME (TT)	11,410 hours
TIME LAST 6 MONTHS	209 hours
B747-4F (TT)	367 hours

CO-PILOT/FIRST OFFICER	
FLT CREW LICENSE	FAA AIRLINE TRANSPORT PILOT – AIRPLANE MULTIENGINE LAND
TOTAL TIME	6,130 hours
TIME LAST 6 MONTHS	130 hours
B747-4F (TT)	78 hours

AIRCRAFT INFORMATION - BOEING 747-44AF

AIRCRAFT DATA

AIRCRAFT TYPE	BOEING 747-44AF
BLOCK NUMBER	RL562
SERIAL NUMBER	35668
LINE NUMBER	1393

ENGINES	GENERAL ELECTRIC CF6-80C2-B5FG01

NOTE: ENGINES - Engine operation was normal at the time of the accident based on the DFDR data and visual inspection of the engines.

AIRCRAFT DISPATCH DATA

ETOW	349751kg/771069 lb
CARGO	103453 kg/228076 lb
T/O FUEL	86633 kg/190993 lb
CG	22.2% MAC

OXYGEN SYSTEM:

A. The flight crew supplemental oxygen system provides gaseous oxygen to the flight crew during normal operational procedures, in the event that the cabin is inadvertently depressurized as the result of a system or structural failure, or is intentionally depressurized as part of controlling a fire in the main deck Class E cargo compartment.
B. The supernumerary supplemental oxygen system, which is separate from the flight crew system, provides supplemental oxygen to the supernumeraries in the event of an inadvertent cabin depressurization or an intentional cabin depressurization to control a fire in the main deck Class E cargo compartment.
C. Portable oxygen bottles with masks and other emergency equipment are provided in the flight deck and supernumerary area for use, as needed.

The accident airplane was equipped with five portable oxygen cylinders, one located in the cockpit, and four portable bottles in the supernumerary: one on the wall, one in the lavatory, and two in the separate sleeping quarters. The portable bottle located in the cockpit was the only portable unit that had a full face mask.

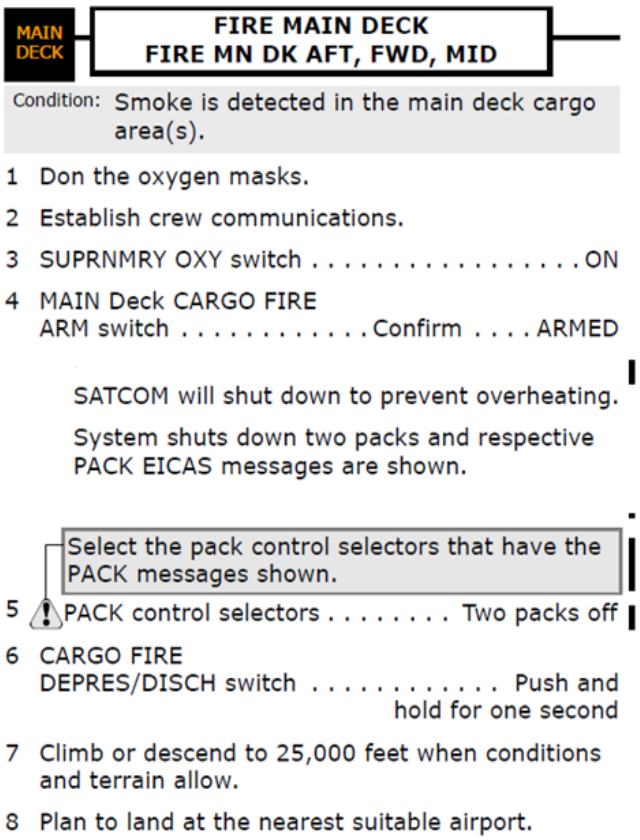
FLIGHT CREW OXYGEN SYSTEM

The 747-400F Crew Oxygen System consists of high pressure bottles of gaseous oxygen, pressure regulators to transition high bottle pressures to lower pressure distribution lines and masks, distribution lines to transport oxygen from the bottles to the flight deck, and individual crew oxygen masks and mask stowage boxes located at the captain, first officer, and observer stations. The flight crew masks are diluter-demand oro-nasal masks (covering the nose and mouth) designed for rapid donning in the event of a depressurization to prevent incapacitation of the flight crew due to hypoxia. If smoke or fumes are present, eye protection is provided by separate smoke goggles which can be donned and which can be interfaced with the oxygen mask to blow oxygen from the mask into the goggles to clear smoke from the goggles. Oxygen flow to each individual oxygen mask is controlled by a regulator mounted on the mask. This regulator has 3 oxygen feed settings:

(i) NORMAL: mixes ambient air in the cockpit with emergency oxygen at ratio determined by the cabin pressure altitude
(ii) 100%:: provides direct emergency oxygen undiluted
(iii) EMERGENCY: provides 100% direct emergency oxygen with over pressure.

FIRE SUPPRESSION CHECKLIST/PROCEDURES

FIRE MAIN DECK AFT/FWD/MID checklist – see below



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

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.

The CARGO FIRE ARM switches when pushed will arm the MAIN and/or the FORWARD and AFT compartments

MAIN CARGO COMPARTMENT (CLASS E) - ARMED -

- enables main deck fire suppression
- turns off two Packs (2 AND 3)
- configures equipment cooling to closed loop and turns off two packs and airflow to all cargo compartments
-
- closes master trim air valve

LOWER DECK FWD or AFT CARGO COMPARTMENT S (CLASS C)- ARMED -

- turns off two Packs (2 AND 3)
- arms lower cargo compartment fire extinguishers
- configures equipment cooling to override mode
-
- and heat into lower cargo compartments
- closes master trim air valve

CARGO FIRE Warning Light when Illuminated (red) indicates -

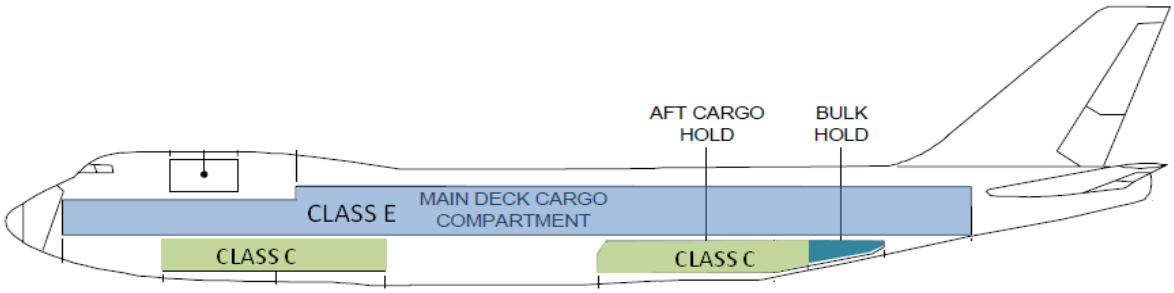
- fire in related cargo compartment, or
- the Fire/Overheat Test switch is pushed

CARGO FIRE Depressurization/Discharge (DEPRESS/DISCH) Switch
When pushed will perform the following:

- MAIN CARGO - ARMED - initiates airplane depressurisation
- FWD or AFT LOWER CARGO - ARMED - initiates extinguisher discharge sequence

CARGO COMPARTMENT ZONES/ CERTIFICATION

CARGO COMPARTMENT –FAA 14 CFR Part 25 - Smoke compartment - 747-400F



CLASS 'C' AND 'E' CARGO COMPARTMENTS

Cargo compartment information for Class C and Class E location and certification requirements.

Class E cargo compartments are not required under Part 25 to have built-in fire extinguishing or a suppression system controllable from the cockpit.
The original equipment manufacturer (OEM) requirements for the suppression of cargo fires as per the FIRE MAIN DECK or FIRE MN DK AFT, FWD, MID checklist is to 'Climb or descend to 25,000 feet when conditions and terrain allow.

Cargo-Compartment Class on Boeing- and Douglas-Designed Airplanes		
Model	Lower cargo compartment	Main cargo compartment
747-400F	Class C	Class E

14 CFR Part 25 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES
Subpart D--Design and Construction/Fire Protection

Class C Cargo Compartment: A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which:

i. There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station.
ii. There is an approved built-in fire extinguishing or suppression system controllable from the cockpit.

iii. There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;
iv. There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.

Class E Cargo Compartment:: A Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which:

i. There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;
ii. There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;
iii. There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment
iv. The required crew emergency exits are accessible under any cargo loading condition.

COMMUNICATIONS

Air Traffic Control: The Designated Area of Coverage (DOC) for the FIR regions are in accordance with industry normative range and coverage requirements for VHF coverage. Refer to ICAO Annex 10.

During the emergency descent from the Bahrain FIR into the Emirates FIR, communication between the ATC at Bahrain and the UAE and the accident aircraft was complex due to the flight crew's inability to change the radio frequency due to the smoke in the flight deck.

As the crew could not change radio frequencies from the BAH-C frequency, BAH-C used relay aircraft to communicate with the accident aircraft as the aircraft was transitioning back to DXB, through the Emirates FIR. BAH-C and UAE-C were in landline communication.

Outbound from DXB, the crew passed from the Emirates FIR into the Bahrain FIR. Standard practice is to set the radio frequency for the next ATC region or FIR. BAH-C had confirmed the aircraft for the next destination waypoint of COPPI and advised that the aircraft was on radar. The flight crew acknowledged the ATC transmission from BAH ATC.

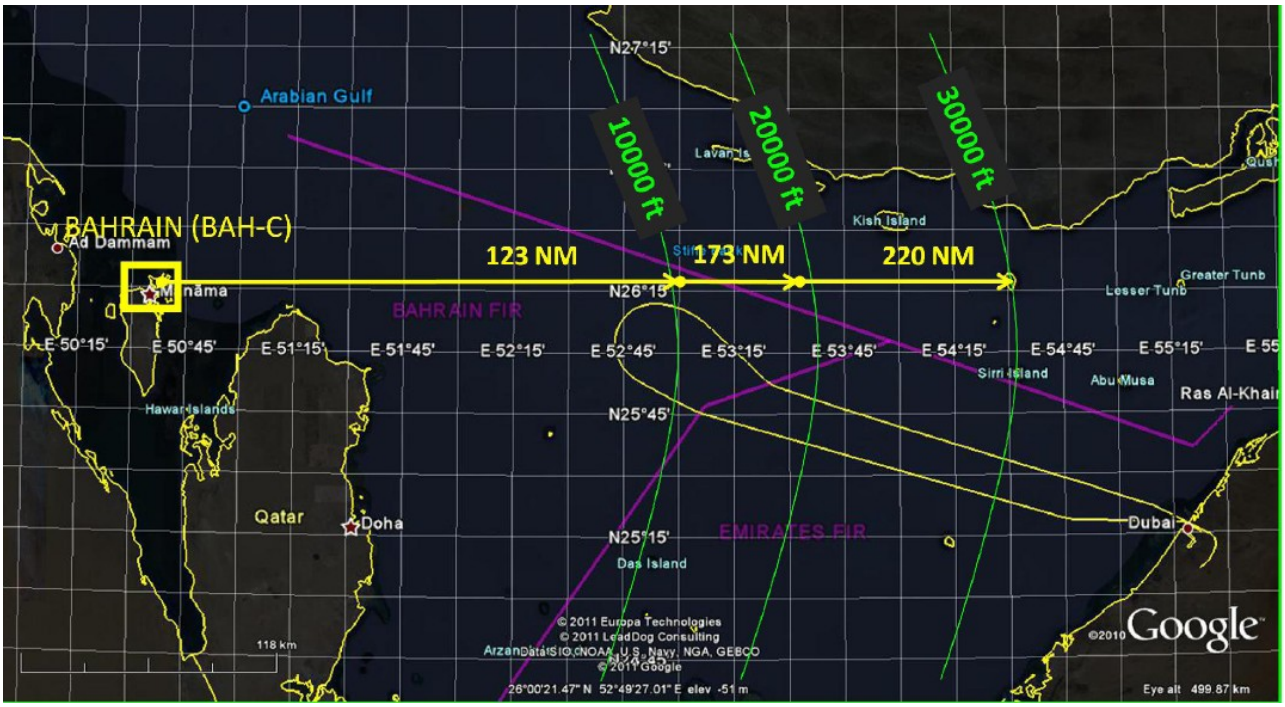
When the aircraft turned back to DXB, the flight crew of the aircraft advised BAH-C that they would stay on the BAH-C frequency due to smoke in the cockpit as it was not possible to change radio frequencies from BAH-C to the UAE ATC frequencies required for the return back through the UAE FIR and to DXB.

BAH-C contacted transiting traffic within effective VHF range of the aircraft and Bahrain ATC. The transiting traffic aircraft relayed messages to BAH-C from the crew. BAH-C were in landline communication with the controllers in the UAE.
The process was reversed to communicate the required heading, altitude, speed and tracking data back to the flight crew of the aircraft.

ATC VHF radio transceivers normally cover 360° in Azimuth although VHF radio is subject to line-of-sight restrictions, and the range varies proportionally to the altitude of the receiving equipment.
As the aircraft descended and moved farther away from the BAH-C transceiver site, it exited the usable range for direct two-way communication with BAH-C.

Following the emergency descent to 10,000 ft, all communication with BAH-C was through relay aircraft.

Nominal effective range of communication is shown below.



VHF COMMUNICATIONS RANGE FROM BAHRAIN – DISTANCE/ALTITUDE

METEOROLOGICAL INFORMATION

METAR: OMDB 031500Z 32006KT 290V030 8000 NSC 35/28 Q0999 NOSIG=
SUMMARY: DXB/15:00 hrs GMT(Zulu)/Wind 320 degrees at 6 knots, and variable from 290 to 030 degrees; Visibility 8000m; Ceiling unlimited; Temperature 35°C, Dew Point 28°C; 999 hPa.

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=

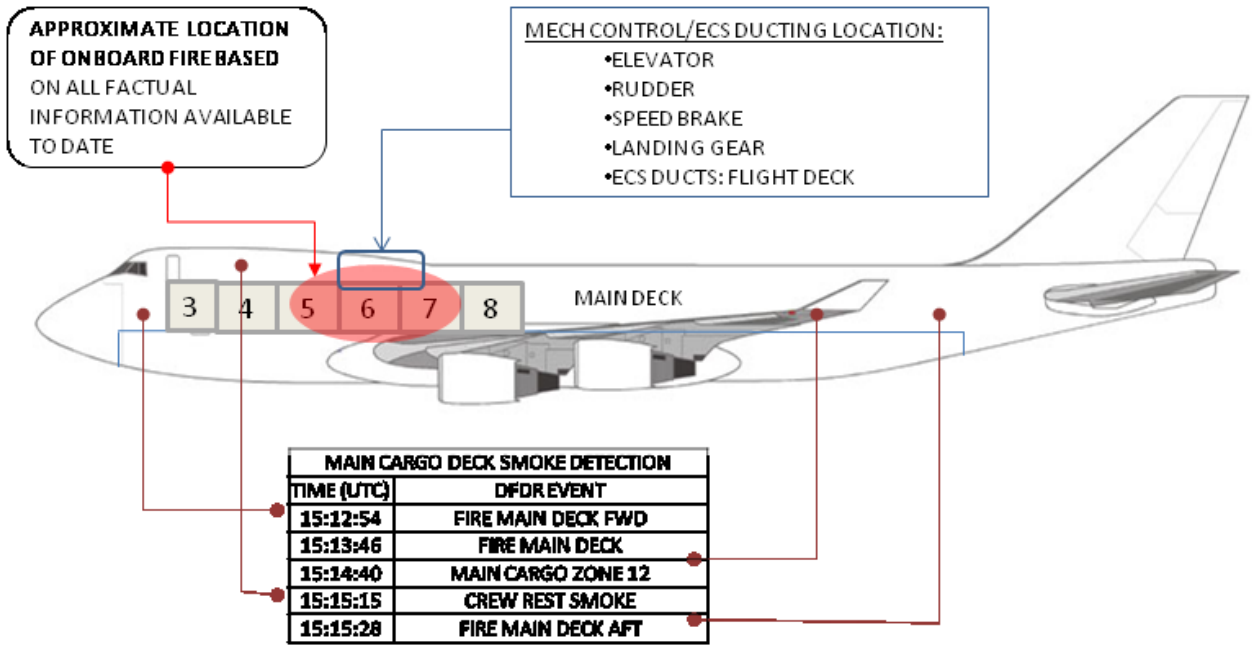
SUNSET: 18:36 LOCAL/ 279°← [direction of sunset]
CIVIL EVENING TWILIGHT (CET): 18:59 GST

The aircraft was airborne at dusk (at DXB airport elevation), climbed west into the sun which was on a radial of 279°, this would have provided sufficient ambient solar illumination as the aircraft was climbing to FL320 to illuminate the flightdeck. When the aircraft turned back onto 106° and descended, the flight deck would have been in shadow.

ONBOARD FIRE LOCATION AND ADJACENT FLIGHT CONTROL/ECS SYSTEMS

Analysis of the location of the onboard fire is ongoing with various working groups determining the factual information from the AHM, DFDR with detailed laboratory research, analysis and testing in progress.

Based on the factual information available, it is possible to determine through the available data, the approximate location of the onboard fire. The first fire alarm is in the forward main cargo compartment zone .



DFDR SMOKE DETECTION/SYSTEMS LOCATIONS

AID TO NAVIGATION

The ILS for DXB RW 12L - ATES Daily Occurrence Log indicates that it was operational. This concurs with the operation detailed in the ATC Tower Log.

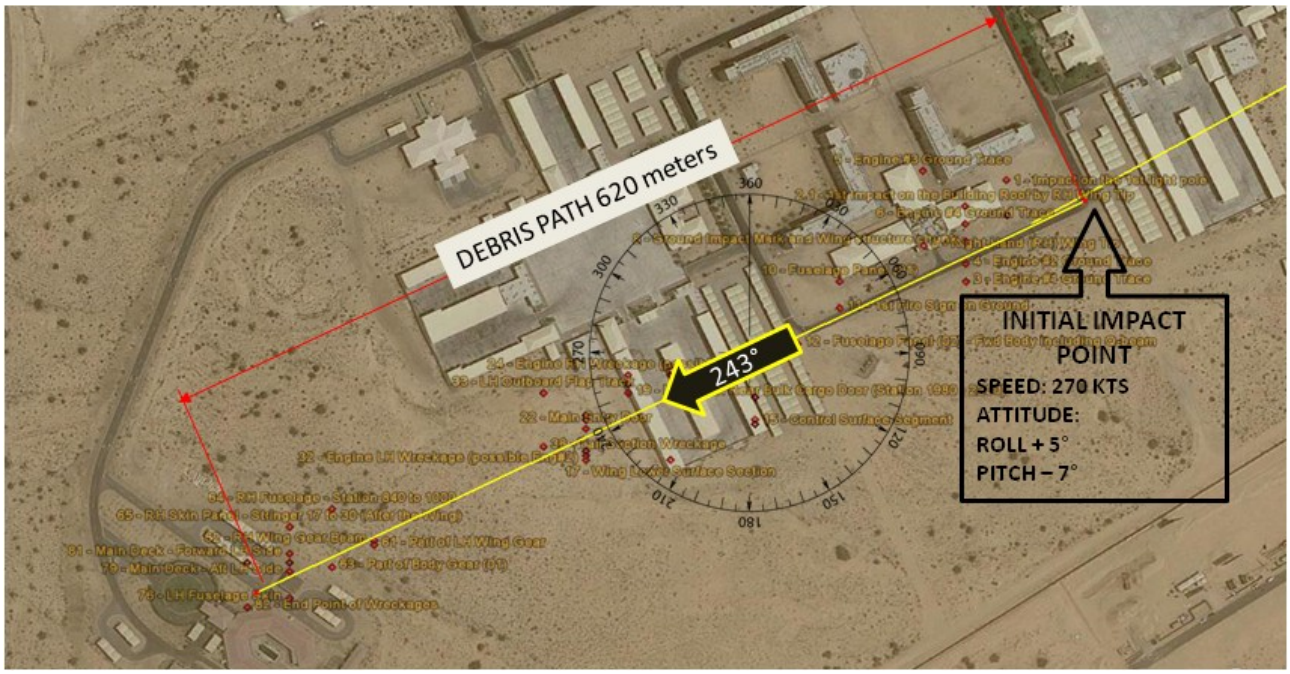
WRECKAGE AND IMPACT INFORMATION

The aircraft crashed 9 NM south of DXB onto a military installation. The aircraft attitude at impact was a shallow right hand descending turn. Judging by the ground scars and debris path, the aircraft was almost at a level attitude, see picture below: The debris path was linear, covering a distance of 620 meters, spread along the heading at the initial point of impact continuing on the impact heading of 243°.

The aircraft initial impact was on a perimeter service road, the RH wing contacted several buildings, and the engines separated, before the fuselage went through a group of service sheds. The bulk of the airframe mounted a sand bank, where the tail section separated.

The wings, center and forward fuselage was spread over a 300 meter area, with the cargo, some of the aircraft systems and associated onboard equipment distributed around the debris field.

The majority of the wreckage was damaged in the post accident fire.



OVERVIEW OF THE ACCIDENT LOCATION

ACCIDENT LOCATION – LOOKING EAST

SURVIVAL ASPECTS

The accident was not survivable.

TESTING AND RESEARCH - ONGOING ORGANISATION OF THE INVESTIGATION

In accordance with ICAO Annex 13, the GCAA investigation team includes an Accredited Representative and Technical Advisors from the United States, as State of Manufacture and Design, State of Operator, and State of Registry. The Accredited Representative and advisors from the National Transportation Safety Board were joined by technically qualified advisors from the aircraft manufacturer, the Federal Aviation Administration (FAA), the operator, and the labour union representing the pilots. The GCAA, U.S. representatives, and aviation regulators in Europe have established specific working groups to gather factual data and perform testing and research. Working groups include:

- Operations/Human Performance Working Group
- Airworthiness/Aircraft Systems Group
- Fire/Smoke Working Group
- CVR Working Group
- Sound Spectrum Analysis
- Flight Data Recorder Group
- Master Timeline Working Group
- Cargo/Hazardous Materials Working Group
- Maintenance Records Group

The investigation and analysis is ongoing, with several lines of enquiry open as the investigation progresses.

ORGANISATION AND MANAGEMENT INFORMATION

The operator's training, operations, training and safety programs are under review as part of the ongoing investigation.

ADDITIONAL INFORMATION:

SAFETY INFORMATION

1. Following the identification of certain cargo items on board the aircraft which have been associated with previous events where fire, smoke and fumes were the result of combustion of cargo onboard freighter aircraft, the following 2 Safety Information Advisory Notices have been released.

   FAA Safety Alert for Operators SAFO # 10017: Risks in Transporting Lithium Batteries in Cargo by Aircraft

   GCAA Safety Recommendations/Ref:26030/50659/10

   Safety Recommendation 1 (SR20/10):

   - Request customers to identify bulk shipments of currently excepted lithium batteries by information on airway bills and other documents provided by shippers offering shipments of lithium batteries.

   Safety Recommendation 2 (SR 21/10):

   - Where feasible and appropriate, stow bulk shipments of lithium batteries in Class C cargo compartments or in locations where alternative fire suppression is available.

Safety Recommendation 3 (SR 22/10):

- Evaluate the training, stowage, and communication protocols in your operation with respect to the transportation of lithium batteries in the event of an unrelated fire.

Safety Recommendation 4 SR (23/10):

- Pay special attention to ensuring careful handling and compliance with existing regulations covering the air transportation of Class 9 hazardous materials, including lithium batteries.

In view of this, all involved would have to be advised to:

- Educate all those who carry out activities related to Class 9 hazardous materials, including lithium batteries on the best practice to identify Lithium Batteries in particular in "Items/ shipments carried by Passengers, in Cargo, in Courier and in Mail modes" in/to/via UAE so that they are conversant with these new recommendations.

- Perform a risk assessment of their own practices for transporting lithium batteries.

2. **ICAO Electronic Bulletin EB 2011/7: Guidance for the shipment of lithium batteries by air**

   This is to advise ICAO Member States of the ICAO Dangerous Goods Panel's (DGP) concerns involving the transport of lithium batteries by aircraft, and to request States' assistance in helping to ensure their safe transport. Lithium batteries are commonly transported both as cargo and in carry-on or checked baggage, and are transported in packaged form as well as installed in or packed with equipment.

3. **The investigation identified a potential risk with the non-normal checklist procedure for Boeing 747-400F which has been revised by the manufacturer, refer to:**

   Boeing Multi Operator Message: B747 FCOM/FIRE MAIN DECK: FIRE MN DK AFT/FWD/MID

4. **EASA - Risks in Transporting Lithium Batteries in Cargo by Aircraft**

   EASA Safety Information Bulletin SIB 2010-30R1 dated 31 March 2011

   This SIB makes reference to the ICAO Document 9284 Technical Instructions for the Safe Transport of Dangerous Goods by Air, and clarifies that EASA recommends that operators take actions as currently described in the ICAO Technical Instructions publication. EASA wishes to further highlight the safety issues associated with the transport of lithium batteries by air and asks those involved in such operations to carefully note the points made in the ICAO Bulletin.

   http://ad.easa.europa.eu/ad/2010-30R1

ACCIDENT INVESTIGATION PROGRESS REPORTING

In complex air accident investigations there are multiple lines of enquiry and analysis. To date the investigation has identified several areas to pursue in relation to indentifying the root cause, the associated causal factors and the probable cause of this accident.
The GCAA Air Accident Investigation Dept will provide updates on the investigation in line with the recommendations of ICAO Annex 13. If no probable cause of the accident has been identified within 12 months of this accident, an Interim Accident Report will be available to update on the progress of the investigation.

Any specific safety issues identified during the course of the investigation will be advised to all parties through the GCAA Safety Recommendations (SR) procedures.

GCAA Accident / Incident Investigation Reports can be found here at this link:
http://www.gcaa.ae/en/epublication/pages/investigationreport.aspx