دولة الامارات العربية المتحدة
الهيئة العامة للطيران المدني
UAE General Civil Aviation Authority

United Arab Emirates
General Civil Aviation Authority
Accident Final Report

(Accident Report N° 04/2010)
(Issued on 03/08/2010)

Hot Air Balloon Accident
Cameron Z-425-LW
A6-JBR
Al Ain, UAE 25 April 2010

In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the prevention of accidents and incidents.

GENERAL STATEMENT

Decree no. 92-2010 was issued by the Director General (DG/GCAA) establishing an Investigation Committee, accordingly the Regulations and Investigation Department (R&I) started an investigation pursuant to Article 48 of the Civil Aviation Law no. 20 of 1991, Part VI, Chapter 3 of the Civil Aviation Regulations, and Annex 13 to the Chicago Convention.

This report contains the conclusions of the accident investigation involving a Cameron Hot Air balloon, type Z-425-LW, registration A6-JBR, on the 25th April 2010, in the United Arab Emirates by Balloon Adventures Emirates

The accident investigation was conducted by the General Civil Aviation Authority (GCAA) Regulations and Investigation Department, in accordance with ICAO Annex 13.

(i) Refer to GCAA Directive# 1020/01 for mandated Hot Air Balloon operational requirements

(ii) In the event of any discrepancies arising from translation, this English language version will take precedent over all other versions of this report.

ABBREVIATIONS

AAL: Local Airport Administration
ATC: Air Traffic Control
BST: British Summer Time
GMC: Ground Movement Controller
GMT: Greenwich Mean Time
Kph: Kilometers per hour
kts: Knots
m/sec: meters per second
NCMS: National Center of Meteorology and Seismology
Nm : Nautical Miles (linear distance)
OMAL: Al Ain International Airport
POB: Passengers On Board
RDS: Rapid Deflation System
ROC: Rate of Climb
SOP: Standard Operating Procedure
TAF: Terminal Aerodrome Forecast
UAE: United Arab Emirates
UTC : Coordinated Universal Time

SYNOPISIS

At 02:20:30UTC on the 25th April a Cameron L-425-LW passenger balloon, A6-JBR, launched on a passenger scenic flight in marginal weather conditions suitable for balloon flight operations.

The balloon had been flying for several minutes in variable weather conditions, involving fluctuating high wind speeds. Following the balloon launch, around 16 minutes into the flight the GPS records a steady increase in wind speed, exceeding the balloon's normal flight manual limitations - the pilot elected to land the balloon as soon as practical.

The pilot of the balloon elected to land forward of a large sand dune directly in the line of travel, the balloon travelling up and over the sand dune. 3 occupants were displaced from the balloon basket: 2 passengers received fatal injuries, 1 supernumerary crewman received serious injury.

Operational factors addressed are the significant wind speed change , combined with the pilot's inexperience in high wind speed landing conditions , the approaching boundary of the designated balloon flying area, in association with the area selected by the pilot to land the balloon and the time required for the operation of the Rapid Deflation System (RDS) were factors in this accident.

Safety factors addressed in this report are the company flight planning processes and the pilot's decision making delegation, the pilot's inexperience operating in high wind speed conditions, passenger survivability and passenger restraint mechanisms, the allocated designated balloon flying area and the balloon company systemic organisational and procedural deficiencies.

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FACTUAL INFORMATION

All times are UTC , unless indicated as Local Time – for UAE Local Time the correction is UTC/GMT +4 hours during BST (GMT+1)

All balloon speeds are in Knots (kts), nautical miles per hour (conversion to Kph – multiply by 1.852)

Date:	Sunday, 25 April, 2010
Accident flight duration:	From 02:20:30 to 02:43:51
Location:	South East of Nahel Town, United Arab Emirates (UAE)
Coordinates:	LAT : N024° 30’ 20”
	LONG : E055° 31’ 14”
Balloon authorised flying zone:	As designated inside AL AIN CTA AREA 1
Balloon type:	Cameron Hot Air Balloon Z-425-LW
Registration:	A6-JBR.

The balloon at the time of the accident was equipped with a transponder and a GPS capable of recording balloon speed and direction only; OMAL radar tracked the balloon intermittently.

1.1 HISTORY OF THE FLIGHT

On 25th April 2010, a Cameron Z-425-LW passenger balloon, with a crew consisting of 1 pilot, 1 supernumerary crewman and carrying 11 passengers, made a high speed hard landing on to uneven terrain while operating in the designated balloon flying area in AL AIN CTA AREA 1.

The balloon landing position was upwind of a large sand dune – the pilot’s stated intention was to land before the dune, relying on friction and gravity as the braking action to slow the balloon down - the investigation has been unable to conclude if this was the intent due to the unstable approach of the balloon to the landing point and the variable descent rates associated with the timing and activation of the Rapid Deflation System (RDS), combined with the GPS evidence that does not indicate that the balloon was stationary between the initial hard landing position and the full stop location of the balloon.

Based on witness reports and observed damage on the balloon basket, it is highly probable that the balloon contacted trees on the descent to the landing position.

Following the initial ground contact of the balloon basket, the balloon traversed a large sand dune at approximately 23 kts, travelling over the top of the sand dune before coming to a full stop 200 meters from the initial ground contact position.

As the balloon travelled across the top of the sand dune, the balloon envelope was not fully deflated due the time lapse in the actuation of the vent valve of the RDS. As the balloon passenger basket was dragged over the top of the sand dune, the passenger basket was at or approaching a horizontal attitude as it traversed the crest of the dune: at this point 2 passengers and 1 crewman were displaced forward of the balloon basket, resulting in the death of the 2 displaced passengers and the serious injury of the displaced crewman. The cause of the injuries was contact with the balloon basket after the passengers were outside of the balloon.

The balloon came to a full stop approximately 200 meters from the initial hard landing impact point and 175 meters from the point that the passenger injuries occurred.

1.1.1 BALLOON LAUNCH PREPARATION:

The pilot reports that the standard procedure was for the forecasted meteorological information to be checked on the NCMS website the day prior to the flight for the Terminal Aerodrome Forecast (TAF) for OMAL.

On the morning of the flight on 25 April, due to the high winds which delayed the balloon launch, the balloon pilot requested an updated meteorological forecast from the operations manager .

The pilot and ground handling crew waited until the wind speed reduced sufficiently to enable inflation of the balloon envelope.

1.1.2 BALLOON LAUNCH AND SEQUENCE OF EVENTS:

00:58:00: The balloon pilot contacted OMAL ATC as per the normal SOP, advising the flight planning, the POB, confirmed the transponder code, advising OMAL ATC that intention after launching was to climb to an altitude of 4000.

01:20: (approximately) A launch attempt of the balloon was abandoned due to the high winds

01:49:00: The balloon pilot made a further call to OMAL ATC advising the flight was delayed due to the current strong winds. The pilot advised OMAL ATC that he would attempt to launch the balloon at 02:15:00

NOTE: At this point, a second balloon operator at the launch site abandoned their balloon launch due to the high winds. The operator noted the unstable weather and a peak high local wind speed of 29 kts (15 m/sec) based on a hand held anemometer reading

02:20:30: The balloon GPS is activated .The balloon is assumed to have departed the launch point at this time.

02:24:00: The maximum balloon speed recorded by the GPS is 38 kts (19.5 m/sec). The pilot statement records he maximum altitude reached during the flight was 2200 ft Above Sea Level (ASL). The investigation assumes due to the limited data available that the maximum recorded balloon speed and maximum altitude achieved by the balloon occur simultaneously.

02:28:00: OMAL Ground Movement Controller (GMC) noted that the balloon was airborne and operating below 1500 ft.

02:33:38: The minimum balloon speed after launching is recorded as 10 kts (5.14 m/sec), 13 minutes after launch/GPS activation.

02:36:46: The speed increases from 12 kts (6.17 m/sec), with a gradual linear average increase in speed to 23.76 kts (12.22 m/sec).

02:43:00: The balloon makes contact with the ground upwind of a large sand dune.

02:43:51: The balloon mounted GPS stops recording .

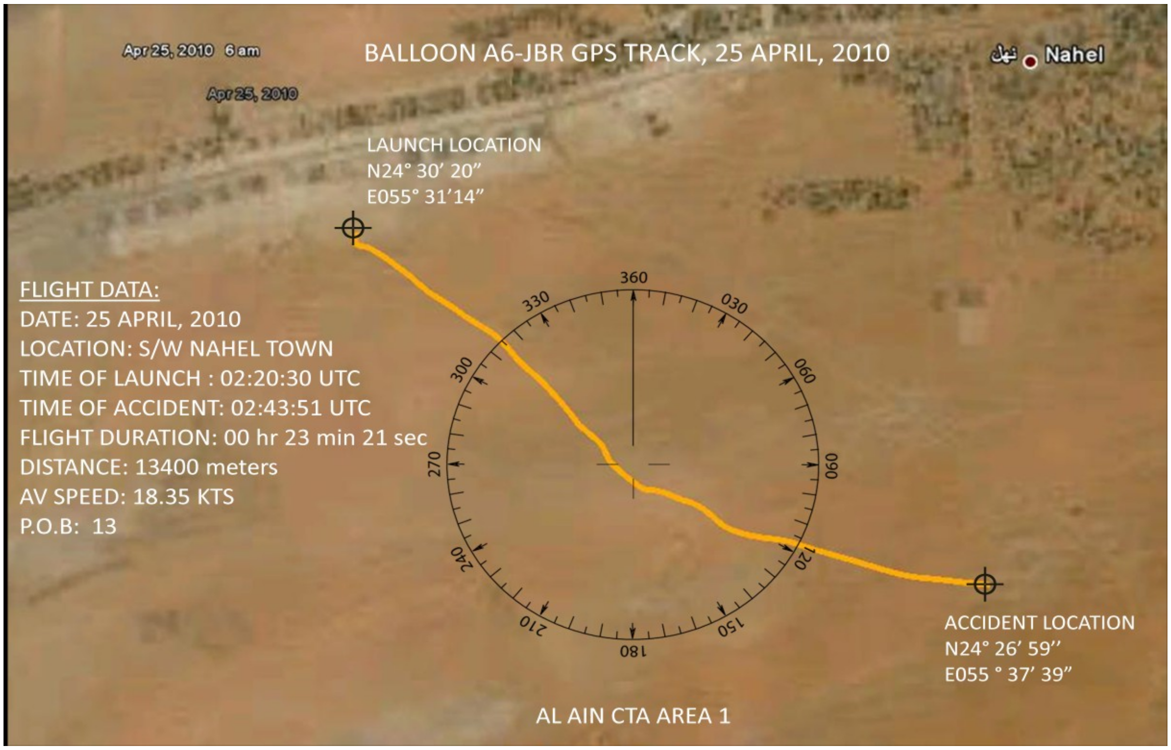
The total flight duration was 23 minutes, 21 seconds.

No emergency call was transmitted to OMAL ATC. The pilot contacted the Director of the balloon company as per the operators SOP’s.

03:46:00: OMAL ATC receive a call from the Al Ain Police asking about the accident balloon location and advises OMAL ATC of the casualties and injuries

1.1.3 BALLOON TRACK (GPS)

Balloon azimuth flight track, distance travelled and balloon speed data

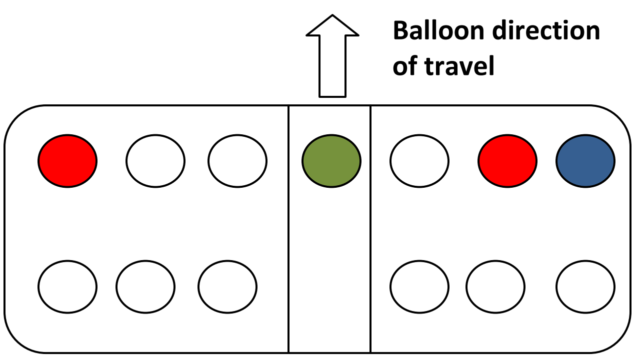


1.2 INJURIES TO PERSONS

INJURIES	CREW	PAX	OTHERS
Fatal		2	
Serious	1		
Minor/None	1		

Passenger Injury Location Map:

RED - Fatal
BLUE - Serious Injury
GREEN - Pilot position



1.3 DAMAGE TO THE BALLOON

Balloon Passenger Basket:

Damage on the lower right hand corner consistent with impact damage, probably contact with a tree on the descent, following RDS activation, prior to the hard landing

The upper left hand corner has tension/torsion induced damage, with multiple tension failures to the nylon webbing connected to the internal steel frame: all of the damage recorded is consistent with a severe hard landing.

The primary structure stainless steel load bearing frame was intact with no obvious damage following a detailed visual inspection.

Balloon Basket Impact Damage

Burner: Tested for fit, form and function – testing was conclusive that the burner was functioning as designed

Envelope: Functioning at the time of the accident

Gas Cylinders: Gas volume confirmed on inspection to be sufficient for the phase of the flight when the accident occurred

1.4 OTHER DAMAGE:

No other damage

1.5 PERSONNEL INFORMATION:

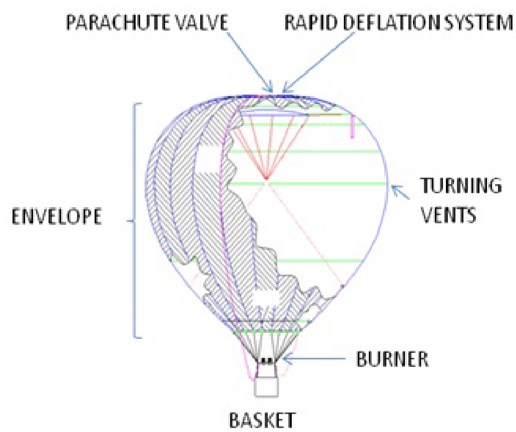
Pilot's Age: 45 years
Pilots License: Commercial Pilots License N° 31675, Issued by the GCAA 23/12/2008.
License Expires 22/12/2016.
Pilots Flying Experience: TT: 777.50 hrs , 213.35 hrs UAE, 10 hrs in the previous 14 days

1.6 BALLOON INFORMATION

Balloon Technical Information:

Balloon type:	Cameron Hot Air Balloon Z-425-LW
Registration:	A6-JBR.
Year of manufacturer	2007
Constructor's number:	11058
Empty Weight:	1080 kg
Operational weight on the day of the accident:	1990 kg (estimated), ICAO passenger standard weights

Balloon Rapid Deflation System (RDS) Information



The Rapid Deflation System (RDS) is a pilot actuated system which opens a section at the top of the balloon to vent the captured hot gases to atmosphere.

In the Cameron balloon design, the RDS is actuated by a rope in from the pilot's position via a pulley system to the RDS at the top of the balloon envelope.

The Cameron balloon uses a pulley system in the rope architecture which is prone to sand accumulation in the moving parts if not serviced regularly in desert conditions. This sand accumulation was recognised by the operator as factor in the Cameron balloon design for desert operations; the operator adopting a specific maintenance procedure for the pulley system.

The pilot of the accident balloon stated that Cameroon balloon RDS was slower to release envelope gas compared with other types of RDS design which use a simplified, non pulley actuation system

1.7 AIRWORTHINESS:

The investigation concluded that at the time of the accident the balloon was:

(i) Airworthy at the time of the accident
(ii) Held a valid Certificate of Airworthiness

1.8 METEOROLOGICAL INFORMATION

Meteorological information – Balloon Launch Site

There was no precise weather information at the time of accident in the launching site, however the nearest weather information locations are Al Ain airport which is 15.3 Nm to the accident site and Abu Dhabi which is 48 Nm from the launching site, which are available for reference.

The weather / wind speed at the time of the accident was represented by the balloon speed. 3 minutes after launching the balloon GPS was reading 7 knots until it reached a peak of 37 knots, 4 minutes after launch, consistent with a rapid ascent and associated increasing wind speed with altitude.

At aerodromes the requirement is to measure winds at a height of 10m. At Al Ain there are two wind towers that record these winds. The GCAA DIR 01/2010 requires balloon operators to measure and record local wind and direction parameters prior to launching the balloon.

At Abu Dhabi there is Radiosonde equipment that directly measures the entire atmosphere's winds at 12 hour intervals.

OMAL METARS FOR DT: 25/04/2010

METAR OMAL 250000Z 07007KT 7000 NSC 27/17 Q1010 A2982
METAR OMAL 250100Z 07007KT CAVOK 28/17 Q1010 A2983
METAR OMAL 250200Z 10010KT CAVOK 28/17 Q1010 A2983
METAR OMAL 250300Z 31018KT 270V340 6000 NSC 29/18 Q1012 A2991
SPECI OMAL 250338Z 32005KT 7000 NSC 29/18 Q1012 A2990
METAR OMAL 250400Z 33005KT 280V010 8000 NSC 29/19 Q1012 A2990
METAR OMAL 250500Z 31014KT 9000 NSC 31/20 Q1013 A2991
METAR OMAL 250600Z 30016KT 7000 NSC 32/19 Q1014 A2994

THE GENERAL SYNOPTIC SITUATION ON THE MORNING OF APRIL 25, 2010:

Based on the synoptic chart from 00Z 25 April, a ridge of high pressure was building into the western areas of the UAE. Low pressure areas were centered southeast and northeast of the UAE.

A weak trough of low pressure was crossing the UAE. This weak trough of low pressure does not show up well on the surface pressure maps but was well defined by cloud, with some precipitation and a distinctive wind shift.

The trough was in fact orientated from the southeast to the northwest and was moving from the southwest to the northeast. The trough crossed Al Ain and Dubai airports near the same time near 0230Z.

By looking at the Radiosonde ascent at 00Z that day, a saturated layer was seen between 5000' and 8000'. This was indicative of the cloud cover present at that time.

From the radar imagery of the morning scattered showers and possible thundershowers were associated with the precipitation areas.

The precipitation was more dominant along the coastal areas and it was drier inland.
It is clear that as the trough of low pressure moved across Al Ain a significant change in wind speed and direction occurred.

This significant wind change is associated with the passage of this trough and should not be considered a Shamal like condition (note: Shamal is a non technical meteorological term which covers several different conditions which produce significant northwest winds over the lower Arabian Gulf.)

It is know that the atmosphere was somewhat unstable at the time and therefore there would have been reasonable mixing of the winds in the lower atmosphere. This mixing in the lower atmosphere would have lead to reasonable consistent winds through the lower atmosphere at the time or only slightly increasing winds. The instability would have also lead to slightly gusty winds.

The synoptic chart from 00Z 25 April, indicates a ridge of high pressure was building into the western areas of the UAE. Low pressure areas were centered southeast and northeast of the UAE, consistent with the published METARS for OMAL

ADDITIONAL INFORMATION:

1.9 COMMUNICATIONS.

The aircraft was equipped with Portable VHF communication and a mobile phone. VHF radio shadowing requires a mobile phone as back up in the event that normal VHF comms are not possible.

1.10 AERODROME INFORMATION.

The balloon was operating out of aerodrome airspace in a designated balloon flying area in Al Ain CTA 1

1.11 FLIGHT RECORDERS.

Equipped with personal GPS Gamin 12, it's a handheld Personal Navigator, equipped with 12 parallel channels.

There are various features, for the purpose of this investigation, only relevant information is presented, the waypoint recording mode is 500 waypoints, the Track log record is 1024 track log points, an additional tracking feature is track back ,available to turn the track log into an instant traceable trail and to reverse the route. It also has a position averaging feature which displays a value that reflects the estimated accuracy of the averaged positional information.

The Recording Mode in this GPS was set to Resolution Mode, Resolution Mode is the best option for the Recording Mode, as it will only record when there is change in position, consequently there will be no data if there was no balloon movement.

1.12 ORGANISATIONAL , CERTIFICATION, COROLLARY INFORMATION

THE COMMERCIAL PASSENGER BALLOON AVIATION SCENARIO IN THE UAE

Balloon flying operations are limited to the UAE seasonal variations due to the high ambient temperatures, the density altitude considerations and localised, regional variations in wind speed and direction. The season normally starts in September and finishes in June dependent on the weather and flying conditions.

For the operator of the accident balloon, in the previous ballooning season - 2009-2010 - the total flyable days were 191 days, with 6.8% of flights cancelled on site due to unflyable weather.

ORGANISATIONAL FACTORS WITHIN THE BALLOON OPERATOR

The investigation determined several systemic management causal factors in the company management structure affecting pilots decision making, notably, that on previous flights where there has been damage to property caused by a balloon, or a pilot's reluctance to fly or where regulatory investigation had been instigated by the GCAA, that this has resulted in termination of employment of the pilots involved.

Mandatory Safety Management Systems (SMS) are obliged to provide a 'Blameless Safety Culture' as an intrinsic function of the SMS methodology in a company's safety operating culture.

Other determinant factors were company Standard Operating Procedures (SOP) and the accident notification procedure of the balloon company.

BALLOON CERTIFICATION – STATE OF DESIGN

Cameron balloons are designed and certified according to EASA CS-31: Certification Specifications for Hot Air Balloons

COROLLARY PHOTOGRAPHIC EVIDENCE

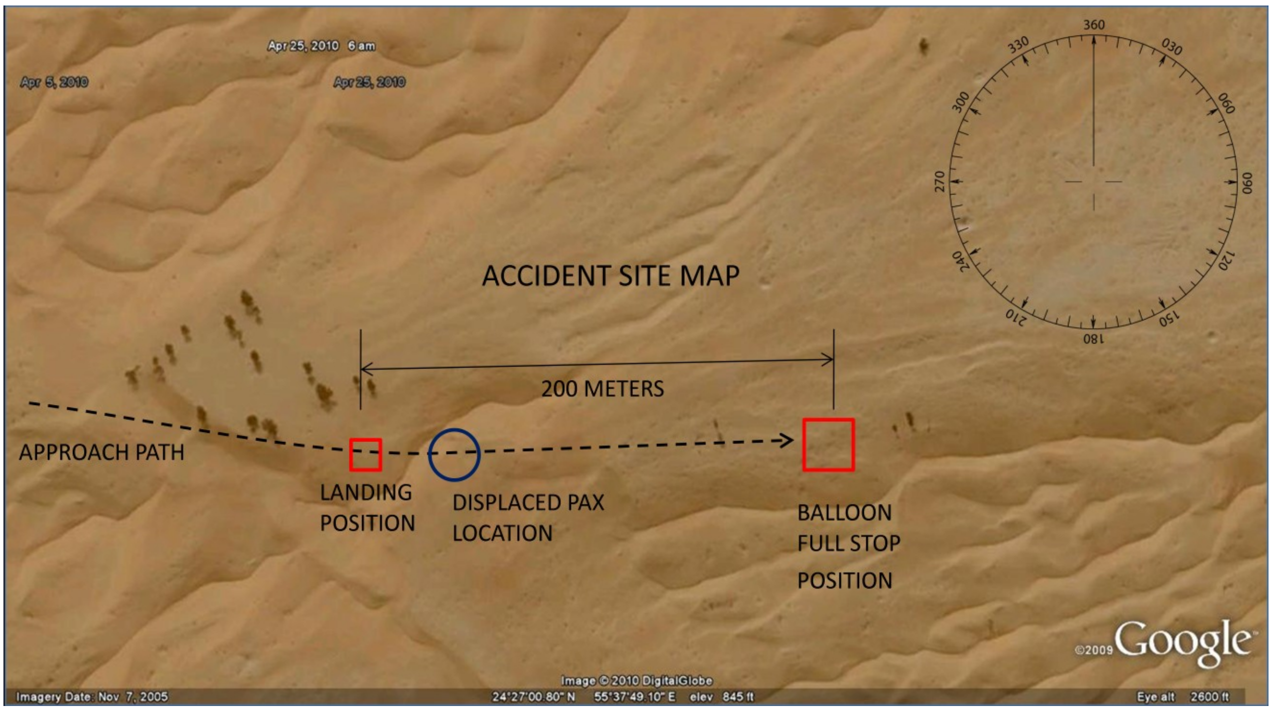
Witness photos - A6-JBR photo on landing approach 25 April – a composite of 2 photos taken from a chasing vehicle

Composite photo A6-JBR Approach

These two time lapsed photos taken of the balloon on the approach to the landing site do not indicate any:

(i) Abnormal envelope function
(ii) Additional safety hazards such as envelope deformation, an onboard fire or structural anomalies or any other hazards to the conduct of safe flight

ACCIDENT SITE MAP



ACCIDENT SITE MAP OVERVIEW:

The balloon was tracking approx 100/095°, which was the prevailing wind direction.

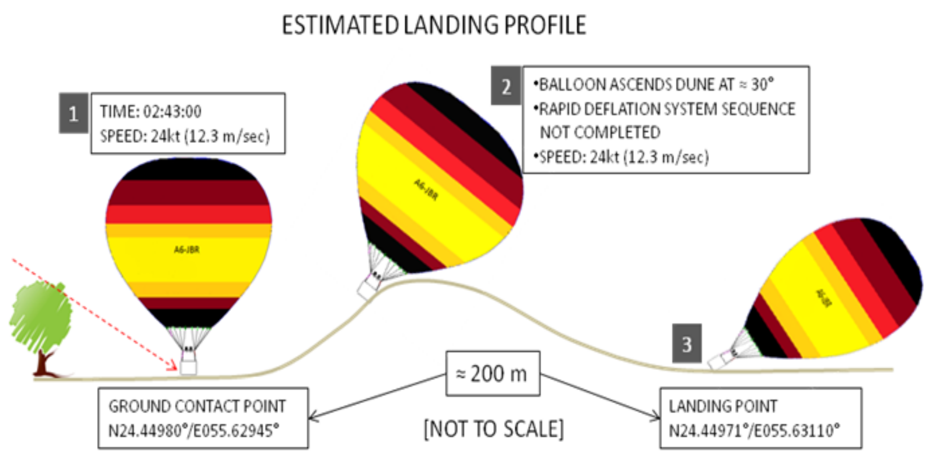
There is a minor track correction after the initial impact point of approximately 10° onto a due east 090° heading, before the balloon is at a full stop 200 meters from the initial impact point.

The balloon assembly was intact at the point it was recovered by the Police

2 ANALYSIS

BALLOON LANDING SEQUENCE/PROFILE:

(i) Landing phases of the balloon.
(ii) Sequencing based on GPS data and witness statements.
(iii) Not to scale



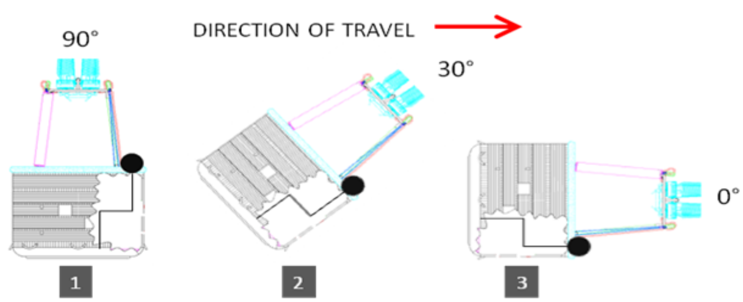
Phase 1: Approach and initial landing position.

Phase 2: Transition of the balloon over the sand dune

Phase 3: Passenger basket is dragged by the envelope as the RDS releases the envelope gas.

Balloon passenger basket orientation – general diagram is below

Balloon Basket Attitude diagram below indicates the balloon basket attitude as it crossed the crest of the sand dune (note - the sequential numbers do not relate to the Estimated Landing Profile schematic above)



BALLOON BASKET ATTITUDE

OEM Flight Manual, Section 3-Emergency Procedures, para 3.8: PREPARATION FOR A HARD LANDING

The OEM manual does not specify a recommended maximum landing speed. Given the variance in operating environments combined with various operational factors, it is incumbent upon the crew to adequately brief and prepare the passengers with a thorough safety briefing in the event that a hard landing is inevitable.

The mechanism that ejects passengers from the basket in a hard landing with a high lateral speed is recognised as a significant passenger safety factor by the balloon OEM and the balloon operators SOP.

The manual advises the operator that *'In a fast landing the basket may tip forward violently on impact, tending to throw the occupants out'.*

BALLOON PASSENGER BASKET LANDING BRIEFING

Passengers are briefed to crouch in the basket and face away from the direction of travel while gripping a rope handle attached to the balloon basket outer wall or the median separation barrier

The passenger restraint consists of a hand held strap connected to the balloon basket wall or internal separation barrier: the briefing is to hold onto the strap for the duration of the landing run

ASPECTS OF SURVIVAL AND/OR EVACUATION FROM THE AIRCRAFT

The Cameron balloons are designed to EASA CS-31HB, Certification for Hot Air Balloons.

Passenger restraint is covered under CS 31HB.63 - Occupant restraint:

(a) There must be a restraining means for all occupants, which can take the form of hand holds.

In normal operating conditions this is an acceptable means of passenger restraint.

In high speed/high loaded hard landings, additional passenger restraint systems are available, including seat belts, passenger restraint inserts and head protection.

The certification criteria for passenger restraint acceptable means of compliance is to provide passenger hand hold restraints.

The investigation concludes that given the demographics of the distribution of the passenger load, the passengers age and assumed hold/grip capability, that the location of the passenger seating was a determining factor in the survivability of this accident

FLIGHT DATA ANALYSIS FROM GPS DATA – FLIGHT PROFILE AND WIND SPEED

Balloon GPS: The balloon was optionally equipped with portable GPS, the GPS used was Garmin GPS12A limitation of the GPS 12 model is that it is not equipped with an Altitude Recording Mode Capability.
The calculation of wind speed was based on the lateral path which is projected to earth with zero (0) altitude to surface level.
The balloon speed is assumed to be the approximate wind speed.
The flight data reconstruction is based on the limited GPS parameters, data interpretation, witness photographs/statements and the pilot's statements.

GPS COMPARATIVE ANALYSIS FOR ALTITUDE ESTIMATION

As the GPS that was used during the accident does not provide altitude information, the team have obtained from the Flight Operations section previous GPS downloads that were obtained during periodic operational audits between 2008-2009 to determine the maximum altitude reached

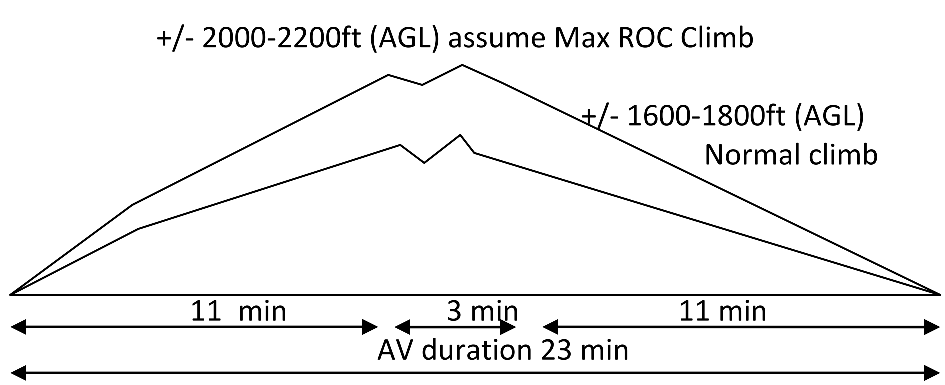
Based on average rate of climb that was obtained from 15 random representative flights from 2008-2009 that were GPS downloaded, the average Rate of Climb were as follows:

1. Average Rate of climb after takeoff to peak altitude was : 153 ft/min
2. Average Rate of climb after takeoff within the first 10 point was : 207 ft / min

The following data were obtained from GPS downloads

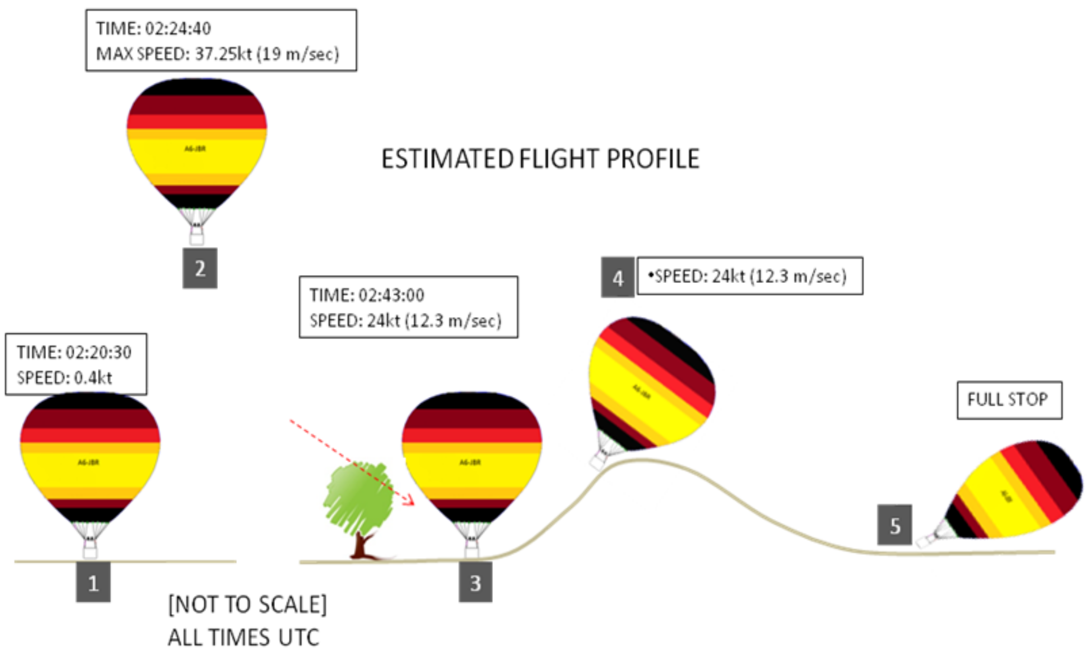
Random flight	Average Rate of Climb (fpm)	First 10 pt ROC (fpm)
Flight 1	163	289
Flight 2	108	122
Flight 3	93	94
Flight 4	190	185
Flight 5	134	214
Flight 6	133	133
Flight 7	208	237
Flight 8	140	133
Flight 9	158	298
Flight 10	225	416
Flight 11	211	351
Flight 12	99	263
Flight 13	179	144
Flight 14	103	117
Flight 15	150	108
Average ROC	**153**	**207**

From the ROC data above , a vertical flight profile can be estimated as illustrated below:



BALLOON FLIGHT PHASES

The balloon flight phases are demonstrated below with the relevant time, speed and balloon attitude.



Note on accident phases #3,#4,#5:

#3: Unstable approach followed by a hard landing
#4: Uncontrolled dragging of the passenger basket over uneven terrain, combined with basket instability
#5: Terminating with the balloon at a full stop 200 meters from the initial hard landing position.

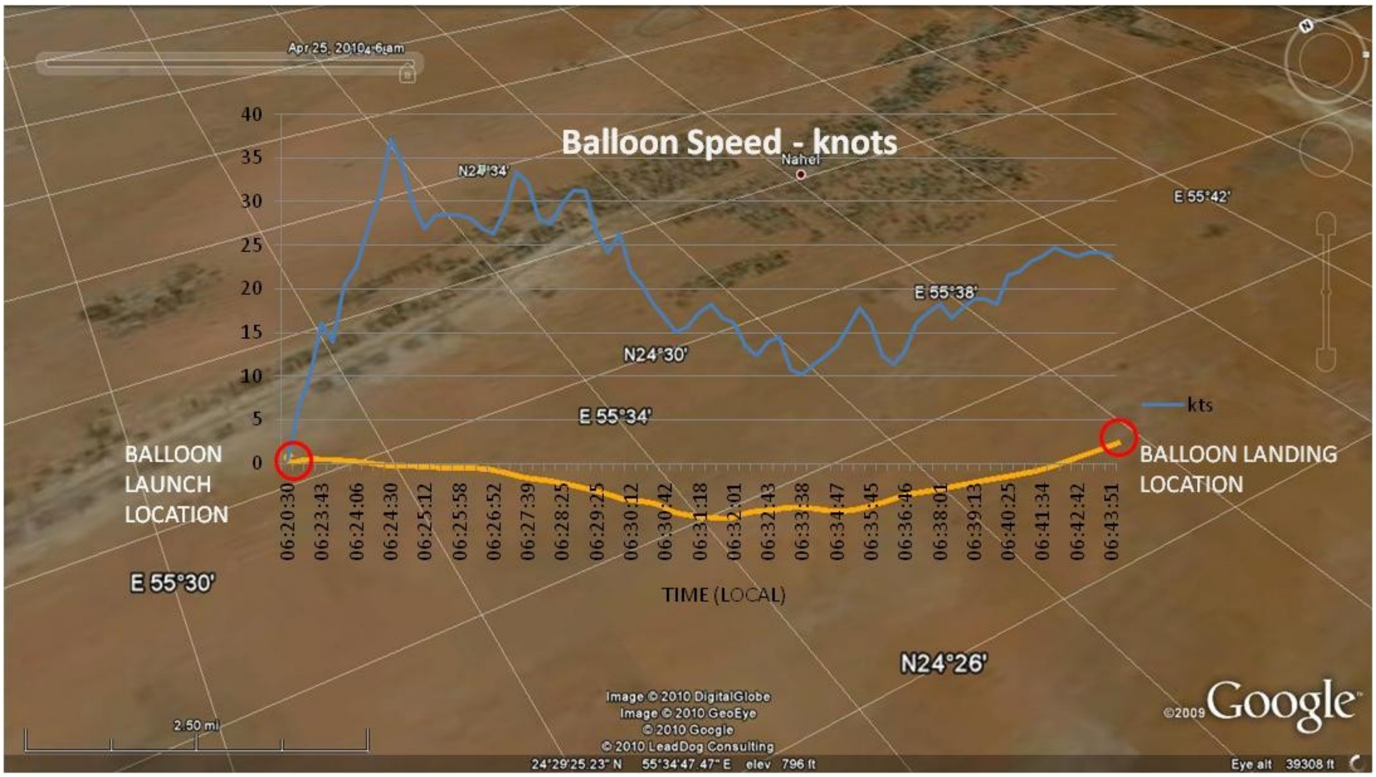
Without an ALT function on the GPS, it is possible to use the previous GPS flight data to estimate the flight profile by mapping the nominal ROC against the time elapsed during the flight, for the ascent phases - this is a simple function of the ROC and the elapsed time.

The GPS was switched on at 06:20:30(Local), the estimated wind / Balloon speed 3 minutes after launching was 7kts, 3 minutes 23 seconds after airborne 06:23:17(Local), at this point the estimated height was within 450-600 ft, considering the past random 15 flights equipped with GPS, the ROC (Rate Of Climb) for the first 10 recorded points was 200ft/min and the average ROC was 150ft.

The pilot reports reaching 2200’ ASL at the maximum altitude for this flight, before descending to a lower altitude, a maneuver which can be employed to reduce balloon speed, in accordance with known meteorological ALT and wind speed behavior.

BALLOON SPEED/FLIGHT DURATION

The flight data reconstruction is based on the GPS parameters



QUANTITATIVE GPS DATA ANALYSIS:

The speed and distance travelled data indicates that:

- within 4 minutes of launching the balloon the balloon speed peaked at 37 kts
- there is a nominal balloon speed decrease for the following 6-7 minutes
- the low speed recording is 10 kts around 13 minutes into the flight
- the balloon speed increases linearly until the GPS stops recording at 24 kts, which is the assumed time of the event

The gradual increase in balloon speed from 06:36:00 (Local) is significant as the pilot reports descending to reduce the balloon speed, at the time the GPS stops recording the balloon speed is around 24 kts.

3 CONCLUSIONS

Based on the evidence available, the following findings have been determined with respect to the balloon accident on 25 April 2010. These should not be read as apportioning blame or liability to any particular organisation or individual; these conclusions are factual only.

3.1 PROBABLE CAUSE

The General Civil Aviation Authority determine the primary probable cause of this accident as follows:

I. The unanticipated increasing balloon speed after the balloon launch which did not abate below a reasonable threshold for a safe landing before exiting the designated balloon flying area.

II. In the final phase of the flight, with the increasing balloon speed, the pilot elected to land the balloon onto an area of uneven terrain at an unavoidable high balloon speed.

3.2 FINDINGS

I. The high balloon ground speed combined with the time lapse of the RDS actuation and the pilot's judgment in the selection of the landing area are all contributing probable causal factors
II. The pilot's decision to launch the balloon in marginal weather conditions was a contributing cause to the accident
III. The balloon hard landing resulted in the passengers and extra crewman being displaced from the balloon due to the speed of the balloon and the instability of the balloon passenger basket as it travelled over the sand dune.
IV. The balloon hard landing loads resulted in tension failures in the fittings and tension straps of the steel frame of the basket with localised deformation of the passenger separating partition, which combined with the passenger injury statements and supporting medical evidence, was a contributing factor in the accident injuries.
V. The pilot workload while locating and selecting the landing site precluded a thorough passenger briefing for a hard landing. The briefing should have been sufficiently reinforced to emphasis to the passengers that they should maintain a constant grip of the retaining hand hold straps for the duration of the landing sequence.
VI. It is concluded that a contributing factor to the accident was that the hard landing inhibited the pilots reaction time due to the balloon passenger basket unusual attitudes, combined with the high balloon speed.

3.3 SIGNIFICANT SAFETY FACTORS

I. According to the pilot's statement, the pilot had no previous experience of high wind speed balloon operations
II. Launch wind speed limitations in the operators SOP have a top wind speed launch limit higher than the practical balloon operating limitations – this needs to be reviewed and reduced to an acceptable, safe level
III. Due to the unstable balloon approach to the landing site and the timing of the operation of the RDS, balloon operators should select flat landing sites when landing outside the balloon operating limits.

IV. Balloon operators should notify the ATC in the zone they are operating if there is a risk of injury to passengers

V. The location of the passenger seating in the balloon basket for landing was a factor in the survivability of this accident.

VI. The geographical boundary for balloon operations imposed by the designated flying area can contribute to the pilot's decision making on the landing site location. This can unintentionally increase the risk to the safety of passengers in the event that meteorological conditions change rapidly, combined with a priority to land the balloon as soon as practical inside the ballooning operating boundary.

VII. The certification of the balloon basket needs to address passenger safety when the passenger basket is in unusual attitudes and/or travelling at high speeds on uneven terrain, in particular passenger head protection and additional passenger forms of restraint .

VIII. The operating culture of the balloon operator is a factor in limiting the pilot's discretion concerning flyable weather conditions.

IX. The SOP of the operator did not allow for an emergency notification to OMAL ATC, consequently the pilot did not notify OMAL ATC that an accident had occurred.

X. The suspension of the operation a passenger balloon company under the jurisdiction of another CAA due to safety concerns of the balloon operation. The management of the suspended balloon operation are directly associated at an operational level with the management of this UAE balloon operation.

4 SAFETY RECOMMENDATIONS

1) The GCAA is recommended to perform a Safety Benefit Analysis (SBA) on balloon passenger safety modifications.

   The objective of the SBA is to build a safety case for passenger protection, including the requirement for passenger safety belt restraints, head protection helmets, passenger foam rubber insert 'wedges' or any other industry recognized safety enhancing feature:

   (a) This safety analysis should be conducive with all flight phases for passenger safety, including heavy landings, fire and passenger egress for passengers of reduced mobility.

   (b) The analysis should indentify all factors passenger protection, including providing passenger restraint belts/head protecting,

   (c) It is recommended to use Computer Aided Design tools to model passenger anthropomorphic limitations for use in identifying improved methodologies for certification, including modeling passenger behavior in high stress situations – for example, passenger behavior on weight and balance with a fire onboard.

   (d) Operational constraints should be factored into the SBA for safe and effective conduct of flight, for example – helmet use and unintentional jettison by passengers onto inhabited or built up areas.

   (e) A Cost Benefit Analysis (CBA) justification for the embodiment of safety factors in comparison to the overall potential safety risk is advised.

2) The GCAA should analysis the wind and flight monitoring data for seasonal local variations in wind speed and behaviour.

   (a) It is suggested that the GCAA, in conjunction with the balloon operators, build an empirical data model for balloon operating zonal trends due to the seasonal wind variations and localised temperature inversions/diurnal katabatic/anabatic winds

(b) If the balloon operators request an extension to the launch speed upper limit of 8 kts, the collection, storage and retrieval of the anemometer and GPS data will be required to formulate the safety case justification.

3) The GCAA should review the hot air balloon operating zone, indicating areas of allowable fly over or alternate landing zones if the metrological circumstances change and if landing in the designated landing zone will present a hazard to passenger safety.

(a) The existing zone should be rephrased as an Interim Agreed Flying Zone between the military, civilian or local authority, pending a GCAA update

(b) It is further recommended that the Military should define and request airspace restrictions to be included in the VFR chart issued by the GCAA

(c) Additionally as there are several GCAA file differences to ICAO, the allowable flying zone should be defined through the GCAA prior to implementing further requirements such as reporting incidents unless there is an agreement on interim local flying procedures.

(d) GCAA should update the VFR charts used by the operators

4) The GCAA Licensing should review the current licensing standards for issuing commercial pilots licenses.

5) The GCAA is recommended to review CAR Part IV/E, Special Purpose Operations/Manned Balloon Operations and update to the European Aviation Safety Agency (EASA) balloon OPS standards

6) The GCAA is requested to evaluate the feasibility of delegating the balloon oversight to an authorized private balloon operator club (similar to the UK BBAC). The club would then report to the GCAA as a self regulating entity

7) The GCAA is requested to regulate the process of the weather data gathering prior to the flight/launch decision, with accountable processes for decision making if the pilot's decision is delegated to the Duty Pilot or the Operations Manager and the balloon crew are offsite without internet access and the launch wind speed is marginal.

It is recommended to include the following:

I. The Duty Pilot or the Operations Manager/Chief Pilot involvement should be formalised unless the pilot and launch crew have onsite internet data available

II. In conditions of marginal mean high wind speeds up to the 8 kts limit, it is recommended that the GCAA introduce a cut off limit where the pilot has to report to operations if the mean wind speed is >5kts fluctuating -1kts/+3 kts for launch approval to the chief pilot who may clear the flight with no objections

ACCIDENT REPORT ENDS

REGULATIONS AND INVESTIGATION DEPARTMENT
GENERAL CIVIL AVIATION AUTHORITY
UNITED ARAB EMIRATES
INVESTIGATOR IN CHARGE: D. STRAKER
ISSUED ON 03 AUG 2010