الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

Air Accident Investigation Sector

Accident

- Final Report -

AAIS Case Nº: AIFN/0001/2016

Balloon Hard Landing

Operator:	Sindbad Gulf Balloon LLC
Make and Model:	Ultra Magic S.A, N-425
Nationality and Registration:	The United Arab Emirates, A6-AAN
Place of Occurrence:	Dubai
State of Occurrence:	United Arab Emirates
Date of Occurrence:	15 February 2016

Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

Accident Brief

AAIS Case Nº:	AIFN/0001/2016
Operator/owner:	Sindbad Gulf Balloon LLC
Aircraft make and model:	Ultra Magic S.A, N-425
Registration mark:	A6-AAN
MSN:	425/72
Number and type of engines:	MK-21 Quadruple burners
Date and time (UTC):	15 February 2016, 0342 UTC
Place:	Dubai, the United Arab Emirates
Category:	Transport (Passenger)
Persons on board:	21
Injuries:	1

Investigation Objective

This Investigation is performed pursuant to the UAE Federal Act No. 20 of 1991, promulgating the *Civil Aviation Law, Chapter VII- Aircraft Accidents*, Article 48; It is in compliance with the UAE *Civil Aviation Regulations, Part VI, Chapter 3*; in conformity with *Annex 13 to the Convention on International Civil Aviation*; and in adherence to the *Air Accidents and Incidents Investigation Manual*.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

Investigation Process

The occurrence involved an Ultra Magic N-425 balloon, registration A6-AAN, and was notified to the Air Accident Investigation Sector (AAIS) by phone call to the Duty Investigator (DI) Hotline Number +971 50 641 4667.

After the Initial/On-Site Investigation phase, the occurrence was classified as an 'Accident'.

An Investigation Team was formed in line with the *Annex 13* obligations of the United Arab Emirates, being the State of Occurrence, Registry, and the Operator.

The scope of the Investigation into this Accident is limited to the events leading up to the occurrence or the severity of its consequences; no in-depth analysis of non-contributing factors or non-safety related issues was undertaken.

Notes:

1 Whenever the following words are mentioned in this Report with the first letter Capitalized, it shall mean:

- (Accident) - this investigated accident.
- (Balloon) - the balloon involved in this accident.
- (Investigation) - the investigation into this accident.
- (Operator) – Sindbad Gulf Balloon
- (Pilot) - the pilot of the accident balloon.
- (Report) - this accident Final Report.

2 Unless otherwise mentioned, all times in this Report are 24-hour clock in Coordinated Universal Time (UTC), (UAE Local Time minus 4).

Synopsis

On 15 February 2016, at approximately 0650 United Arab Emirates (UAE) local time (LT), an Ultramagic Balloon, registration mark A6-AAN, operated by Sindbad Gulf Balloon (SGB), was conducting a commercial sightseeing flight at Margham, Dubai. There were a total of 21 persons onboard, 1 Pilot and 20 passengers.

The Balloon took off into conditions of almost no wind. The flight was carried out over a distance of approximately 10.8 kilometres with a duration of approximately 51 minutes 42 seconds. The maximum altitude reached was 1,937 feet, while the maximum Balloon speed was 9.1 knots, and the average speed was 7.3 knots.

Approximately five minutes prior to descent, the Pilot informed the passengers that the landing would take place within 15 minutes. About one minute before landing, the Pilot instructed the passengers to take the landing position, as briefed before the flight.

On landing, the Balloon contacted the ground with a smooth touchdown, and climbed again. Most of the passengers then attempted to stand up from the landing position while the Balloon was climbing. Thereafter, the Pilot announced that the landing was not yet completed and requested the passengers to remain in the landing position. When the Balloon reached approximately 54 feet above ground level, it descended continuously until the second touchdown, a hard landing.

Fourteen passengers were injured because of the hard landing, including one with serious injury. All of the injured passengers were hospitalised for medical attention.

The Air Accident Investigation Sector (AAIS) determines that the cause of the Accident was an uncontrollable Balloon condition prior to the second touchdown, which resulted in a hard landing and, as most of the passengers were not in the proper landing position, consequently fourteen passengers were injured.

The AAIS identifies the following contributing factors to the Accident:

- The Pilot did not abort the landing by reversing the fast deflation system, which was the correct recovery action, when the Balloon was climbing again after the first touchdown.
- The ‘couple landing position’ introduced for couple passengers by the Pilot, was not in accordance with the Operator’s manuals, *passenger safety instructions*, and the manufacturer *flight manual*.
- The relatively limited time available to the passengers to re-adopt the landing position, prior to the hard landing.
- It is likely that the Pilot was distracted due to his personal concerns, and this affected his performance on the occurrence flight, which resulted in loss of his situational awareness, especially in the landing phase.

Ten safety recommendations are included in this Report. They are addressed to the Operator and to the General Civil Aviation Organisation (GCAA) of the United Arab Emirates.

Abbreviations

AAIS	The Air Accident Investigation Sector
AOC	Air operator certificate
ARC	Airworthiness review certificate
CAAP	Civil Aviation Advisory Publication
CAR	*Civil Aviation Regulation*
CFR	Code of Federal Regulations of the United States
CoA	Certificate of Airworthiness
CoR	Certificate of Registration
CPL	Commercial pilot license
CSN	Cycles since new
DGAC	Direccian General de Aviacion (the Civil Aviation Authority of Spain)
EASA	European Aviation Safety Agency
ELP	English language proficiency
FDS	Fast deflation system
Ft	Feet
GCAA	The General Civil Aviation Authority of the United Arab Emirates
GPS	Global positioning system
ICAO	International Civil Aviation Organisation
Kt	Knot
L	Lift
MCTOM	Maximum certified takeoff mass
MHz	Megahertz
MSN	Manufacturer serial number
MTOW	Maximum takeoff weight
No.	Number
POC	Private operator certificate
ROC	Rate of climb
SEP	*Safety equipment procedures*
SGB	Sindbad Gulf Balloon
SOP	Standard operating procedure
TSN	Time since New
UAE	The United Arab Emirates
UTC	Coordinated Universal Time
VHF	Very high frequency

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1. Factual Information

1.1 History of Flight

On 15 February 2016, at approximately 0650 United Arab Emirates (UAE) local time (LT), an Ultramagic Balloon, registration mark A6-AAN, operated by Sindbad Gulf Balloon (SGB), was conducting a commercial sightseeing flight at Margham, Dubai. There were a total of 21 persons onboard, 1 Pilot and 20 passengers.

The Pilot reported for duty at approximately 0430 LT. He reviewed the weather forecast (METAR[1]) for OMDW[2] provided by the Operator's dispatcher. He then proceeded to the Balloon and checked the Operator's weather station located at the take-off site. The Pilot decided that conditions were suitable for the flight.

At the take-off site, the Pilot provided the safety briefing to the passengers for approximately five minutes before they boarded the Balloon. The briefing included takeoff and landing precautions, and various other safety requirements. The briefing highlighted the importance of wearing the safety harness during the flight and explained how to connect the harness to the floor anchor in the basket. For the landing, the briefing referred to the 'landing position', in which the passengers must keep their backs to the direction of flight, their knees bent at an angle of about 45 degrees and they must stand side by side in a shoulder to shoulder position while holding the rope handles in the basket with both hands.

The Pilot also briefed and demonstrated a landing position for couples; the 'couple landing position'. In this position, one person, normally the male, places his back against the wall of the basket as in the normal landing position and the female is seated in front of him facing the same direction. The back of the female rests on the chest of the male passenger.

The basket has four passenger compartments, and the Pilot distributed the passengers so that there were five passengers in each compartment.

After the passengers boarded the basket, the Pilot performed a safety check while the passengers were wearing their safety harnesses. One of the passengers, who was also a balloon pilot employed by the Operator, helped by checking that the passengers had latched their harnesses correctly, depending on the position in which they were located in the basket.

Before takeoff, the Pilot communicated with Dubai approach control using a mobile phone for the take-off clearance, and takeoff was approved.

At approximately 0250 UTC, the Balloon took off into conditions of almost no wind, and the Pilot communicated with Dubai approach control using a portable VHF radio set to 122.5 MHz, requesting clearance to climb to a maximum altitude of 2,000 feet. This request was approved by the controller.

The flight was carried out over a distance of approximately 10.8 kilometers with a duration of approximately 51 minutes 42 seconds. The maximum altitude reached was 1,937 feet, while the maximum Balloon speed was 9.1 knots, and the average speed was 7.3 knots.

According to the Pilot's statement, approximately five minutes prior to descending, he informed the passengers that the landing would take place within 15 minutes.

[1] Meteorological Terminal Air Report (METAR) is a format for reporting aviation routine weather information of aerodromes

[2] ICAO Code for Al Maktoum International Airport

During the descent to the landing zone, the Pilot did not use the parachute control line to control the rate of descent. He managed the rate of descent using only the burners. The maximum rate of descent was approximately 877 feet per minute (ft/min).

About one minute before landing, the Pilot instructed the passengers to adopt the landing position, as briefed. At 1.5 to 2 meters above the ground, he deployed the fast deflation system (FDS).

The sink rate was approximately 53 ft/min when contacting the ground which was a smooth touchdown, however the Balloon climbed again.

Most of the passengers then attempted to stand up from the landing position while the Balloon was climbing. Thereafter, the Pilot announced that the landing was not yet completed and requested the passengers to remain in the landing position.

The Balloon climbed smoothly for about 22 seconds, and reached a maximum rate of climb of 278 ft/min.

While the Balloon was climbing after the first touchdown, the Pilot closed the burners. When the Balloon reached approximately 54 feet above ground level, it descended continuously until the second touchdown, a hard landing, with a sink rate of 406 ft/min on touchdown. The Balloon was in the air for 34 seconds after the first touchdown. The Balloon speed was approximately 2.5 knots on the hard landing. Figure 1 shows the take-off and landing area of the Balloon.

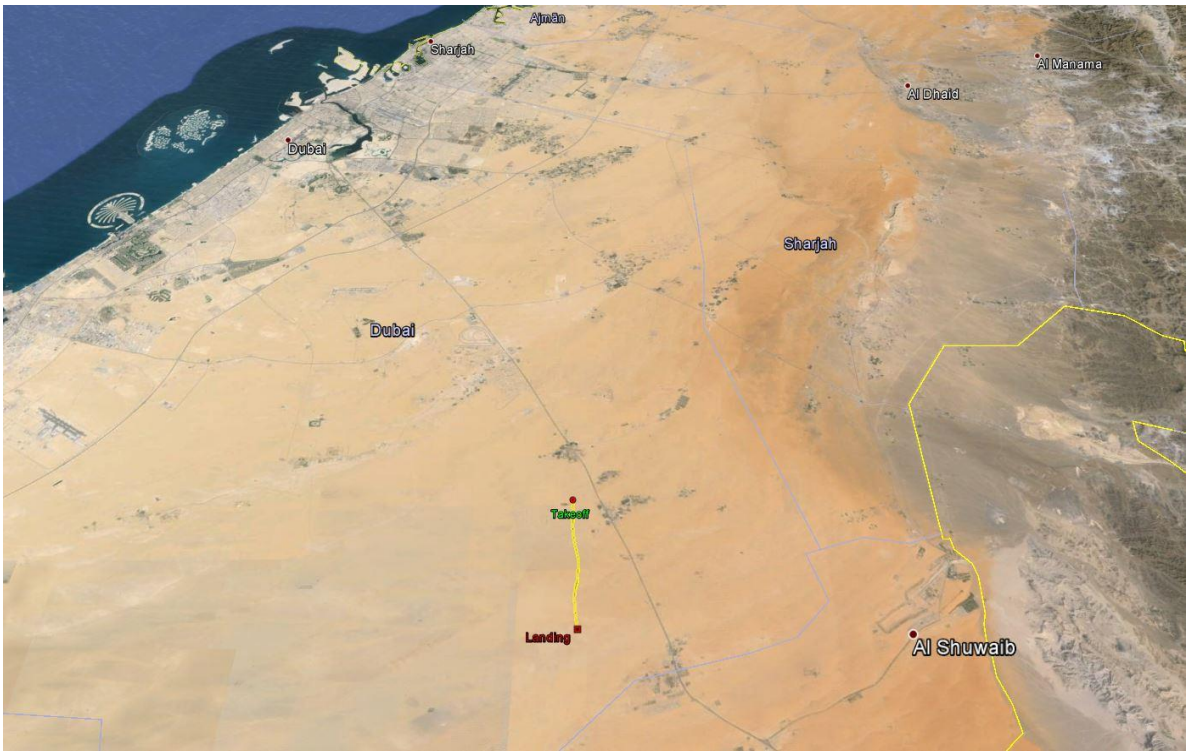

Figure 1. Area of the takeoff and landing

Fourteen passengers were injured because of the hard landing, including one who suffered serious injury. All of the injured passengers were hospitalised for medical examination following the occurrence.

1.2 Injuries to Persons

Table 1 shows the injuries. The seriously injured passenger suffered a dislocation of his right ankle.

Table 1. Injuries to persons

Injuries	Flight crew	Cabin crew	Other crew onboard	Passengers	Total onboard	Others
Fatal	0	0	0	0	0	0
Serious	0	0	0	1	1	0
Minor	0	0	0	13	13	0
None	1	0	1	5	7	0
TOTAL	**1**	**0**	**1**	**19**	**21**	**0**

1.3 Damage to Aircraft

The Balloon was undamaged.

1.4 Other Damage

There was no damage to property, or the environment.

1.5 Personnel Information

The qualifications of the Pilot are as shown in table 2.

Table 2. Qualifications of the Pilot

Gender	Male
Date of birth	2 September 1981
UAE GCAA license category and rating	Commercial pilot license (CPL) (B) temporary validation No. REF-1407 referring to foreign license, hot air balloon
Issue date	24 November 2015
Expiry date	23 February 2016
Class and date of last medical	Class II ; 2 March 2015
Flying Experience	
Total hours all balloon types	951.4 Hours
Total hours on type	502.05 Hours
Total last 7 days	5 Hours and 15 Minutes
Total last 28 days	12 Hours and 10 Minutes
Total last 24 hours	45 Minutes
English language proficiency (ELP)	Level 4

The Pilot had been employed by the Operator since the company started operations on 1 January 2016. The Pilot was scheduled to operate one flight only on the day of the Accident. As per the Operator's policy, each pilot can perform only one flight per day.

According to a foreign civil aviation authority of a country where he did most of his flying, the Pilot had never experienced an accident, incident or any enforcement actions until he joined the Operator in the UAE acting as a balloon pilot.

One day before the occurrence, the Pilot asked the Operator's management whether he could take a short leave as he had to visit his home country. He did not mention the purpose of his request.

The Pilot informed the Investigation that he had family issues at home over several days before the occurrence flight.

1.6 Aircraft Information

1.6.1 General

The certification basis for the Ultramagic N-425 balloon is in accordance with the requirements of la Direccion General de Aviacion Civil (DGAC) of Spain, following the United States *14 Code of Federal Regulations (CFR),* part 31, amendment 5, dated 18 August 1990. The type certificate approval of the Ultramagic N-425 balloon was obtained on 30 April 2001 from the DGAC. The European Aviation Safety Agency (EASA) certification for the Ultramagic N-425 balloon type was obtained on 19 January 2006.

The Balloon configuration was:

- Envelope, type N-425 (volume 12,000 m^3)
- Quadruple burners, type MK-21
- Basket, type C12
- Empty weight: 860 kg
- Maximum lift (Lmax): 3,860 kg

Table 3 illustrates the Balloon data.

Table 3. Balloon data

Manufacturer:	ULTRA MAGIC, S.A
Model:	ULTRAMAGIC N-425
Manufacturer serial number (MSN):	425/72
Date of manufacture:	December 2013
Nationality and registration mark:	UAE, A6-AAN
Name of the owner:	Sindbad Gulf Balloon
Name of the Operator:	Sindbad Gulf Balloon
Certificate of Airworthiness (CoA)	
Number:	UAE-COA-0367
Issue date:	25 November 2015
Valid to:	1 year as Airworthiness Review Certificate (ARC) valid to 24 November 2016
Certificate of Registration (CoR)	
Number:	UAE-COR-0878
Issue date:	19 November 2015
Valid to:	Open
Date of delivery	18 November 2014
Time since new (TSN) – flight hours:	20.4 Hours
Last inspection and date:	10 February 2016
Engines	burner

Maximum takeoff weight (MTOW):	4,140 Kg

The allowable maximum rate of descent is 5 m/sec (1000 ft/min).

The Balloon had not suffered any failures and was airworthy when dispatched for the flight.

1.6.2 Burners

The burner is the engine of the hot air balloon which converts the fuel (liquid propane) stored in the fuel cylinders into heat energy. This energy is used to heat the air inside the balloon envelope and thus provide the means of inflation and altitude control during flight.

The MK-21 Quadruple type burners, as illustrated in Figure 2, were used to inflate the Balloon envelope to provide lift.

The burners are controlled by an On-Off main blast valve mounted below the burner, and within easy reach of the Pilot.

Figure 2. Burners

1.6.3 Envelope

1.6.3.1 General

The N-425 type envelope was composed of 28 gores stitched together. The envelope material was manufactured from a high resistance polyamide fabric reinforced by several polyester load tapes. The tapes transmit load forces via stainless steel cables to the load frame. The lowest part of the envelope was made of heat resistant Nomex.

The envelope had the following specifications:

- Volume: 12,000 m^3
- Total height: 31.2 meters
- Weight: 360 kg
- Diameter at the equator: 35.5 meters
- Diameter at the mouth: 4 meters
- Parachute diameter: 7.5 meters with FDS

1.6.3.2 Parachute

On the top of the envelope there was a large hole where there was no fabric, only the mesh of the load tapes. The hole is covered from the inside of the envelope by a loose panel of fabric, which is centered by a system of cords and the fabric panel resembles a parachute. The parachute was kept closed by the internal pressure of the balloon, so that it seals tightly against the opening and the mesh formed by the load tapes. The parachute can be opened from the balloon basket by pulling a cord. When the cord is released, the parachute reseals after a few seconds.

The parachute control cord activates the parachute vent, or valve. This can either vent off hot air, or can completely deflate the envelope. Final deflation is achieved by pulling the line completely and holding in this position. Figure 3 shows the parachute control mechanism.

The parachute control cord, which is a red-white coloured polyester on the outside with a Kevlar inside, runs through a pulley inside the envelope to the parachute lines at another pulley and then back to a fixed point inside of the envelope. The pulleys reduce the effort required to open the parachute.

According to the *Flight Manual*, using of the parachute vent system in-flight should not be longer than three seconds at a time. Re-use must not be attempted until the envelope has re-inflated. This limitation is labelled as a CAUTION.

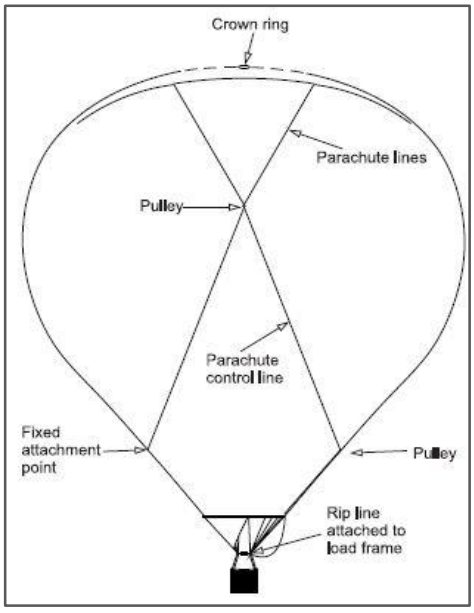

Figure 3. Controlling the parachute

1.6.3.3 Fast deflation system (FDS)

The Balloon was equipped with a fast deflation system (FDS), which incorporates the parachute venting system, and it has extra opening capabilities. As shown in Figures 4a and 4b, the rip line, which is red in colour, pulls the centre of the parachute together creating a large opening, which allows a large outflow of hot air for final deflation of the envelope. The line must not be used for venting. The opening action of the red rip line (the FDS) can be reversed by pulling on the red/white parachute (vent) cord/line.

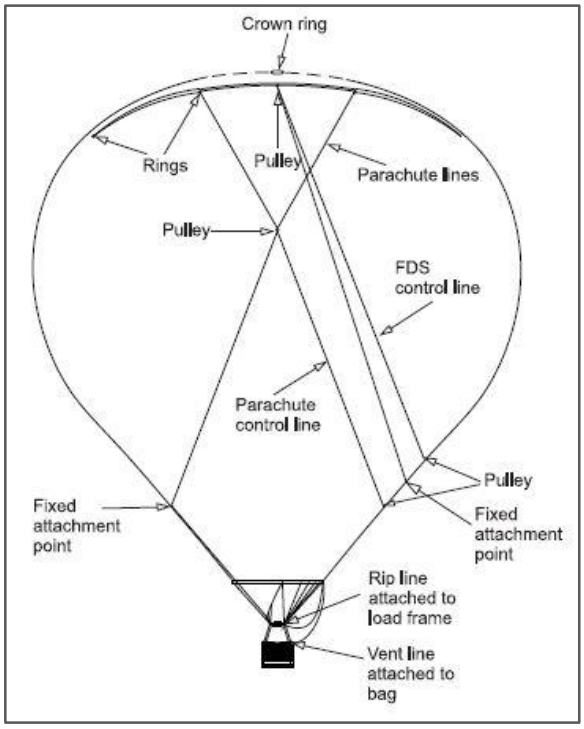

Figure 4a. FDS closed

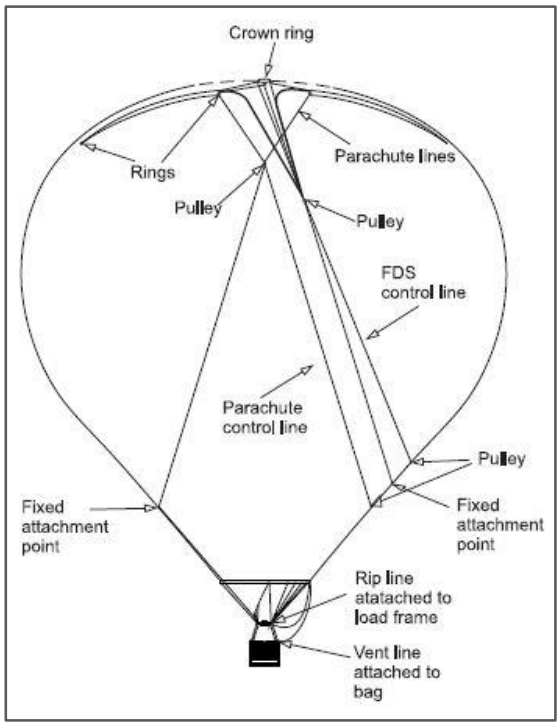

Figure 4b. FDS open

According to the *Flight Manual*, it is forbidden to use the red rope of the FDS at an

altitude higher than 10 m (30 feet) above the ground, and this is labelled in the manual as a WARNING.

1.6.3.4 Rotation vents

The Balloon was equipped with rotation vents to rotate the Balloon about the vertical axis, either to position the long side of the basket for landing, or for general positioning of the Balloon. Rotation is achieved by venting air through a panel about the equator of the Balloon. There are vents to rotate the Balloon in either direction. The blue line rotates the Balloon in a clockwise direction, and the black line in an anticlockwise direction. The panel reseals against its overlap panel when the line is released. Figure 5 shows a single-side turning vent assembly. An equivalent double-sided turning vent was installed on the Accident Balloon.

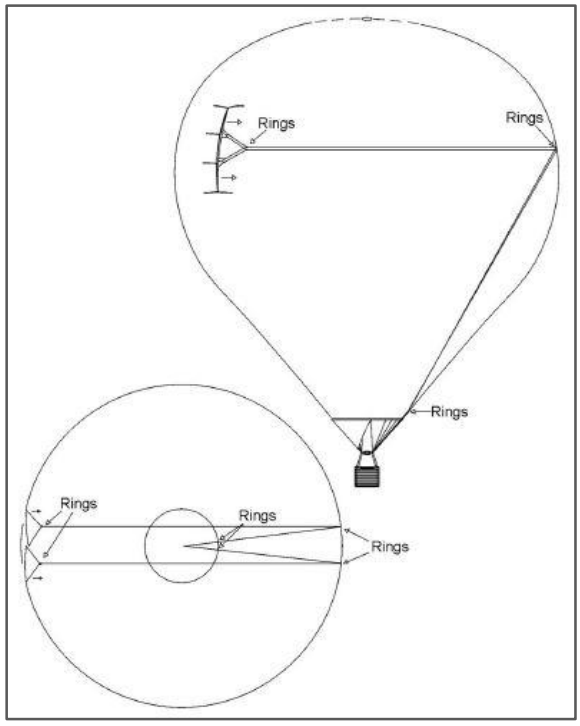

Figure 5. Turning vents assembly

1.6.4 Basket

The Balloon was equipped with a C12 type basket which had five partitioned compartments, as shown in Figure 6. The passengers are accommodated in four compartments. The Pilot and fuel cylinders are accommodated in a separate compartment. The maximum number of passengers in each passenger compartment is six.

The basket was made from woven willow and cane on a marine plywood base. Various openings were woven in to accommodate step holes and strap holes for cylinders.

The basket was connected to the load frame by a minimum of four stainless steel cables that pass down the sides and through and under the base. These cables are continuous in pairs.

The size of the basket was 1.7 x 4.5 meters, and the maximum landing weight was 3,712 kg.

There were five passengers in each passenger compartment of the basket during the Accident flight.

Figure 6. Basket

1.6.5 Maintenance

The technical logbook provided to the Investigation shows a damage to the lower part of the envelope after a flight on 9 February 2016. The envelope fabrics had been replaced according to the Balloon *maintenance manual*, as per Job No. SGBI AAN/003 on 10 February 2016. Three flights were performed uneventfully after the replacement of the fabric.

There were no reported significant technical defects prior to the Accident, according to the records provided to the Investigation, nor was there any mechanical anomaly prior to the liftoff.

No damage to the Balloon was noted following the occurrence.

1.7 Meteorological Information

Table 4 shows the METAR for Al Maktoum International Airport on 15 February 2016, over the period from 0200 to 0400 UTC.

Table 4. METAR, 15 February 2016, 0200 to 0400 UTC
METAR OMDW 150400Z 16006KT 6000 NSC[3] 13/12 Q1021 NOSIG=[4] **METAR OMDW 150300Z 17007KT 5000 NSC 11/11 Q1021 BECMG 3000 BR[5]** **METAR OMDW 150200Z 16006KT 6000 BR FEW001 13/12 Q1020 BECMG 0500 FG BKN001**

Table 5 describes the above mentioned METAR.

Table 5. Description of the METAR			
	0200 UTC	**0300 UTC**	0400 UTC
Wind	160°/06kts	170°/07kts	160°/06kts
Visibility	6 km, Mist	5 km	6 km
Clouds	Few (1-2 oktas) at 100 feet	No Significant cloud	No significant cloud
OAT	13°C	11°C	13°C
Dew Point	12°C	11°C	12°C
Pressure (Altimeter)	1020 mb	1021 mb	1021 mb
Condition	Becoming at 0500 UTC with Fog, and broken (5-7 oktas) clouds at 100 feet	Becoming 3 km visibility and mist	No significant change

The Operator had a Sindbad Gulf Balloons (SGB) weather station at the takeoff / liftoff site. The weather information, which was also recorded in the technical log of the flight, was as follows:

- Time: 0630 LT (0230 UTC)
- Wind at surface: South, 02 knots
- Wind at 2,000 feet: North East, 09 knots
- Clouds: BKN001 (5-7 oktas clouds at 100 feet)
- QNH: 1000.4 HPa

[3] NSC means No Significant Cloud

[4] NOSIG means that no significant change is expected to the reported conditions within the next 2 hours

[5] BR means Mist

1.8 Aids to Navigation

The Balloon was equipped with a portable GPS, an IPAD which had the required Apps installed, a Transponder, and a Flytec 3040 Altimeter, all of which were operating normally.

1.9 Communications

The aircraft was equipped with a portable VHF radio and a mobile phone. The mobile phone was only used for communication when the Balloon was on the ground.

1.10 Aerodrome Information

The Balloon lifted off from the Operator's base located in the desert area of Margham, Dubai, UAE, as shown in Figure 1.

1.11 Flight Recorders

Both the portable global positioning system (GPS), and the iPAD, had the capability to record flight data.

Google Earth Software was used to read out flight data to assist the Investigation.

The downloaded height, rate of climb, and Balloon speed data are given in Figures 7a and 7b. The figures represent the time period from the start of descent, to landing.

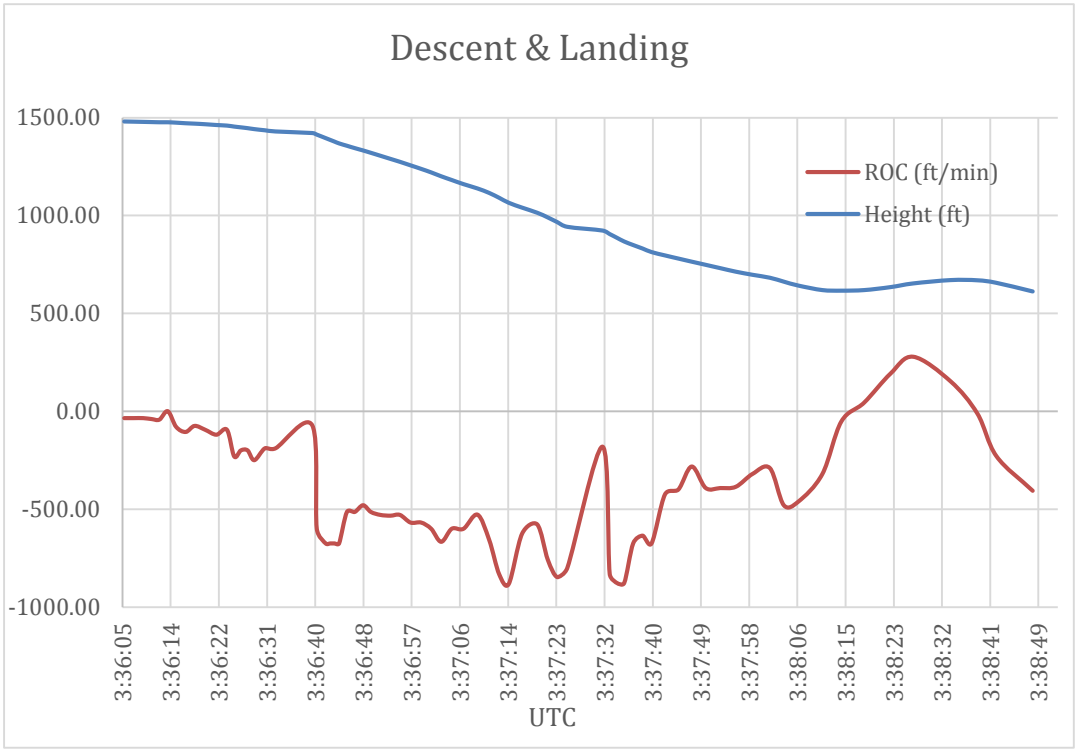

Figure 7a. Vertical speed and height during descent and landing

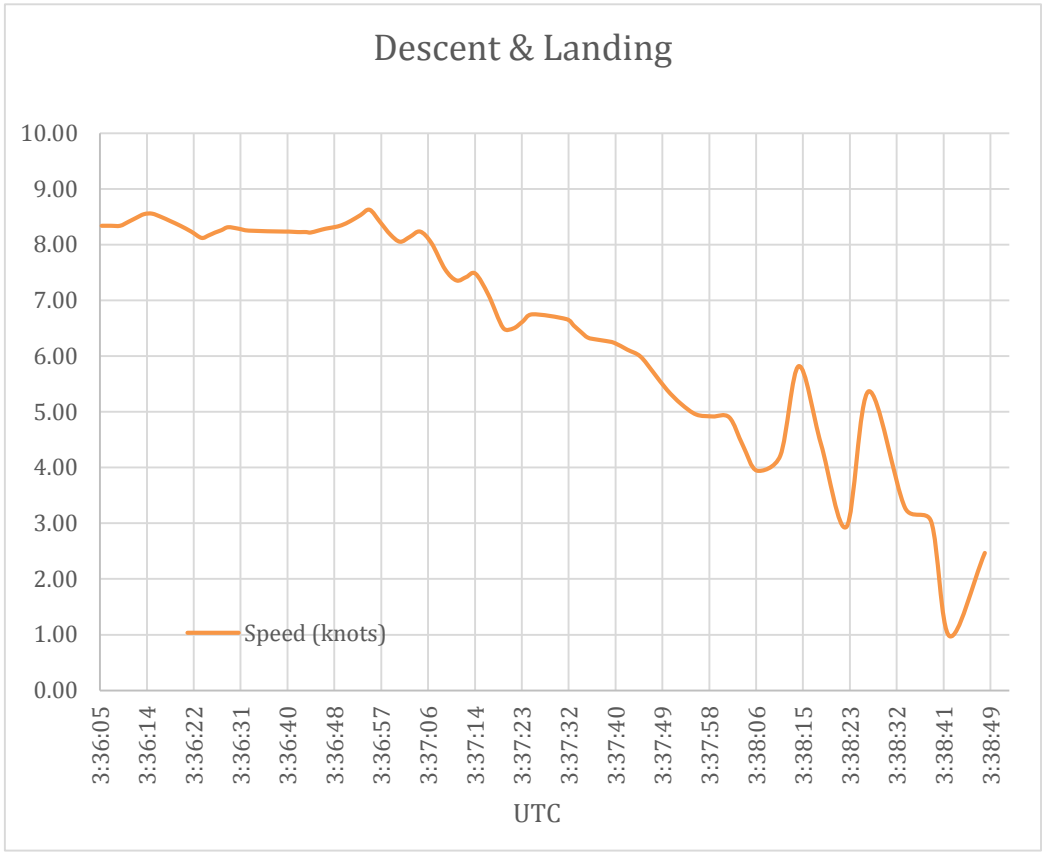

Figure 7b. Balloon speed during descent and landing

Figures 8a to 8c show the last part of the final approach of the Balloon. The events shown in this figure are based on the information obtained from the Pilot, which includes the final application of the burners, FDS deployed, first touchdown, turning off the cylinder valves (shutdown of the burners), and the second touchdown.

The final burner application was estimated to have been between 10 and 12 seconds before the first touchdown, and it was continuously used for a relatively longer period.

The FDS was deployed about 1.5 to 2 meters (4.9 to 6.6 feet) above ground level.

The Pilot extinguished the pilot lights, and all the cylinder valves were closed after the first touchdown as the Balloon was climbing, before it descended again for the second touchdown.

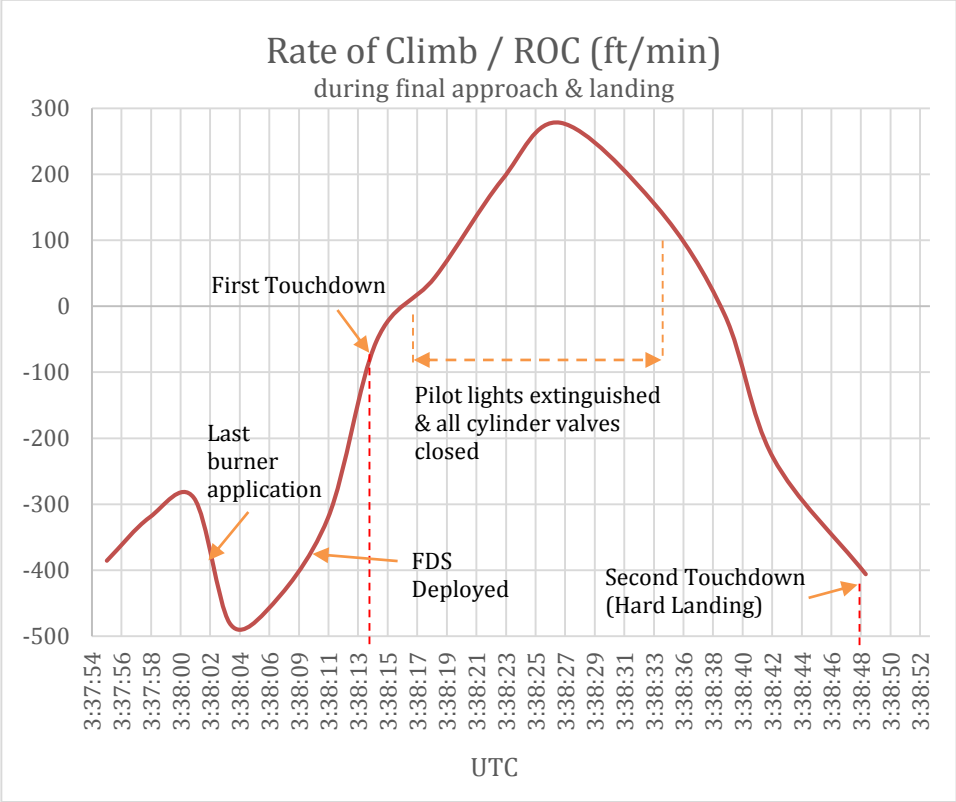

Figure 8a. Vertical speed on final approach and landing

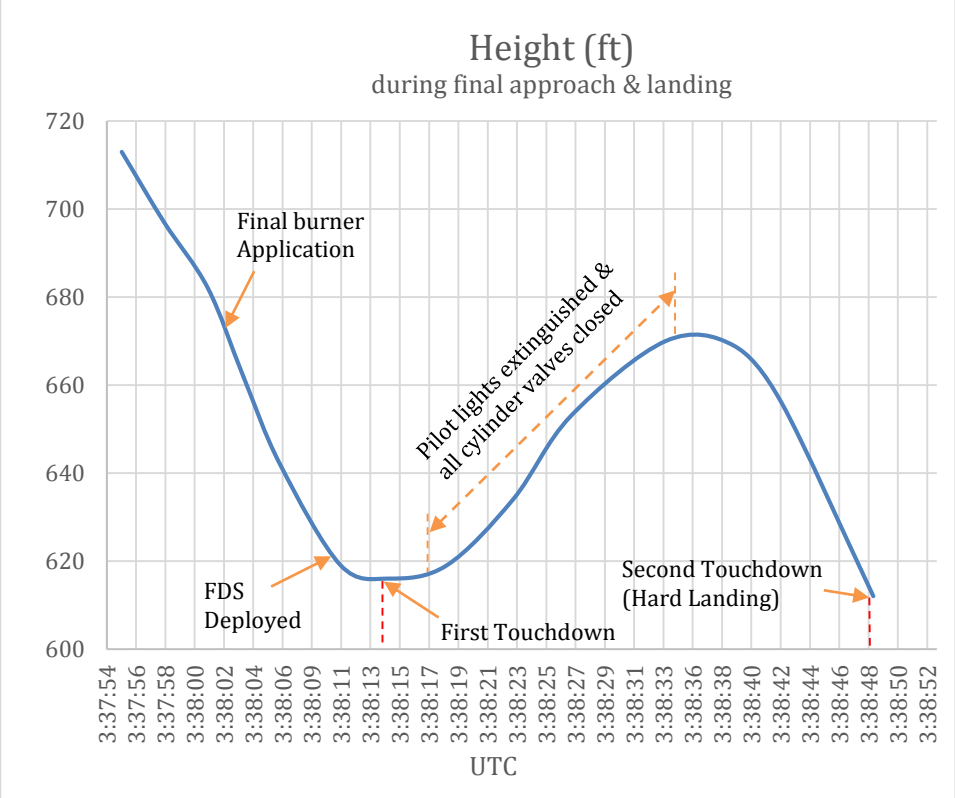

Figure 8b. Height on final approach and landing

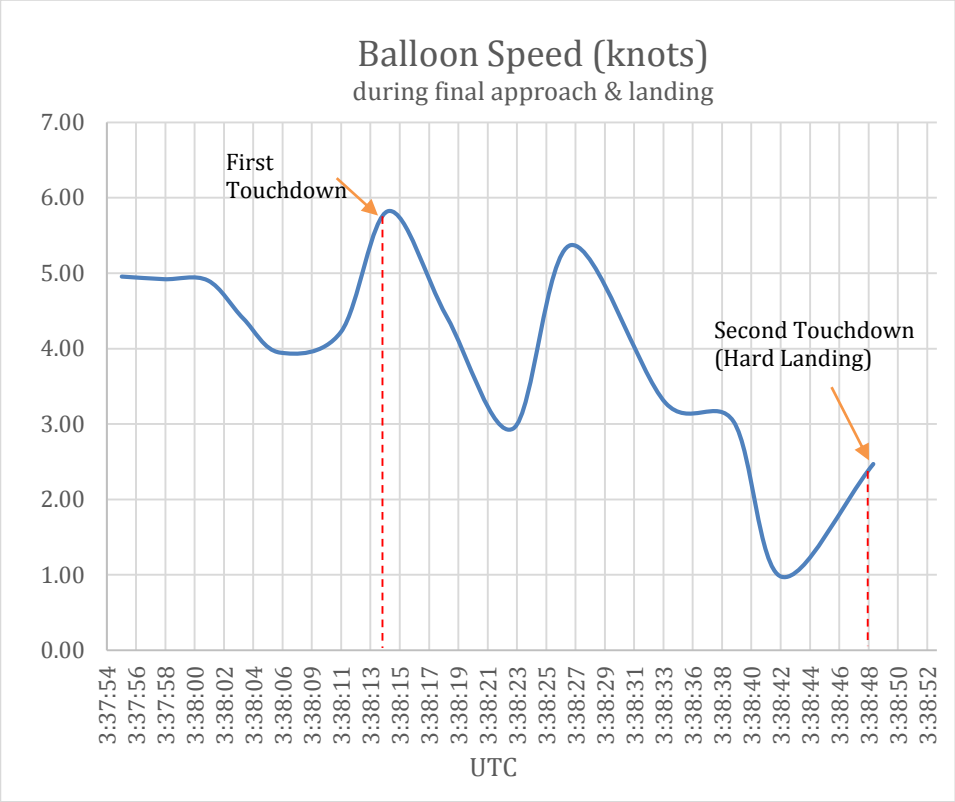

Figure 8c. Balloon speed on final approach and landing

1.12 Wreckage and Impact Information

The Balloon was intact after the occurrence.

1.13 Medical and Pathological Information

Before the flight, all the passengers signed the Operator's terms and conditions for the Balloon flight, which included a declaration that they were physically and emotionally fit. In the terms and conditions declaration form a "not to have" list of serious medical problems is included, as follows:

- Serious Heart problem
- Serious knee and back bone Surgery/problem
- Phobia in height
- Pregnant lady
- Disabilities covering:
  - Mental health and emotional disabilities
  - Physical disabilities covering impairments

As a result of the occurrence, fourteen (14) of the twenty one (21) occupants were injured. Thirteen (13) passengers were released from hospital on the same day with most suffering pain in their neck/shoulder area and ankles. One passenger was seriously injured having suffered a dislocated right ankle, and surgery was required.

1.14 Fire

There was no sign of fire.

1.15 Survival Aspects

On landing, the initial touchdown was smooth and uneventful. Most of the passengers then attempted to stand. However, the Balloon climbed away from the ground. The Pilot advised the passengers that the landing had not yet been completed and he directed the passengers to remain in the landing position. The Balloon was in the air for approximately 34 seconds before it touched the ground for the second time and then halted.

At the time of the second touchdown, most of the passengers had not regained the correct landing position. This resulted in the injuries detailed above. However, all the passengers had fastened their belts during the flight.

The fourteen injured passengers required medical assistance, and they were transferred to hospital.

1.16 Tests and Research

No tests or research were conducted for this occurrence.

1.17 Organizational and Management Information

The Operator obtained its Air Operator Certificate (AOC) from the UAE GCAA on 30 January 2015 with six months validity, and commenced operations on 1 January 2016.

The AOC certified the Operator to perform as a Private Operator providing passenger service.

At the time of the occurrence, Sindbad Gulf Balloon LLC operated two balloons, the Ultramagic N-425 and an S-160, and the company employed two approved operating pilots.

1.17.1 Pilot pre-flight self-check

Section 2 of the Operator's *Operations Manual Part A* prescribes the requirements for operational control and supervision. Under Paragraph 2.2.2., the requirements for pre-flight self-check for the pilot are given, as follows:

> "Every flight Pilot will self-check during which the Pilot will explain the following:
>
> I'M (Pilot) SELF check
>
> I Illness? Do I have any symptoms?
>
> I Medication? Are you using any kind of prescription or drugs?
>
> I Stress? Am I under psychological pressure from the job or home?
>
> Any worries about financial, health or family problems?
>
> I Alcohol? Have I been drinking within eight hours? Within 24 hours?
>
> I Fatigue? Am I tired and not adequately rested?
>
> I Eating? Have I been eating and drinking adequately?
>
> NOTE: Preflight yourself as carefully as you preflight your balloon before any flight. If one of the questions above can be answered with yes then reconsider the flight. If you have any doubt, do not go!"

The same pilot pre-flight self-check requirements are also given in Paragraph 2.1 of the Operator's *Standard Operating Procedures* (*SOP*).

1.17.2 Passenger briefings

The responsibility of the pilot regarding the conduct of passenger briefings is prescribed in Paragraph 1.4 of the Operator's *Operations Manual* Part A, as follows:

> "**1.4 Authority, Duties and responsibility of the commander**
> - The minimum crew shall consist of one pilot. If a crew consist of more than one pilot, then one pilot will be designated a captain. The captain is responsible for briefing the passengers before and during the flight.
> - …"

According to the Operator's *Operations Manual*, the procedures for briefing the passengers are given in Paragraph 8.1.1, as follows:

> "**8.1.1 Passenger Briefing**
>
> PIC shall make sure that occupants other than crew members are properly briefed on the safety features of the Balloon. Briefing must comprise:
>
> - Use of harness.
> - Fire Extinguisher location
> - First Aid Box location
> - No smoking
> - Use of portable electronic devices
> - Airsickness moment
> - Passengers don't touch cylinder, fuel valves and any control ropes in the pilot compartment."

According to the Operator's *SOP*, the requirements for passenger briefing are given in Paragraph 3.10, which are the same as shown in Paragraph 8.1.1 of the Operator's *Operations Manual*.

In Appendix K, Paragraph 1.2 of the *Operations Manual*, prescribes all briefings required given to the passengers, as follows:

> "**Appendix K Briefings**
>
> **1. General Briefing**
>
> **1.1. …**
>
> **1.2. Passengers Briefing**
>
> - Check all of your passengers are present.
> - Introduce yourself.
> - Make sure the listen to your briefing and understand
> - Brief them about :
>   - No smoking
>   - No touch the control and equipment
>   - No dropping object and secure
> - Brief the about the inflation and their involvement if any
> - How to Get in and Exit of the basket

- Explain and demonstrate the takeoff and landing position
- Brief the about the Camera , long Hair, Scarf, Bags and lose items
- Ask them again if they understand your briefing or they have any question

1.3. Pre flight

- Remind them about takeoff position and check
- Brief them that balloon will depart

1.4. Pre landing

- Remind the landing position and check
- Brief them to stay in the basket tell the clear from the captain
- Brief them that will be after landing briefing

1.5. After landing

- Brief them about deflation and keeping away from wire
- Show them best to exit the bask
- Make sure to use the steps and holding safe place."

1.17.3 Landing position

In paragraph 8.2.2 of the Operator's *Operations Manual* Part A, examples are provided as to what the pilot will say in the safety briefing to all passengers. The "Landing Position" (see also Figure 9) is mentioned in points 6 and 8, as follows:

"…

6) ONCE IN THE COMPARTMENT WE SHALL PRACTICE THE 'LANDING POSITION'(demonstrate), WHICH IS: HANDS HOLDING TWO ROPE HANDLES;FEET FLAT ON THE FLOOR;BACK AGAINST THE PADDING;FACING BACKWARDS (OPPOSITE TO SCOOP OR QUICK RELEASE) (indicate); SHOULDERS LEVEL WITH BASKET EDGE;KNEES BENT. LIKE A SKI POSITION.

…

8) QUITE IT IS POSSIBLE THAT THE BASKET MAY TIP OVER ON LANDING.THIS IS NORMAL AND SAFE AS LONG AS YOU ARE IN THE LANDING POSITION."

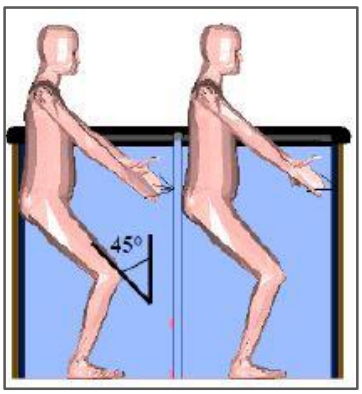

Figure 9. Landing position

In Paragraph 2.1 of the Operator's *SOP*, examples are provided as to the content of the passenger safety briefing:

"…

- Once in the passengers are in compartments pilot will demonstrate the LANDING POSITION during landing. Which includes hand holding one/two rope handles, feet flat on the floor, back against the padding, facing backwards (opposite to scoop or quick release), shoulders level with basket edge, knees bent like a sky positions.

- Quite it is possible that the basket may tip over on landing, this is normal and safe as long as you are in the landing position.
- …"

1.17.4 Signed bond form

In Paragraph 1.7 of the Operator's *SOP* – SGB Passenger Criteria, it is stated that the passengers are required to sign a declaration that he/she does not have certain serious medical problems as listed, called "Read Before Signing (Indemnity) or Bond" form, as given in Appendix - 2 of the Operator's *SOP*.

For the occurrence flight, all of the passengers signed the Bond form. The safety instructions were printed on the back of the form. The passenger Safety Instruction is described in Appendix-1 of the Operators *SOP.*

1.17.5 Training

All required training for the Pilot was provided as per the Operator's *Operations Manual*.

1.17.5.1 In-house training

Section 5 of the Operator's *Operations Manual* Part A describes the qualification requirements for the of the Operator's staff, including pilots. Paragraph 5.4 lists the required in-house training as follows:

"**5.4 PILOTS/ENGINEERS/GROUND CREW TRAINING**

Whenever any new staff (Pilot or Engineer or Ground Crew) join with SGB, before they start to perform duties must undergo the following in-house training.

a. SMS training which include ERP

b. All related approved manual briefing

c. SOP training

d. Human factor training

e. Technical Log filling training"

The same in-house training requirements are also given in paragraph 3.7 of the Operator's *SOP*.

The Operator's pilots were provided with in-house training as listed in the Operator's *Operations Manual* Part A, before they started operating as a balloon pilot.

1.17.5.2 Pilot Training

Section 2 of the Operator's *Operations Manual* Part D – *TRAINING*, describes the requirements of pilot training, as follows:

"**2. Pilot training**

A pilot joining the company will carry out such training as Dir. OPS may require bearing in mind his flying experience. This training will consist of conversion to balloon type and line flying under supervision.

Prior to starting company flying, specialist safety

equipment procedures SEP training must be completed and certified on the Training Check Form (see appendix J) by the authorized examiner and must be repeated at 3 yearly intervals Prior to starting company flying a combined base / line check will be carried out and certified on the combined check form by a type rating examiner, unless the training record of another operator is accepted.

A pilot may be required to perform further line checks under supervision followed by a final check. These flights may be public transport flights with passengers onboard, provided that the initial line check was carried out during the preceding combined check. In the case of an experienced pilot joining the company the Director of Operation may use his discretion and accept the training record.

Pilots upgrading to significantly larger balloons should not fly in surface wind speeds exceeding 8 kts for the first ten public transport flights on the larger balloon. Subsequent to this, the following line check, the restriction may be removed up on the positive recommendation of the chief pilot or TRE. For the purpose of this requirement (significantly) is defined as (envelope capacity in excess of 50% larger than the largest envelope capacity up on which the pilot has under taken ten public transport flights within the past 24 months.) for example a pilot who had previously operated a balloon of 120,000 cu. ft., this requirement would applicable for balloons in excess of (but not including) 180,000 cu. ft

Periodic checks

Pilots are required to complete a combined check flight once every 12 months to check their continued competence to operate a public transport flight. This check will include emergency procedures normal operation and safety and emergency equipment. The check will be certified on the combined check form CCF (see appendix J) by a type rating examiner. The check flight must be free flight.

The company check flight includes all items for a (certificate of test) signature in the pilot's professional license and will include all items shown on the combined check form (see appendix J). Some of the emergency procedures are not required to be carried out in-flight during the check. These items may be simulated on the ground.

Individual checks are not required for each existing balloon group in the pilot's license if a balloon in that group is to be flown for public transport. A test in a Group B balloon is also valid for a Group A balloon. A test in a group C balloon is also valid for groups A & B balloons.

> On completion of a check, the Check Form will be put in the pilot's training file for a period of at least 2 years.
>
> …
>
> **Survival equipment training and testing**
>
> The following equipment must be included in company training:
>
> First Aid Kit
>
> Fire Extinguishers
>
> Passenger safety harness
>
> A company pilot's knowledge of the location and use of the emergency and lifesaving equipment will be tested by Type Rating Examiner as part of the line check
>
> Company personal should be given every opportunity to familiarize themselves with all equipment on regular bases."

The Pilot was type rated for all hot air balloons types, A, B, C and D, by a foreign civil aviation authority. A confirmation letter from the foreign authority to the Operator was produced mentioning the renewal of the Pilot's CPL (Balloon) license on type D, valid from 3 December 2015 until 30 June 2016. Based on the Pilot CPL (Balloon) foreign license and the confirmation letter, the GCAA provided temporary validation of his CPL (Balloon) foreign license from 24 November 2015 to 23 February 2016. The temporary validation authorized the Pilot to perform commercial balloon air transport operations.

Conversion training was not provided, and was not required, prior to the Pilot commencing flying duties with the Operator, as he was already type rated for Balloon Type-D.

Safety equipment procedures (SEP) training was provided to the Operator's pilots prior to the Operator starting operations.

A Base or line check was not required for the Pilot prior to commencing flying with the operator, as his training record from his previous operator had been accepted by the Operator.

Periodic checks were not yet being performed since the Operator had only started operations six weeks before the occurrence.

1.18 Additional Information

1.18.1 Balloon flying operations in the UAE

In the UAE, balloon flying operations are limited because of seasonal variations due to high ambient temperatures, density altitude considerations and localised, regional variations in wind speed and direction. Normally, the balloon flying season starts in September and ends in June, dependent on the weather, and flying conditions.

1.18.2 UAE national standards of manned ballooning operations

Part IV Section E of the UAE *Civil Aviation Regulations – Special Purpose Operations*, prescribes the requirements for manned ballooning operations.

The requirements for visual reference for operating balloon as given in the UAE *CAR Part IV Section E, Sub-Section 2.9 – Visual Reference,* are as follows:

" 2.9 VISUAL REFRENCE

No person may operate a balloon on free flight operations except with visual reference with the surface, clear of cloud, with a minimum cloud ceiling of 1000 feet above ground level, and a minimum visibility of 3 kilometers."

1.18.3 Manufacturer *flight manual*

The Manufacturer *flight manual (FM04),* revision 24 was used by the Operator at the time of the occurrence.

1.18.3.1 Passenger landing position

The passenger briefing is described in Sub Section 4.8.2 of the *Flight Manual FM04* Rev.24, which includes the landing position in the partitioned basket, as follows:

"- …

- When instructed to do so, take up the landing position as follows.

- Ensure that long hair is safely kept inside cloths or tied back.
- Stand squarely with your back against the basket facing away from the direction of travel.
- Keep your knees together and bend them slightly. Do not sit or squat.
- Press back against the basket wall.
- Keep hands inside the basket at all times and hold on to the rope handles.
- Progress the landing and brace for touchdown.
- Be aware that the basket may tip over and drag after touch down.
- Do not leave the basket until the pilot instruct to do so.
- Wear helmets (when necessary)."

1.18.3.2 Landing

Landing techniques are described in Sub Section 4.11 of the *Flight Manual FM04* Rev.24, as following:

"**4.11 Landing**

Before making any landing carry out the following checks:

- Burner: Connected, if possible, to a fuel cylinder filled at least 40% of its capacity.
- Handling line: In light winds, conveniently fastened to the load frame, and ready for easy deployment.
- Rip line at hand during approach
- Passenger briefed.
- The selected landing site is free of obstructions, power lines and animals and is large enough to safely land the balloon in the current weather conditions.

4.11.1 Landing without wind, with parachute

The landing should be made with practically no vertical velocity, the parachute being opened immediately after touch down only long enough to stabilise the balloon on the ground.

4.11.2 Landing with wind, parachute

The technique is similar to 4.11.1 [Landing without wind, with parachute] but horizontal travel must be minimised to avoid downwind obstacles. To achieve this, a steeper angle of descent is chosen, rounded out by a long burn to achieve straight and level flight at about 20 ft (6m) above the ground. The parachute is then opened fully and kept open until the envelope is fully deflated.

The pilot lights will be extinguished and all cylinder valves should be closed before landing.

4.11.3 Landing with wind, FDS

When approaching the ground, open moderately the parachute and when arriving at the selected landing place, open as fast as possible the FDS with red rope. The FDS should never be used at a height above 10 m. The FDS system has the advantage that if the rope is released, the opening remains as it was left. In case of aborting the landing, the white-red line must be pulled to reseal the parachute. The pilot lights will be extinguished and all cylinder valves should be closed before landing.

4.11.4 Landing Large Balloons

Care should be taken when landing large balloons to ensure that the basket is correctly positioned on the approach to allow touch down on the long side. This is particularly important with partitioned baskets. The basket is correctly positioned by rotating the balloon using the rotation vents. Be aware that the use of the rotation vents does vent off hot air whilst rotating the balloon, so allowance should be made for this, particularly when close to the ground."

1.19 Useful or Effective Investigation Techniques

This Investigation was conducted in accordance with Part VI, Chapter 3 of the UAE *Civil Aviation Regulations*, and the AAIS approved policies and procedures, and in conformity with the Standards and Recommended practices of *Annex 13 to the Chicago Convention*.

2. Analysis

The Investigation collected data from various sources for the purpose of determining the causes and contributing factors that led to this accident.

This Analysis covers the issues of required safety briefing, the operations or the landing technique used, human factors, and the UAE Regulations.

This Section of the Report explains the contribution of every investigation aspect to the Accident.

The Analysis also contains safety issues that may not be contributory to the Accident but are significant in adversely affecting safety.

2.1 Safety Briefings and Instructions

The Pilot briefed the passengers on safety aspects before they boarded the basket.

Instruction on the “landing position” was given during the briefing. One of the points briefed was that the passengers were to place their backs against the basket facing away from the direction of travel. This was in accordance with the Operator’s *Operations Manual* and *SOP*, and the Manufacturer *Flight Manual*.

According to the safety instruction card provided to the passengers, during landing, the passenger should be in the landing position facing the direction of flight. Although it may not be contributory to the Accident, the Investigation believes that consistent safety procedures should be put in place by the Operator and the related safety instructions given to passengers.

The Pilot also explained the landing position for couples that the female person should have a landing position in front of the male person’s chest, while the male also needs to adopt the landing position. In fact, the “couple landing position” caused the male passenger to be unable to adopt the correct landing position since he was not able to hold the rope handle(s) due to being hindered by the female’s body. Also, adopting the “couple landing position” meant that the male passenger was unable to keep his knees together, as instructed. The female person could still keep her knees together, however because of the limited space, her knees could touch the basket in front of her. In the “couple landing position”, most of the time, the male person hands just hold the hands of their partners. The Investigation believes that the “couple landing position” was introduced by the Pilot due to the limited space in the passenger compartment.

For a hard landing, the “couple landing position” may result in injuries as the space for movement is limited for the couple: the limitation or inability to hold the rope and the inability to keep his knees together by the by the male member of the “couple landing position”, and for the female due to the fact that her knees touch the basket.

The “couple landing position” was not included in the Passenger Safety Instructions, or the Manufacturer *Flight Manual*. During landing, most of the passengers travelling as couples adopted the “couple landing position”, and most of these passengers were injured as a result of the hard landing on the second touchdown.

The Pilot performed the safety briefing in the English language, and there was no indication that any of the passengers failed to understand the briefing due to lack of understanding of English.

The items included in the safety briefing were in accordance with the Operator’s *Operations Manual*, *SOP*, and the Manufacturer *Flight Manual*, except for the advice on the “couple landing position”.

The Investigation believes that consistent and proper safety procedures create a common safety system and practice which promotes crew and passenger collaboration leading to a higher level of safety. Therefore, the Investigation recommends that the Operator implement consistent procedures for the landing position. Improved training regarding the landing position should be required for pilots, and that the briefing of the passengers should be referred to in the Operator's *Operations Manual*, *SOP*, and Manufacturer *Flight Manual*.

Before commencing the descent to land, the Pilot informed the passengers that the landing would occur within 15 minutes. Approximately 1 minute before the landing, the Pilot instructed the passengers to adopt the landing position, locating themselves side by side and shoulder to shoulder. The Balloon touched down smoothly, and all passengers were believed to be in their landing position during the initial touchdown. However, after the first touchdown, the Balloon climbed again over a period of about 22 seconds. During this period, most of the passengers attempted to leave the landing position and stand up.

The passengers probably assumed that the Balloon was in the air flying again, and therefore it was safe to leave the landing position and stand up. Another possibility was that some passengers thought for a few seconds that the landing had been completed and left the landing position, however they later realized that the Balloon was climbing. During this period, the Pilot had yet to remind the passengers to remain in the landing position, or inform them to leave the landing position.

The Investigation believes that after the Balloon had started the second descent, the Pilot became aware that most of the passengers were not in the landing position, and he then instructed the passengers to adopt the landing position.

The time from commencement of the descent until the balloon touched down on the second occasion, was about 10 seconds. The Investigation believes that there was limited time for the passengers to adopt the landing position, in particular the "couple landing position" for the second touchdown. Fourteen passengers were injured during the hard landing and none of these passengers had adopted the correct landing position. Not being in the proper landing position means that their knees were not together and were not bent. Most of the passengers were, most probably, still in the standing position, or in the process of adopting the landing position. Therefore, absorbing the hard landing shock of the second touchdown, while not in the correct landing position, led to the injuries such as neck and shoulder pain and a dislocated ankle suffered by the passengers.

2.2 Operations and Landing Technique

The takeoff, climb, cruise, descent and the first touchdown were uneventful. However, the Balloon climbed again after the first touchdown and this had not been expected by the Pilot.

The Pilot managed the descent without using the parachute line, and instead relied on the burners to control the rate of descent. From the recorded flight data, shown in Figure 7a, the maximum rate of descent was approximately 877 feet/min (4.45 m/sec), which was below the allowable maximum rate of descent, which is 1,000 ft/min.

Between 6 and 9 seconds before deploying the FDS, when the Balloon was descending from a height of 66 feet to 46 feet above ground level, and having developed rates of descent from 290 up to 480 ft/min, the Pilot, most probably, used the burners continuously to halt and reduce the rate of descent. The rate of descent (ROD) reduced, and with the deployed FDS, the Balloon touched the ground with a ROD of 53 ft/min.

The Pilot deployed the FDS about 1.5 to meters above the ground level. This resulted in reducing the rate of descent from approximately 350 ft/min to almost level or zero vertical speed in 4 seconds, and the Balloon touched the ground. Thereafter, the Balloon

became airborne again to a height of about 3 feet (1 meter) over 4 seconds, as shown in figure 8b.

In this condition, it is likely that the Pilot expected that the Balloon would land and stop about 8 seconds after the FDS was deployed. Since the Balloon speed varied between 5 and 6 knots, the Balloon would have been expected to remain near or on the ground, and might have been dragged along the ground. However, the pilot's expectation that the Balloon would land and stop did not occur, and instead, the Balloon climbed again. This occurred as there was still sufficient hot air in the envelope to cause the Balloon to climb again after the first touchdown.

Usually the effect of a deployed FDS on the rate of descent takes from 3 to 5 seconds and depends on how far the red FDS line is pulled.

The Investigation examined two scenarios in order to understand why the Balloon climbed again after the first touchdown, based on the information provided by the Pilot.

2.2.1 Over-use of burners before landing (first touchdown)

The first scenario is that the Pilot allowed too much hot air into the envelope, which means that he used the burners more than was required. The delivered hot air was so voluminous, such that even with the deployed FDS a sufficient volume of hot air could not be released from the envelope so as to keep the Balloon on the ground, or to deflate the envelope sufficiently.

In this case, the Pilot used the burners to halt and reduce the rate of descent relatively late, such that he allowed more hot air than was required to enter the envelope in an attempt to achieve a smooth landing with almost no vertical speed. If the Pilot had used the burners earlier than he actually did, he may have managed the rate of descent such that when the Balloon touched the ground, it would have remained on the ground, or might have bounced several times and been dragged along the ground for a short distance, since the speed was between 5 and 6 knots.

2.2.2 FDS not on its maximum deflation

Another scenario is that the FDS was not deployed to its maximum (final deflation), such that after the first touchdown, the volume of hot air in the envelope was still sufficient to cause the Balloon to climb again. It took a relatively long time, about 27 seconds, from the FDS deployment, to release the hot air for the envelope to sufficiently deflate so that the Balloon started to descend for its second touchdown.

A combination of these two scenarios is also possible.

In either scenario, the Pilot could have aborted the second landing as the Balloon was climbing. He had about 20 seconds to recover/reverse the FDS by pulling the red/white parachute line.

By performing this recovery action, the Pilot could have aborted the landing and the Balloon may have remained vertically controllable, since the burners were still available, and the FDS was recovered/closed.

The Pilot closed the burners within the 20 seconds while the Balloon was climbing. Closing the burners means extinguishing the pilot lights and closing all cylinder valves. Closing the burners and since the FDS was already deployed, the Balloon became uncontrollable before the second touchdown.

The Balloon started to descend approximately 23 seconds after the first touchdown.

The second touchdown was a hard landing with a rate of descent of 406 ft/min. The time between the first touchdown and the second was about 34 seconds.

From the approach until the expected landing (first touchdown), the Pilot did not use the parachute for the descent and only the burners were used. The Investigation believes that the Pilot planned to use the landing technique for landing with wind using the FDS, as described in the Manufacturer *Flight Manual*, since the wind speed was about 5 to 6 knots.

The pilot lights were not extinguished, and all the cylinder valves were not closed before the first landing, which was not the landing technique suggested in the Manufacturer's *Flight Manual*. However, not closing the burners before landing, was not a contributing factor to this occurrence.

2.3 Human Factors

The Pilot stated that he did not expect that the Balloon would climb again after the planned landing, or first touchdown. This unexpected condition distracted or startled him to such an extent that he did not perform the required actions:

- The action required when the Balloon was climbing was to release the FDS by pulling the parachute red/white line, in order to control the Balloon vertically;
- The pilot lights were extinguished and all cylinder valves were closed during unexpected climb. The Investigation believes that this action was automatically performed with on the assumption of the Pilot that the Balloon would stay in the air for just a few seconds and would not ascend so high, since the FDS was already deployed.

The Pilot stated that he had become confused from the time that the Balloon climbed again until it started its descent to the second touchdown. He realized that he had no control of the Balloon and he expected a hard landing. This prompted him to remind the passengers to remain in the landing position.

The 10 seconds or so remaining before the second touchdown did not allow enough time for most of the passengers to adopt the correct landing position. The Investigation also believes that the Pilot did not inform the passengers that a hard landing was likely to occur so that the passengers were not aware that the Balloon could not be controlled and a hard landing would result.

The Pilot had dealt with a personal issue several days before the occurrence flight, and one day before the occurrence flight, he requested a short period of leave. The Investigation believes that the Pilot was likely distracted due to his personal concerns at the time of the occurrence flight. He may have believed himself that he was able to perform his duty as the Pilot of the flight during his pre-flight self-check

The Pilot did not inform the management in detail why he requested his short leave. The Operator had only commenced operations just one and half months before the occurrence, also, the fact that the Operator had only two operating approved pilots, may have influenced the Pilot's decision making regarding his fitness to fly. Therefore, the Investigation recommends that the Operator evaluate the number of operating approved pilots against the number of operating balloons and flights planned.

Section 2 of the Operator's *Operations Manual,* part A prescribes the requirements for operational control and supervision. Although, the requirements for the pilot's pre-flight self-check is provided under paragraph 2.2.2 of the *Operations Manual*, the Investigation recommends that the Operator enhance the oversight of potential pilot personal issues and

encourage its pilots to report any appropriate private issues whenever they may arise, or when the pilot may think that an issue may have an effect on his flying performance.

As per the Operator's policy, each pilot can perform only one flight per day, consequently, fatigue or tiredness were not issues considering the rest period of the Pilot.

The Pilot made an incorrect decision as the Balloon climbed away following the first touchdown by not releasing/closing the FDS. He could have rejected the landing since he still had sufficient time to release the FDS by pulling the red/white parachute line. Instead, the Pilot closed the burners as he considered the balloon to be in a normal landing condition, even though the Balloon had climbed after the first touchdown. The Pilot, most probably, misjudged, or was not able to identify the rate of climb during the 11 to 12 seconds as the Balloon climbed. The Pilot expected that the Balloon would remain in contact with the ground after the first touchdown since he had already deployed the FDS. The Investigation believes that possible psychological distractions, due to Pilot's personal concerns, affected his performance on the occurrence flight, which resulted in confusion and temporary loss of situational awareness, during the landing phase, following the initial touchdown.

2.4 The *Civil Aviation Regulations* of the United Arab Emirates

The Operator was granted an AOC allowing private operator passenger type operations by the GCAA. The Investigation believes that the AOC was not sufficiently clear as to whether the Operator could conduct its operations as an Air Operator or as a Private Operator, and which operator category could perform commercial transport operations. Also, the referenced paragraph of the UAE *CAR* was not specifically stated in the Operator's AOC.

Part IV Section E of the UAE *Civil Aviation Regulations – Special Purpose Operations*, prescribes the requirements for manned balloon operations. The *Civil Aviation Regulations* does not include the operator certificate category, specifically for balloon operators. The UAE *Civil Aviation Advisory Publication (CAAP) 08* provides guidance procedures for the issuance, renewal and amendment of an air operator certificate (AOC), or private operator certificate (POC), to conduct operations under *CAR OPS 1 or 3*. However, there is no guidance procedure regarding the AOC or POC available for balloon operators. Since there were no requirements or guidance regarding the operator certificate for balloon operators, and in order to distinguish between an AOC and a POC, the Investigation recommends that the GCAA include the AOC/POC requirements for balloon operators.

The Balloon was not equipped with a camera, and therefore it was a challenge for the Investigation to understand the situation and conditions in the basket during the flight, especially for the landing. There are no requirements in the UAE *CARs* that the balloon commercial transport shall be equipped with a camera pointing into the basket. The Investigation believes that an installed camera recorder would be an essential tool for safety investigation of balloon incidents and accidents. Therefore, the Investigation recommends the installation of a camera recorder in balloons used for commercial transport. The Investigation also recommends that the Operator installs video recorders in its balloons.

2.5 Weather

Al Maktoum International Airport is approximately 41 kilometers west-northwest (WNW) of the Balloon take-off site.

Based on the METAR for Al Maktoum International Airport during the flight, the weather was suitable for the take-off, referring to the METAR at 0300z. Visibility was 5 kilometers and possibly lessened to 3 kilometers and became misty within the next hour. The METAR at 0400z shows that the visibility improved to 6 kilometers. Therefore, the flight

was performed in accordance with UAE *CAR* and met the minimum requirements of visual reference for operating balloon.

However, based on the weather information obtained from the Operator's weather station which was placed at the take-off site, BKN001 was included which means that there were 5-7 oktas cloud at 100 feet. This cloud condition was below the minimum requirements of visual reference for operating a balloon. Therefore, the take-off was not performed in accordance with the UAE *CAR*.

The Pilot was aware of the minimum visibility requirements, however, he only knew of the minimum visibility requirement of 3 kilometers. He was not aware that the ceiling of 1,000 feet above ground level was the minimum cloud ceiling in accordance with the UAE *CARs*. His judgement before take-off was that the weather was suitable for the flight, although it was marginal.

There is no minimum cloud ceiling requirement in the Operator's *Operations Manual* and *SOP*. Therefore the Investigation recommends to include the requirement of a minimum cloud ceiling in the Operator's Manual in accordance with the UAE *Civil Aviation Regulations*.

2.6 Other Scenario for the Landing

The effectiveness of the FDS deployment was not in line with the Pilot's expectation. It took a relatively long time, about 27 seconds, from the FDS deployment, when the Balloon started to descend prior to the second touchdown, the hard landing.

It is possible that before the first touchdown the Pilot deployed the parachute, by means of pulling the red/white parachute line, instead of deploying the FDS by pulling the red FDS line as per the Pilot' statement.

In this scenario, when the red/white (parachute) line was pulled, it resulted in the opening of the parachute. After a few seconds, the red/white line was then released, and this caused the parachute to return to its original place. Therefore, the hot air in the envelope was still too voluminous and caused the Balloon to climb. While the Balloon was climbing, the Pilot deployed the FDS and closed the burners. Consequently, when a sufficient amount of the hot air was released and the envelope started to deflate, the Balloon descended in an uncontrollable manner, and experienced a hard landing on the second touchdown.

Whether the landing was in accordance with the information obtained from the Pilot, as given in Paragraph 2.2, or as explained in this "other scenario", the Investigation believes that, in the case of both scenarios, the Pilot had lost his situational awareness in the landing phase which resulted in a hard landing on the second touchdown.

2.7 Training

All required training, including in-house training, was provided to the Pilot as per Operator's *Operations Manual*. However, the Investigation believes that the training and the exemption from his base/line check were not sufficiently effective, since he performed some tasks and procedures on the occurrence flight which were not in accordance with the Operator's Operation Manual, *SOP*, and Manufacturer *Flight Manual*. Therefore, the Investigation recommends an evaluation of the criteria for pilot training and exemptions before pilots commence flying duties.

3. Conclusions

3.1 General

From the evidence available, the following findings, causes and contributing factors were made with respect to this Accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this Investigation, the following sections are included in the conclusions heading:

- **Findings-** are statements of all significant conditions, events or circumstances in this Accident. The findings are significant steps in this Accident sequence but they are not always causal or indicate deficiencies.
- **Causes-** are actions, omissions, events, conditions, or a combination thereof, which led to this Accident.
- **Contributing factors-** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 Findings relevant to the Balloon:

(a) The Balloon was certified, equipped and maintained in accordance with the requirements of the *Civil Aviation Regulations*.

(b) The Balloon was airworthy when dispatched for the flight.

(c) The Balloon maintenance records did not reveal any evidence of pre-existing mechanical anomaly that could have contributed to the occurrence.

(d) The Balloon did not sustain any damage as a result of the occurrence.

3.2.2 Findings relevant to the Pilot:

(a) The Pilot was certified by a temporary validation based on his foreign license and he was qualified for the flight in accordance with the requirements of the *Civil Aviation Regulations* of United Arab Emirates.

(b) The Pilot had total balloon flying experience of 951 hours, with 502 hours on type.

(c) According to the foreign civil aviation authority of the country where he performed most of his flying, the Pilot had never experienced an accident, incident, or any enforcement action before joining the Operator in the UAE.

(d) As per the Operator's policy, the Pilot can only operate one flight per day, consequently, fatigue was not an issue in this occurrence.

(e) The Pilot dealt with a personal issue several days before the occurrence flight, and one day before the occurrence flight he had requested a short leave.

(f) The Pilot may have felt that he was fit to perform his duty as the pilot of the flight during his pre-flight self-check notwithstanding the fact that he was dealing with a personal problem.

(g) The psychological distractions caused by the Pilot's personal issue, most likely affected his performance on the occurrence flight, and contributed to the pilot's loss of situational awareness, especially in the landing phase.

3.2.3 Findings relevant to flight operations:

(a) The Pilot performed the safety briefing including describing the landing position to the passengers, before the passengers boarded the basket.

(b) The landing position was briefed in accordance with the Operator's *Operations Manual* and *SOP*, and the Manufacturer *Flight Manual*, except for the additional "couple landing position".

(c) The "couple landing position" was introduced by the Pilot due to the limited space in the passenger compartment, and most of the passengers travelling as couples used this "couple landing position" and experienced injuries.

(d) The Manuals and the Passenger Safety Instruction Card, contained different information regarding passengers facing the direction of flight or facing backwards, on landing.

(e) The Pilot planned to use the landing with wind technique, using the FDS, as described in the Manufacturer *Flight Manual*.

(f) On descent for landing, the Pilot used only the burners to manage the rate of descent, and the maximum rate of descent was below the allowable maximum rate of descent.

(g) The Pilot, possibly, used the burners for the final time to halt and reduce the rate of descent relatively late, such that he caused more hot air than was required to enter the envelope, in an attempt to have a smooth landing with almost no vertical speed.

(h) The FDS was used when the Balloon was several meters above ground level.

(i) When the Pilot deployed the FDS by pulling the red line, his expectation was that the Balloon would stay in contact with the ground, or near ground level. However, the Balloon climbed again after the smooth initial touchdown.

(j) The FDS, possibly, was not deployed to its maximum (final deflation), such that after the first touchdown, the hot air in the envelope was still voluminous and generated sufficient lift for the Balloon to climb again.

(k) During the first touchdown, all the passengers were believed to have adopted the landing position.

(l) After the first touchdown, while the Balloon was climbing and since the burners were available, the Pilot could have rejected the landing and recovered the Balloon by pulling the red/white parachute line, which he did not do.

(m) When sufficient hot air had been released, the Balloon descended uncontrollably and experienced a hard landing on the second touchdown.

3.2.4 Findings relevant the passengers:

(a) When the Balloon started to descend uncontrollably, the Pilot was aware that most of the passengers were no longer in the landing position, consequently, he reminded and instructed the passengers to adopt the landing position. However, there was limited time for the passengers to place themselves in the landing position. In particular this applied to couples in adopting the "couple landing position".

(b) Most of the passengers were, most probably, still in the standing position, or in the process of adopting the landing position, during the hard landing of the second touchdown.

(c) Absorbing the shock of the hard landing shock caused the passenger injuries, such as pain on their neck/shoulder and a dislocated ankle.

(d) Fourteen of the twenty passengers were injured and required medical assistance, and they were transferred to the hospital.

(e) Thirteen of the fourteen injured passengers suffered minor injuries, while one passenger was seriously injured having suffered a dislocated right ankle, which required surgery.

3.2.5 Finding relevant to weather conditions

(a) The Balloon took off with BKN (5-7 oktas) clouds at 100 feet, which was below the minimum cloud ceiling requirements of the UAE *CAR*.

3.2.6 Findings relevant to the Civil Aviation Regulations

(a) There were no requirements in the existing UAE *CAR* or guidance procedure in *CAAP 08* regarding operator certificates to distinguish between the AOC and POC categories, for balloon operators.

(b) The referenced paragraph of the UAE *CAR* was not specifically mentioned in the Operator's AOC.

3.2.7 Findings relevant to the Operator

(a) There was no minimum cloud ceiling requirement included in the Operator's *Operations Manual* and *SOP*.

(b) The AOC was not sufficiently clear as to whether the Operator could conduct its operation as an Air Operator or a Private Operator, and which operator category could perform commercial transport operations.

3.3 Causes

The Air Accident Investigation Sector determines that the cause of the Accident was an uncontrollable Balloon condition prior to the second touchdown, which resulted in a hard landing and, as most of the passengers were not in the proper landing position, consequently fourteen passengers were injured.

3.4 Contributing Factors to the Accident

The Air Accident Investigation Sector identifies the following contributing factors to the Accident:

3.4.1 The Pilot did not abort the landing by reversing the FDS, which was the correct recovery action, when the Balloon was climbing again after the first touchdown.

3.4.2 The ‘couple landing position’ introduced for couple passengers by the Pilot, was not in accordance with the Operator’s manuals, Passenger Safety Instructions, and the Manufacturer *Flight Manual*.

3.4.3 The relatively limited time available to the passengers to re-adopt the landing position, prior to the hard landing.

3.4.4 It is likely that the Pilot was distracted due to his personal concerns, and this affected his performance on the occurrence flight, which resulted in loss of his situational awareness, especially in the landing phase.

4. Safety Recommendations

4.1 General

The safety recommendations listed in this Report are proposed according to paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation*, and are based on the conclusions listed in heading 3 of this Report; the GCAA AAIS expects that all safety issues identified by the Investigation are addressed by the concerned organizations.

4.2 Final Report Safety Recommendations

The Air Accident Investigation Sector recommends that:

4.2.1 Sindbad Gulf Balloon-

SR54/2016

Ensure that safety procedures for passengers are consistent across all the Operator's manuals and safety instructions provided to the passengers.

SR55/2016

Ensure that all pilots perform flight operations and safety briefings in accordance with the Operator's *Operations Manual*, *SOP*, and Manufacturer *Flight Manual*.

SR56/2016

Enhance policies and procedures in order to encourage pilots to report any private issues that may affect their performance.

SR57/2016

Evaluate the balance between the number of operating approved pilots against the number of operating balloons.

SR58/2016

Include a minimum cloud ceiling requirement in the Operator's Manuals, in accordance with the UAE *CAR*.

SR59/2016

Re-evaluate the criteria for pilot training and exemptions before pilots commence operations.

SR60/2016

Install a video camera recorder on the balloon.

4.2.2 The General Civil Aviation Authority of the United Arab Emirates-

SR61/2016

Review the requirements regarding categorization, type of operation and issuance guidance for a balloon operator certificate.

SR62/2016

Ensure that the related UAE *CAR* paragraph(s) are mentioned, as the reference, in any operator's certificates.

SR63/2016

Propose regulation(s) for installing a video camera recorder on balloons operating commercial transport flights.

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