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FLIGHT SAFETY & QUALITY ASSURANCE

Issue 11, Sept.2006

Introduction

We hope you enjoyed reading the August issue. In this issue, we look into the Gulf Air A320 crash into the sea which vividly highlights the shortcomings leading to a fatal accident. This is followed by an article on Visual approaches adopted from ALAR kit of Flight Safety Foundation. Finally there is a brief description of Somatogravic illusion. We hope you will enjoy reading these.

Your feedback is very important. We welcome your feedback, suggestions and contributions to this newsletter in the form of articles, anecdotes, pictures, etc. which can be sent to the address given below.

The Crash of Gulf Air A320

Adopted from A320(A40-EK) aircraft accident report, July 2002

On 23 August 2000, at 1652 local time, Gulf Air flight GF-072 an Airbus A320-212 got airborne at Cairo, Egypt on a regular scheduled flight to Muharraq, Kingdom of Bahrain.

The original departure was at 1600. On board the aircraft were 2 pilots, 6 cabin crew & 135 passengers. GF-072 was operating under the convention on International Civil Aviation and the provisions of the Sultanate of Oman Civil Aviation Regulations Part 121 and was on an Instrument Flight Rules (IFR) flight plan. At 1925:45, about 7 nm from the runway, Bahrain Approach cleared GF-072 for the VOR/DME approach to Runway 12 and instructed the flight to contact Bahrain Tower. At about 1927:23, about one nautical mile from the touch down and at an altitude of about 600 feet, the flight crew requested for a 360 deg. left orbit, which was approved by the air traffic control (ATC). Having flown the orbit beyond the extended centerline on a south-westerly heading, the Captain decided to go-around. Observing the maneuver, the ATC offered the radar vectors, which the flight crew accepted. GF-072 initiated a go-around, applied take-off/go-around thrust (TOGA), and crossed the runway on a north-easterly heading with a shallow climb to about 1000 feet. As the aircraft rapidly accelerated, the master warning sounded for flap over-speed. During the go-around the flight crew probably experienced a form of spatial disorientation, which could have caused the Captain to falsely perceive that the aircraft was 'pitching up'. He responded by making a 'nose-down' input, and, as a result, the aircraft commenced to descend. The ground proximity warning system (GPWS) voice alarm sounded: "whoop, whoop pull-up …". The GPWS warning was repeated every second for nine seconds, until the aircraft impacted the shallow sea. The aircraft was destroyed by impact forces, and all 143 persons on board perished. In page 2. the aircraft trajectory during the last three and half minutes is shown.

The accident investigation showed that no single factor was responsible for the accident to GF-072. It was the result of a fatal combination of many contributory factors, both at the individual and systemic levels. These are summarized below.

1. **Non-adherence to SOPs**: The Captain did not adhere to SOPs, particularly during the approach and final phases of flight:
   - During the descent and the first approach, flight GF-072 had significantly higher speed than standard.
   - During the first approach, standard 'approach configurations' were not achieved, and the approach was not stabilized on the correct approach path by 500 ft.
   - When the Captain perceived that he was 'not going to make it' on the first approach, standard go-around and missed approach procedures were not initiated.
   - Instead, the Captain executed a 360-degree orbit, a nonstandard maneuver close to the runway at low altitude, with a considerable variation in altitude, bank angle and 'g' force.

In this issue

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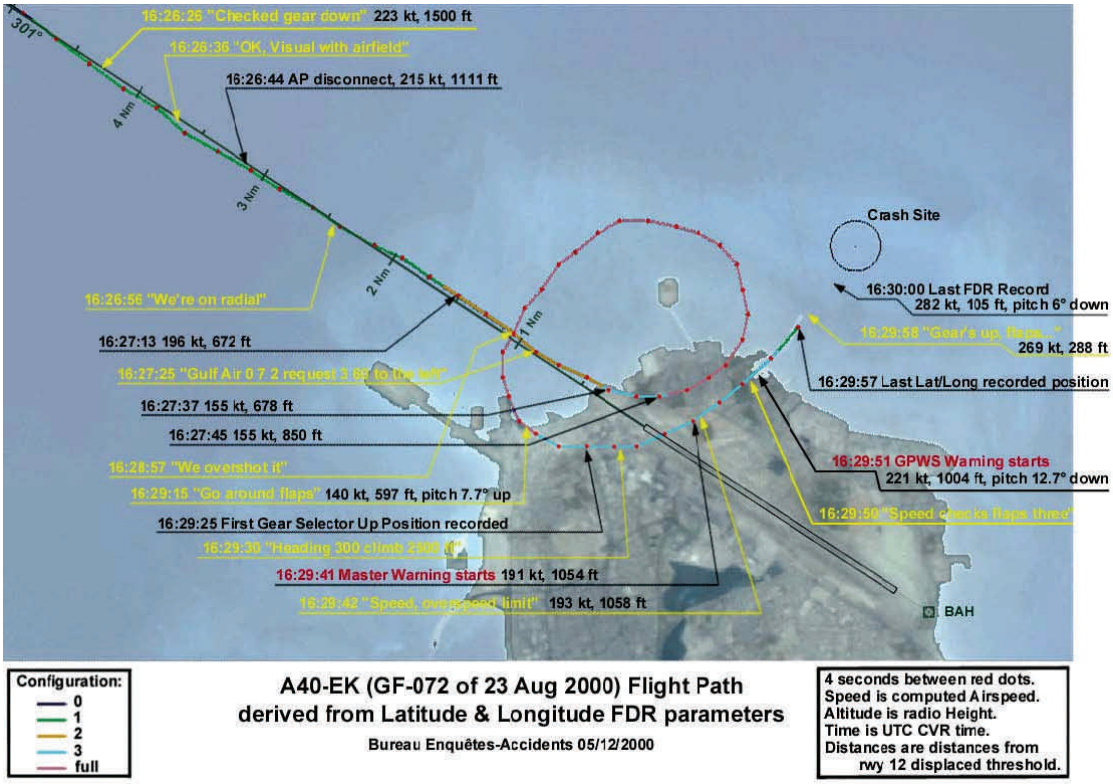

- A 'rotation to 15 degree pitch-up' was not carried out during the go-around after the orbit.
- Neither the Captain nor the First Officer responded to hard GPWS warnings.
- In the approach and final phases of flight, there were a number of deviations of the aircraft from the standard flight parameters

2. **Deviation of standard flight parameters and profile:** During the approach and final phases of flight, in spite of a number of deviations, the First Officer (PNF) did not call them out, or draw the attention of the Captain to them, as required by SOP's.
3. **Spatial disorientation:** During the go-around after the orbit, it appears that the flight crew experienced spatial disorientation.
   - During the go-around the aircraft was accelerating rapidly, as the Captain was dealing with the flap over-speed situation, he applied a nose-down side-stick input that was held for about 11 seconds, resulting in a nose-down pitch of 15 degrees.
   - A perceptual study conducted using FDR recordings of the accident flight indicated that while the aircraft was accelerating with TOGA power in total darkness, the Somatogravic illusion could have caused the Captain to perceive (falsely) that the aircraft was 'pitching up'. He would have responded by making a 'nose down' input. As a result the aircraft descended and thereafter flew into the shallow sea.
4. **Controlled Flight Into Terrain:**
   - The GPWS 'sink rate' alert sounded, followed by the ground proximity warning 'whoop, whoop, pull up' which sounded every second for nine seconds until the impact.
   - The analysis of FDR and CVR recordings indicated that neither the Captain nor the First Officer perceived, or effectively responded to, the threat of the aircraft's increasing proximity to the ground in spite of repeated hard GPWS warnings, and continued addressing the comparatively low priority flap over-speed situation.
   - The Captain did not fully utilize critical information provided by the aircraft instruments during the final phases of the flight, where he was also experiencing 'information overload'.
5. **Crew Resource Management (CRM):** A lack of training in CRM contributed in the flight crew not performing as an effective team conducting the operation of an aircraft. During the approach and final phases of the flight, the Captain did not consult the First Officer in the decision making process, and did not effectively use this (the First Officer) valuable human resource available to him.
6. **Organizational Factors:**
   - Inadequacy was identified in Gulf Air's A320 training programmes such as adherence to SOPs, CFIT, and GPWS responses.
   - At the time of accident, Gulf Air's flight data analysis system was not functioning satisfactorily, and the flight safety department had a number of deficiencies, which restricted the airline's awareness in many critical safety areas.
7. **Safety Oversight Factors:** A review of about three years preceding the accident had shown that:
   - The regulatory authority (DGCAM) had identified cases of noncompliance, and inadequate or slow responses in taking corrective actions to rectify them, on the part of Gulf Air in some critical regulatory requirements.

- Although the DGCAM was attempting to ensure regulatory compliance by Gulf Air, it could not accomplish it in some critical regulatory areas, due to inadequate response by the operator.
- The regulatory authority and the airline are expected to fulfill complementary roles in maintaining safety of aircraft operations. The evidence indicated inadequacies in the fulfillment of the above, and highlighted the systemic factors in the airline's mechanisms to respond to the regulatory requirements.

Following this accident, Gulf Air addressed all the issues that contributed to the accident and appropriate corrective measures were taken.

This accident reflects and substantiates the fact that an accident is a culmination of a chain of events and shortcomings in the system and the individuals responsible for the safety of air transport which could have been prevented by safe practices. A reminder to all responsible for safety!?

Visual Approaches

Adopted from Flight Safety Foundation ALAR (Approach and Landing Accident Reduction) briefing note- Flight Safety Digest Aug-Nov2000

A statistical study by Boeing indicated that during 1995-2004, 51% of the fatal accidents were in the final approach and landing phase. The Flight Safety Foundation task force for Approach and Landing Accident Reduction (ALAR) found that visual approaches were being conducted in 41% of 118 fatal accidents worldwide during 1980-1996 involving jet and turbo-prop aircraft with MTOW above 12,500 pounds, and in which the type of approach being conducted was known.

As per the *FAA aeronautical Information manual*, Visual approach is defined as

- An approach conducted on an IFR flight plan which authorizes the pilot to proceed visually and clear of clouds to the airport;
- The pilot must, at all times, have either the airport or the preceding aircraft in sight;
- The visual approach must be authorized and under the control of the appropriate ATC facility; and
- Reported weather at the airport must be ceiling at 1000ft or above 1000ft and visibility 3 miles or greater.

- Accepting an ATC clearance for a visual approach or requesting a visual approach should be carefully balanced against the following factors:
  - Ceiling and visibility conditions: - Darkness; Weather: Wind, turbulence - Rain or snow; and/or Fog or smoke;
  - Crew experience with airport & airport environment:
    - Surrounding terrain; and/or, Specific airport & runway hazards (obstructions etc.)
  - Runway visual aids
    - Type of approach light system (ALS); and
    - Availability of visual approach slope indicator (VASI) or Precision approach path indicator (PAPI)

During a **visual approach at night**, fewer visual references are usable, visual illusions and spatial disorientation occur more frequently. Visual illusions (such as the "black-hole effect" *) affect the flight crew's vertical situational awareness, particularly on the base leg and when turning final.

A visual approach at night should be considered **only if:**

- Weather is suitable for flight under visual flight rules
- A close-in pattern is used (or a published visual approach is available)
- A pattern altitude is defined; and,
- The flight crew is familiar with airport hazards and obstructions (availability of current NOTAMs)

At night, whenever an instrument approach is available(particularly an ILS approach), it should be preferred to a visual approach. If a precision approach is not available, an approach supported by VASI or PAPI should be selected.

Visual approach should be conducted with reference to either

- A published visual approach chart for the intended runway; or,
- The visual approach procedure published in the AOM/QRH or the pattern published in the AOM/QRH

Surrounding terrain awareness is important in visual approach. For example, at night, with an unlighted hillside between a lighted area and the runway, the flight crew may not see the rising terrain.

If the aircraft is not stabilized by 500 ft above airport elevation or if the approach is unstabilized below 500ft above airport elevation, the action is to go around. The approach is stabilized when all the following criteria are met.

1. The aircraft is on the correct flight path;
2. Only small changes in heading/pitch are required to maintain correct flight path;
3. The aircraft speed is not more than Vref + 20 knots IAS and not less than Vref;
4. The aircraft is in the correct landing configuration;
5. Sink rate is not greater than 1000 ft per minute; if an approach requires a sink rate greater than 1000 ft per minute, a special briefing should be conducted;
6. Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined by the aircraft operating manual;
7. All briefings and checklists have been conducted;
8. Specific types of approaches are stabilized if they also fulfill the following: instrument landing system (ILS) approaches must be flown within one dot of the glide slope and localizer; a category II or category III ILS approach must be flown within the expanded localizer band; during a circling approach, wings should be level on final when the aircraft reaches 300 ft. above airport elevation; and
9. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach requires a special briefing.

Unstabilized visual approaches result from one or many of the following factors.

1. Pressure of flight schedules (making up for delays);
2. Crew or ATC induced circumstances resulting in insufficient time to plan and execute safe approach;
3. Excessive speed or altitude early in the approach ;
4. Downside leg too short or interception too close;
5. Inadequate awareness of tailwind and or cross wind component;
6. In correct anticipation of aircraft deceleration characteristics in level flight or on a three deg. Glide slope;
7. Failure to recognize deviations or failure to adhere to excessive parameter deviation criteria
8. Belief that the aircraft will be stabilized at the minimum stabilization altitude or shortly thereafter;
9. Excessive confidence of the PNF that PF will achieve a timely stabilization, or reluctance of PNF to challenge PF;
10. PF/PNF too reliant on each other to call excessive deviations or to call for a go-around;
11. Visual illusions;
12. Inadvertent modification of aircraft trajectory to maintain a constant view of the visual references;
13. Loss of ground visual references, airport visual references or runway visual references, with the PF AND NPF both looking outside to reacquire visual references.

The following deviations are typical of unstabilized visual approaches

1. Steep approach (high and fast, with excessive rate of descent)
2. Shallow approach (below desired glide path)
3. Ground-proximity warning system (GPWS)/Terrain awareness Warning System (TAWS) activation:
   - Mode - sink rate
   - Mode 2A ; "terrain" (less than full flaps)
   - Mode 2B ; "terrain" (full flaps)
4. Final-approach-course interception too close to the runway threshold due an inadequate outboard tear drop leg or downwind leg;
5. Laterally unstabilzed final approach because of failure to correct for crosswind;
6. Excessive bank angle and maneuvering to capture the extended runway centerline or to conduct a sideslip maneuver;
7. Unstabilized approach with late go-around decision or no go-around decision; and
8. Inadvertent descent below the three degree glide slope

For the safety, it is imperative that SOPs are adhered to during the visual approach.

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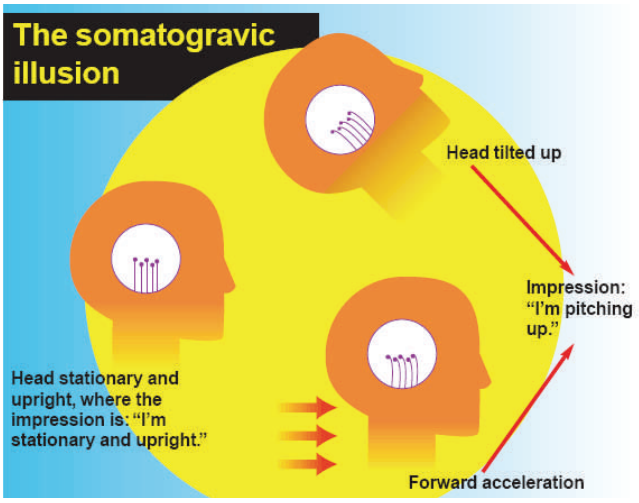
* The ***black-hole effect*** *typically occurs during a visual approach on a moonless or overcast night, over water or over dark, featureless terrain where the only visual stimuli are lights on and or near the airport. The absence of visual references in the pilot's near vision affect depth perception and cause the illusion that the airport is closer than it actually is and, thus, that the aircraft is too high. The pilot may respond to this illusion by conducting an approach below the correct flight path(a low approach).*



As the aircraft accelerates forward after takeoff, there is an overwhelming sensation of pitching to a high-nose attitude. This is somatogravic illusion. This illusion is produced by the otolith organ of the inner ear which senses head tilt and linear motion. Picture a little fluid-filled bag in your ear, with hair-like projections from the walls into the fluid. On the ends of the hairs are little rocks. When your head is upright and at rest, the hairs are also upright, and send a signal to your brain which you have learned to interpret as "head upright and still". If your head tilts upward, the pull of gravity on the little rocks bends the hairs back. The signal sent to your brain is interpreted as "head tilting up " (*see the diagram*). However, a forward acceleration will also cause the rocks to pull the hairs back, sending exactly the same signal to your brain. If you are flying in the dark or in cloud, your brain simply cannot tell the difference. The urge is to lower the nose. If you push the stick forward, the airplane accelerates more, increasing the pitch-up sensation, so you push the stick forward more.

The classic somatogravic accident results in a crash shortly after take-off, more or less off the end of the strip. The best way to prevent it is to maintain the right take-off and climb attitude using the instruments. In other words, provide a visual reference from instruments to overcome the incredible urge to push the stick forward.

Web watch

www.pprune.com - a professional pilot rumour and news site - visit for lively discussions on various aspects of aircraft accidents and other issues by the pilot community and others

The Confidential Aviation Hazard Reporting System (CAHRS) provides a means of reporting hazards and risks in the aviation system before there is loss of life, injury or damage. It is open to anyone who wishes to submit a hazard report or safety deficiencies confidentially and non-punitively. Reports help to identify deficiencies and provide safety enhancement in areas of aviation. CAHRS forms can be collected at different location of KAC (i.e. Flight Dispatch) Premises. Completed forms can be dropped in FS&QA allocated box at Flight Dispatch or e-mailed to kwioe@kuwaitairways.com or faxed to 00965-4749823 or mail to Flight Safety and Quality Assurance office, Operations Department, P.O. Box 394, Safat 13004, Kuwait Airways –Kuwait.