

Controlled Flight into Terrain: Atmospheric White Out

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ABSTRACT

Ever since helicopter operations commenced about three decades back for maintenance of troops in glaciers in the high altitude region, the Indian Armed Forces have had a number of accidents. Out of the recent ones, apparently three accidents involved White out or "Flat light" conditions leading to Controlled Flight into Terrain (CFIT). While most CFIT incidents occurring in general aviation involve night operations or inadvertent entry into instrument metrological conditions, all of these accidents occurred during daylight hours in visual metrological conditions. With good judgment, proper training and planning it is possible to safely operate an aircraft in Flat Light conditions. The helicopters described in this paper were not equipped with radio altimeters, which indicate the actual height of the aircraft above ground and which warns the pilot of proximity to terrain. It is felt that the aircraft accident which occurred in the presence of Flat Light or white out conditions over featureless, snow covered terrain might have been prevented had the helicopter been equipped with a radio altimeter. It is recommended that Spatial Disorientation simulator training be made compulsory for all Army aviators and those posted to these areas must undergo training before induction.

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Introduction

Our senses do not deceive us. This is not because they always judge correctly, but because they do not judge at all - Immanuel Kant

Helicopters are a lifeline for maintenance of forward areas in high altitude regions including the glaciers. The missions include reconnaissance and observation, aerial photography, air surveillance, maintenance of posts and casualty evacuation. Ever since helicopter operations commenced about three decade back for maintenance in the glacial region in northern latitudes of our country, Armed Forces have had approximately fifty accidents. Out of these in the recent past, apparently three involved white out conditions leading to Controlled Flight into Terrain (CFIT). CFIT occurs when an airworthy aircraft under the control of a pilot is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew. While most CFIT events occurring in general aviation involve night operations or inadvertent entry into Instrument Metrological

Condition (IMC), all of these accidents occurred during daylight hours in Visual Meteorological Conditions (VMC). One fourth [1] to one third [2] of aviation accidents occurring each year are attributed to atmospheric factors.

Case report

Two Cheetah helicopters took off from base (Location 'A') at 1115h on D day to evacuate a Priority-1 casualty. Weather check was carried out abeam the glacier and finding it comfortable, they decided to proceed further to location 'C'. Winds were assessed over Location 'B' helipad and the same was passed to No. 2 heptr, to attempt a landing and assess power. The No. 2 heptr carried out a normal approach and landing at 'B'. The No.2 heptr got airborne and established visual contact with No.1 heptr. Thereafter, they both proceeded to loc 'C'.

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The No 1 heptr carried out a normal approach and landing after assessing winds and calculating power. Facing ground resonance on the left helipad, the pilot repositioned the heptr on the right helipad and asked No 2 heptr to maintain above and short of loc 'C'. The communication with the post revealed that the casualty had not arrived. The pilot gave a call to No. 2 heptr before getting airborne. A normal take off was carried out. The internal parameters of the aircraft were satisfactory. Heptr executed a normal left hand cross turn at the nominated parameters of height 300' AGL and speed 40 Knots IAS, confirmed by the co-pilot. During the turn a mild turbulence was experienced by the crew. As the sky was overcast and slopes covered with thick snow the only reference point available, was a foot track in the snow. During the turn, the pilot lost sight of the track, lost orientation and asked the co-pilot if he was visual with the track to which he confirmed. A fraction of a second later, the helicopter crashed ahead of the track into the snow.

Both the aviators had certified themselves medically fit. Both the aviators gave no history of consumption of alcohol and had adequate sleep the night prior. The aviators were carrying adequate oxygen. They inhaled 100% intermittently. Both pilots had taken oxygen on down wind and before take-off. Both the aviators had sufficient flying experience in the glacier. None of the aviators suffered any grievous injury.

Discussion

In this incident, both the aviators were medically fit for flying. Pre-flight medical checks of the aviators were done and both aviators had their pre-flight meals. There was no history of any significant illness in the recent past, a state of good health of the air crew and absence of any other circumstantial evidence precludes the possibility of in-flight incapacitation due to any pre-existing or in

flight cause. There is no evidence suggesting the existence of any other stress like hypoglycaemia, etc on board.

The aviators were flying at an altitude above 16000 ft. in an un-pressurized cabin using intermittent 100% oxygen. This could have caused some degree of hypoxia. Possibility of hypoxia with the use of intermittent oxygen has been reported in past [3,4]. The aviators were experienced enough with the pilot having around 3000h of flying and over 700h of glacier flying. The co pilot had 1100h of flying experience. The extreme weather conditions (sub zero temperatures) and the featureless terrains are stress factors in glacier flying. The pilot-in-command had been flying in the glacier for almost 2 yrs which itself is a prolonged and cumulative stress factor which is further augmented by the weather conditions. On 'D' day they were launched to evacuate a P1 casualty from a post in the glacier. The ground around this loc and the mountain slopes on its either side were uniformly white due to continuous snowing in the area over the last 10 days prior to the accident. The overcast sky merged imperceptibly with the snow bound terrain and the ground and met conditions at the time of accident resulted in total lack of external visual cues creating a situation of 'Flat light'. White out results in loss of depth perception causing difficulty in estimating height in attempting to maintain ground clearance while flying over such featureless terrain, making conditions conducive to Spatial Disorientation (SD) which is the most probable cause of the accident as brought out during the investigation.

Helicopter missions in high altitude compounded by the inherent weather conditions pose a high risk for accidents which can be prevented to a large extent by proper planning and training. Good judgment and adequate equipment can help reduce accidents. Chances of SD due to

weather phenomena can be greatly lowered with the help of efficient training making use of simulators, visual displays in the form of videos and didactic lectures explaining the root cause and ways to lower these conditions. Flat light and White out are forms of SD caused by absence or lack of sufficient ambient visual orientation cues. The two variants of this illusion are discussed below.

Flat light is an optical illusion, also known as “sector or partial white out.” It is not as severe as “white out” but the condition causes pilots to lose their depth perception and contrast. Flat light conditions are usually accompanied by overcast skies inhibiting any good visual cues. Such conditions occur primarily in snow covered areas but can occur in dust resulting in an inability to distinguish distances and closure rates. As a result of this, it can give pilots the illusion of ascending or descending when actually flying level [5]. In clear air conditions, when there is no snow falling, diffuse lighting from overcast cloud may cause all surface definition to disappear. It becomes impossible to tell how far away the snowy surface is. In Polar Regions, this optical illusion can make completely snow-covered mountains invisible against the background white cloud, the horizon unidentifiable, and difficulty in judging steepness. This effect is exacerbated by a smooth surface of fresh snow. It is only when a contrasting object is placed on a snowy surface that the surface can be detected. In less extreme cases, it may suffice to break the snow surface by throwing a snowball ahead. This form is known as “flat light” [6].

Federal Aviation Administration (FAA) Advisory Circular AC-00-61 describes “whiteout” as a “visibility-restricting phenomenon that occurs in the Arctic when a layer of cloudiness of uniform thickness overlies a snow or ice covered surface. Parallel rays of the sun are broken up and diffused when passing through the cloud layer so that they

strike the snow surface from many angles. The diffused light then reflects back and forth countless times between the snow and the cloud eliminating all shadows. The result is a loss of “depth perception” [7]. As defined in meteorological terms, it is the situation when a person becomes engulfed in a uniformly white glow. The glow is a result of being surrounded by blowing snow, dust, sand, mud or water. There are no shadows, no horizon or clouds and all depth-of-field and orientation is lost. A white out situation is severe in that there aren’t any visual references. Flat light conditions can lead to a white out environment quite rapidly, and both atmospheric conditions are insidious. They sneak up on you as your visual references slowly begin to disappear. White out has been the cause of several aviation accidents in snow-covered areas. There are two types of white out [8]:-

(a) *Atmospheric White Out:* Snow covered ground merges with a white overcast, creating a condition in which ground textual cues are absent and the horizon is indistinguishable. Although visibility may be unrestricted in the atmospheric white out, there is essentially nothing to see except the runway markers. An approach made in this condition must therefore be accomplished with a close eye on the altitude and attitude instruments to prevent SD and inadvertent ground contact.

(b) *Blowing Snow White Out or Self Induced White Out:* This effect typically occurs when a helicopter takes off or lands on a soft snow-covered area. The rotor down wash picks up particles and re-circulates them through the rotor system. The effect can vary in intensity depending upon the amount of light on the surface. This phenomenon can happen on the sunniest, brightest day with good contrast everywhere. However, when it happens, there can be a complete loss of visual cues. If the pilot has not prepared for this immediate loss of visibility, the results can be disastrous. A similar

condition exists for helicopters in dusty and sandy environments.

Dynamic roll over is a condition into which a pilot gets while trying to maintain visual contact with the ground during the sudden rotor induced white out and gets into an unrecognized drift to one side, and shortly thereafter contacts the ground with sufficient lateral motion to cause the aircraft to roll about its centre of gravity until a rotor strikes the ground [8]. White out approaches cause SD unexpectedly under VMC rather than IMC.

One way to compensate for the lack of visual contrast and depth perception is wearing amber tinted lenses also known as blue blockers. Special note of sensitivity and ambient lighting conditions is of prime importance [5]. When in such a condition trust the cockpit instruments execute a 180-degree turnaround and start looking for outside references and above all, fly the aircraft.

Getting caught in a no visual reference situation can be fatal. Physical awareness may tell the pilot that he is flying straight but he may actually be in a spiral dive with centrifugal force pressing against him. Having no visual references enhances white out. Just because the pilot has a good visual reference doesn't mean that it is safe to continue. There may be snow-covered terrain not visible in the direction that he is traveling [5].

Accidents resulting from Controlled Flight into Terrain involve flight crew situational awareness. Situational awareness means the pilot is aware of what is happening around his/her aircraft in both the vertical and horizontal plane. The basic cause for CFIT is the flight crews' lack of vertical or horizontal position awareness in relation to the ground, water, or obstacles. During daylight hours in VMC, CFIT can also be attributed to fatigue, task saturation, and/or mission fixation. Simply stated, flight crews need to know where they are

and maintain a safe altitude for flight. Minimum altitudes, operating airspeeds, terrain and environmental factors must be considered at all times.

National Transport Safety Board (NTSB) in their safety recommendations has raised concern on the instrument rating and demonstration of instrument competency during initial and recurrent evaluation checks. It has recommended FAA to implement criteria to this effect, for pilots operating in flat light or white out conditions. The board also recommended that radar altimeters be installed in all helicopters operating in the above mentioned weather conditions [7].

The Flight Safety Foundation in its helicopter safety issue recommends that during simulator training compliance with standard procedures and practices be emphasized and use of reflective markers on departure and approach paths be made compulsory [9].

Recommendations

The helicopter in this case study was equipped with a pressure altimeter, which indicates the aircraft's height above sea level by measuring atmospheric pressure from a static port outside the aircraft. Availability of a radar altimeter which measures separation from the ground using the time taken for a radio signal to reflect back to the aircraft might be helpful in preventing such accidents. Therefore, it is recommended that all helicopters, flying in these and similar type of terrain be fitted with radar altimeters.

Hands on SD training in a SD simulator along with didactic lectures explaining the cause and condition under which these weather phenomena can occur should be made compulsory for all aviators either at the training stage i.e. before induction into aviation or before posting to areas

where flying is likely to encounter flat light or white out conditions. This shall help to reduce the occurrence of this type of SD.

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