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HELICOPTER FLIGHT IN DEGRADED VISUAL CONDITIONS.

1 Introduction

1.1 A review of helicopter accidents covering the period 1997 to 2001, and reported in Helicopter General Aviation Safety Information Leaflet (GASIL) December 2002, identified disorientation as the largest single cause of helicopter fatal or serious injury accidents. More recent data, including from detailed studies by the International Helicopter Safety Team (IHST) and the European Helicopter Safety Team (EHEST), demonstrates the continuing occurrence of helicopter pilot disorientation and loss of control in conditions of low cloud or poor visibility, or at night. Although the basic instability of most small and some medium-sized helicopters is a major factor in such accidents, it is recognised that little can practicably be done to address this issue with existing aircraft, or new aircraft, in the near term. The CAA believes, however, that a combination of improved regulations and education will help to reduce the incidence and mitigate the consequences of such events.

1.2 The UK Air Navigation Order and the Rules of the Air Regulations were amended in 2007 to include, amongst other matters, visibility minima for helicopter flight under Visual Flight Rules (VFR) and Instrument Flight Rules (IFR). In an attempt to address education, this AIC is published to provide guidance on the problems and hazards associated with flight in degraded visual conditions. The information contained in this AIC has been distilled from research into helicopter flight in degraded visual conditions, carried out for the CAA by QinetiQ. The research highlighted the strong relationship between helicopter handling characteristics and available visual cues (Reference 1), and clearly showed that there are likely to be visual cueing conditions, helicopter handling characteristics and pilot capabilities which, although allowed individually by the regulations, can be predicted to be unmanageable in combination.

2 Aim

2.1 The aim of this AIC is to improve the safety of helicopter operations by providing guidance to enable pilots to make more informed decisions regarding whether to fly. In particular, guidance is presented on the types of weather and visual reference conditions that should be considered appropriate to commit to fly with, given the handling characteristics of the helicopter and the pilots' own training and experience.

3 Flight with the Surface in Sight

3.1 Under the current regulations, there are provisions to enable flights to be conducted by visual reference 'with the surface in sight'. This is defined as *'…with the flight crew being able to see sufficient surface features or surface illumination to enable the flight crew to maintain the aircraft in a desired attitude without reference to any flight instrument…'*. This underlines the fact that safe flight by visual reference is essentially dependent on the nature and sufficiency of the available visual cues. For example, it is clear that for flight in good daylight CAVOK conditions over populated or cultivated rural areas there will normally be a multiplicity of visual cues to support control of aircraft attitude and state (height, speed, heading and acceleration), provided by physical features such as roads, buildings, fields and a natural horizon. However, for VFR flight over calm water or at night over unpopulated areas with little or no lighting, adequate visual cues may not be available.

3.2 In conditions where flight by visual reference is known not to be feasible, the regulations require that such flying is conducted under IFR. This requires that both the helicopter and the pilot meet the appropriate standards. However, this would not be the case in the event of an inadvertent encounter with Instrument Meteorological Conditions (IMC) or other degraded visual environment while conducting a flight by visual reference. In these circumstances it may not be possible to maintain safe flight if the pilot is not qualified for IFR flight and/or if the helicopter is not IFR certificated. A primary influencing factor in determining the likely outcome of such a situation would be the level of pilot workload associated with the control and stabilisation of the aircraft so, before other issues are examined, the issue of stability is reviewed in the next section.

4 Helicopter Stability

4.1 The classic example often used to illustrate stability is to consider a ball resting on either a convex, flat or concave surface. If the ball is disturbed and left unchecked, in the first case it will continue to roll away (negative stability, or unstable); in the second case it will roll away and come to rest at some new point (neutral stability or neutrally stable); in the final case it will always return to the same point of rest (positive stability, or stable). The great majority of helicopters with their basic equipment fit, i.e. without a system that provides artificial stability, are technically unstable. Positive stability characteristics can usually only be achieved through use of an automatic stabilisation system.

4.2 Small helicopters have to meet less stringent stability requirements (FAR/JAR/CS-27) during certification than do their larger counterparts and small aeroplanes. To 'compensate' for this reduced level of stability, helicopters in this class are restricted to flight in Visual Meteorological Conditions (VMC) where the pilot will normally have sufficient visual cues to detect attitude changes and make the appropriate corrections to keep it 'right side up' without undue difficulty. To qualify for flight in cloud (IMC), i.e. without any external visual cues, much more stringent stability and instrumentation requirements must be met. It is worth noting, however, that these higher standards are only approximately equivalent to those required of small fixed-wing aircraft for VMC flight.

4.3 The only way that helicopters can meet the equivalence of the small aeroplane stability requirements, or the helicopter IFR requirements, is through the use of Artificial Stability Equipment (ASE). Larger helicopters tend to have ASE fitted as standard, and are normally capable of flight in IMC. Small helicopters, however, are at a particular disadvantage here as they are much less likely to have such equipment due to its cost, complexity and weight. For small unstabilised helicopters, therefore, it is generally only the pilot and the visual cues available to him/her that keep the rotor pointing towards the sky and the skids towards the ground. The pilot has to provide the stability and needs visual cues to do so. To set this in context, for an average VFR-only certificated helicopter without ASE, the pilot workload (attentional demand) for flight control alone is likely to rise rapidly from around 25-30% in VMC to 100% in poor visual conditions. In the following paragraphs the issue of visual cueing is examined.

5 The Nature and Sufficiency of Visual Cues

5.1 In VMC, the pilot navigates the aircraft and controls its motion and state using information that he derives from looking out of the window, i.e. the outside visual scene. This includes navigational references such as roads, rivers, railway lines and other landmarks; and attitude cues from the natural horizon. Less obviously, significant information is also derived from the more subtle parameters of motion parallax (the relative movement of near and far objects relative to the eye), edge rate (the flow of objects relative to the cockpit window) and looming of objects (the rate of expansion in size) as they are approached.

5.2 Obviously, the information available to the pilot from the outside visual scene will deteriorate as his ability to see it reduces and, during visual reference flight, this can typically occur as a result of a gradual decline in weather conditions en-route, or due to inadvertent entry into IMC. However, it is also possible for the pilot to have insufficient information to support safe flight by visual reference alone in conditions of good visibility due to poor visual scene content, i.e. there is not enough out there to look at. Adequate visibility and visual range alone will not necessarily ensure adequate visual cues for maintaining safe flight.

5.3 Loss of navigational references will be obvious to the pilot and, apart from getting lost and possibly colliding with an obstacle or high ground (Controlled Flight Into Terrain (CFIT)), this can significantly distract the pilot from the near-term guidance and stabilisation tasks and from the cockpit instruments. This was the case in many of the accidents reviewed and, in some examples, the pilot's attention was distracted by deteriorating visual cues and concern about getting lost to the point where cockpit instruments were ignored for significant periods of time. The danger here is of a gradual and undetected change in aircraft attitude or state. Loss of height can lead to CFIT; inattention to aircraft attitude can lead to the development of extreme attitudes followed by disorientation and loss of control; loss of airspeed can contribute to loss of height and, since stability reduces with reducing airspeed, also loss of control.

5.4 Loss of the cues necessary to control the helicopter's motion and state due to poor weather are also likely to be obvious to the pilot. Typically, however, it seems that accidents occur because entry into cloud or fog is sudden and leaves no opportunity for a precautionary landing, or because events are allowed to continue beyond the point where such a course of action remains open, i.e. pilots attempt to cope with the deteriorating conditions and do not appreciate the danger until it is too late. Pilots often attempt to manoeuvre to escape or avoid the region of impaired visibility by climbing above it, descending below it, or backtracking. Unfortunately, anything other than very gentle manoeuvring increases the demand for visual cues, increasing the likelihood of disorientation and loss of control. Alternatively, where the loss of visual cues is either wholly or partially due to poor scene content, it is quite possible that the pilot is unaware of a subtle loss of visual references, which can then lead to CFIT or loss of control, especially if the pilot is distracted.

5.5 It is possible that a navigation aid such as Global Positioning System (GPS) could alleviate pilot workload during encounters with degraded visual cueing environments, allowing the pilot to apply greater resources to the task of maintaining control of the aircraft. However, even a moving map display requires interpretation and it has been suggested that the availability of such systems could encourage pilots to fly when they might otherwise think twice, leading to increased exposure to poor visual cueing environments. It must be remembered that GPS is a most useful tool which, subject to some limitations, will tell you where you are but will not tell you which way up you are. Ultimately there will be a point at which the visual cues available will simply be insufficient to maintain control of the aircraft even if the workload associated with the task of navigating the aircraft is completely eliminated.

5.6 Given the above, it would be helpful to know what actually constitutes an adequate visual cueing environment in practical terms. To help answer this, examination of the accident data provides useful insights regarding the critical factors and visual cues which, if lacking, can result in tragedy. Some general pertinent features revealed by accident investigations are as follows:

a. After astronomical twilight there may be no true horizon and optical perception of the horizon plane is provided by an illuminated ground plane;

b. Current regulations governing VMC flight at night do not require the existence of a visible true horizon and, in any event, there is no method of predicting its existence;

c. Rural localities can be unexpectedly dark because of the limited artificial lighting outside populated areas;

d. It is likely that at night minor terrain features will not be visible from 1500-2000 ft above ground level, and unlit features such as rivers and roads can be hard to see and follow (motorways provide the best line features).

5.7 Other common factors which act to degrade the available visual cues include:

a. Low levels of ambient light leading to a general reduction in the quality of the visual scene and the available optical cues, e.g. at night;

b. Reduced visual range and/or loss of sight of the ground/surface of the sea due to the effects of fog or cloud;

c. The presence of atmospheric haze or sun glare;

d. Lack of surface texture or features such as buildings, roads and rivers;

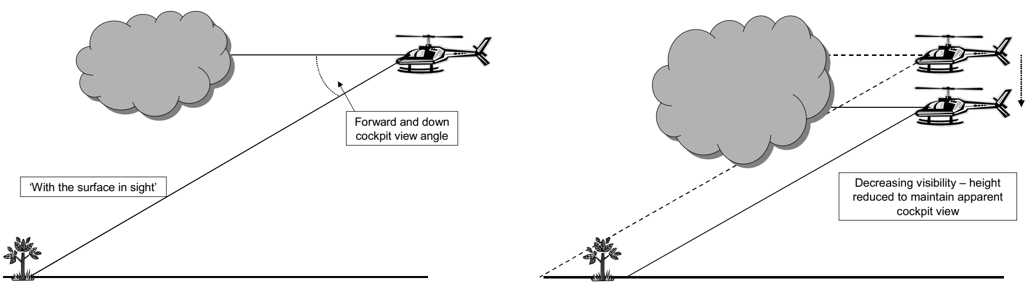
e. Lack of texture on the surface of the sea/water, i.e. calm water;

f. Poorly delineated sloping or rising ground contours;

g. Misleading cues such as a false horizon from, for example, a distant row of street/road lights;

h. Obscuration due to precipitation on the cockpit windows.

5.8 It should also be noted that the forward cockpit window's downward cut-off angle will have a detrimental effect on the forward view, which is made worse by increasing nose-up pitch attitude. Its effect will be compounded by increasing height when flying in poor visibility with a reduced visual range, ultimately to the point where it is possible that few or no visual cues will be visible through the forward windows. As a result, there is a tendency for pilots to inadvertently descend as they attempt to retain the visual picture 'out of the window' as illustrated below.



Such descent, if undetected, could obviously lead to dangerous situations developing in terms of CFIT or collision with an obstacle. In addition, the increased perception of ground speed at lower height could lead to an inadvertent reduction in airspeed and hence more height loss and reduced stability.

6 How and Why Accidents Happen

6.1 Examination of accident reports indicates that any of, or a combination of, the following three scenarios could result in a serious accident:

a. Loss of control when attempting a manoeuvre to avoid a region of impaired visibility, i.e. backtrack, climb above or descend below;

b. Spatial disorientation or loss of control when transferring to instrument flight following an inadvertent encounter with IMC;

c. Loss of situational awareness resulting in controlled flight into terrain/sea.

6.2 The likelihood of an accident is dependent on a variety of contributory factors such as the degree of visual degradation; the aircraft type; and pilot experience, currency and training. However, the evidence shows that for a significant number of fatal accidents the primary causal factor was degraded visual cues, and detailed examination highlights a number of visual cueing issues that resulted in accident situations. The following sections present a more detailed look at these particular circumstances, using specific accident cases to illustrate some of the key issues.

6.3 Another factor that should be considered, especially if a pilot is attempting to regain visual cues by manoeuvring for example, is the need to reduce any other unnecessary distraction at that time. Such distraction could be attempting to change a radio frequency or a transponder code, both of which would normally require releasing controls and movement of the head to focus on the display thereby potentially further increasing any disorientation factors. The pilot should consider declaring an emergency early so that any Air Traffic Service Unit trying to assist is aware of the situation and that changing frequencies or transponder settings may not be possible. Once the pilot has regained sufficient cues to manage the aircraft safely, he should advise Air Traffic Services accordingly and follow their instructions.

6.4 **Manoeuvring to Clear a Region of Impaired Visibility**

6.4.1 If a manoeuvre is attempted in poor visual conditions, unless pilots have adequate instrument training, are current and refer to instruments to effect a recovery they can become disorientated and lose control of the situation very quickly. As illustrated in the following examples, an aircraft without auto-stabilisation equipment can be particularly difficult to manoeuvre safely in such circumstances.

Example 1 (Squirrel AS355, G-CFLT, 1996):
The aircraft was en-route at night, at a cruise speed of around 100 kt and a height of around 1200 ft, just below a lower layer of broken cloud. The aircraft was not equipped for IFR operations and the pilot was not instrument rated. However, these would not be required when flying by visual reference. The accident occurred during the execution of a climb to a higher altitude to ensure maintenance of a 'Minimum Safe en-route Altitude' (MSA). During the climb, the pilot was deprived of external visual references, and the aircraft entered an unintentional steep, nose-up attitude and lost airspeed (circa 30 kt). This manoeuvre subsequently developed into a fast, spiral descent from which the aircraft did not recover; it crashed into a field and all occupants were killed. The investigation concluded that the weather conditions were regarded as acceptable for the flight in relation to visibility, cloud and terrain separation; and analysis indicated that immediately prior to the accident the aircraft was in view of the ground and did not enter cloud. However, although there was good visibility, because of the cloud cover and the lack of background lighting from the sparsely lit rural locality, the visual horizon was poorly defined. When combined with high pilot workload, these factors would have created difficulty in discerning aircraft pitch attitude and bank angle using only the outside visual scene. During the climb, it is surmised that the aircraft achieved an excessive nose-up attitude, which led to the loss of speed and visual references, and in the pilot becoming spatially disorientated.

Example 2 (Robinson R44, G-ROTG, 2011):
The pilot was planning to fly from Aldwick, near Blagdon, south of Bristol Airport, to visit friends near Padstow in Cornwall. The forecast and aftercast for the route flown by the helicopter indicated that the weather was likely to have been marginal for flight under VFR west of Okehampton, due to the low cloud and hill fog. The helicopter's altitude gradually reduced as it progressed west of Okehampton. This is consistent with the pilot trying to stay clear of cloud as cloud base and in-flight visibility reduced. The helicopter turned through approximately 180º and then started climbing. This was probably an attempt by the pilot to turn around to find better weather conditions and was flown at a rate of about 1º/sec. This gentle turn could be another indication that the pilot was encountering poor flight conditions. Having climbed into a low cloud base during the turn, or if encountering very poor visibility upon rolling out, the pilot may then have decided to continue climbing. As the helicopter climbed its ground speed decreased from about 105 kt to approximately 55 kt and the pilot reported “lost in cloud”. At about 3800 ft amsl, immediately before the helicopter started its final high rate of descent, its groundspeed was approximately 30 kt. As the wind at FL 040 was predicted to have been from the west to north-west at about 25 kt, the Indicated Airspeed (IAS) of the helicopter was likely to have been less than 15 kt, which would have made it very difficult to control in VMC or IMC. Such a situation is likely to require much of a pilot's effort to control the helicopter, leaving insufficient capacity to plan for a safe outcome. The maximum rate of descent recorded by the radar and GPS during the final seconds of the accident flight was approximately 14000 ft/min. This, together with the pilot's transmission “what am I doing?”, suggested that he had become spatially disorientated and had lost control of the helicopter. There was a post-impact fire and the pilot was fatally injured.

Example 3 (Enstrom F28, G-OIGS, 1997):
The aircraft was a single-engined type on a VFR transit flight during the daytime. The weather was fine with a visibility of 3.5 km with haze and varying amounts of cloud. The transit was underway at a height and speed of 600-700 ft and 78 kt when the aircraft entered a layer of cloud embedded within the haze layer. Initially, the pilot was able to maintain visual contact with the ground, but then decided to attempt a 180° turn to leave the cloud. During the turn, visual references were lost, and subsequently the aircraft's speed decayed and a high rate of descent developed. The aircraft broke through the cloud very close to the ground; the pilot managed to level the aircraft attitude but it struck the ground heavily and rolled over, causing extensive damage. The investigation concluded that the pilot had become disorientated due to inadvertent IMC and lack of instrument flying practice, and inappropriate control inputs had further compounded the problem.

Example 4 (Gazelle HT3, G-CBXT, 2011):
The aircraft was en-route from a private site near Tamworth, Staffordshire, to a maintenance facility near RNAS Yeovilton, Somerset. As it approached Langley Hill (850 ft amsl), near Winchcombe, Gloucestershire, it appears to have unintentionally entered IMC and subsequently impacted the hillside. All three occupants were fatally injured. The person who later discovered the wreckage stated that at the time of the accident there was ‘really dense fog’ over the accident site and surrounding hills. An aftercast of the routing and accident site stated that above 700 ft amsl, there was likely to have been cloud covering hills that would almost certainly have reduced visibility locally to less than 1000 m, and quite likely to less than 200 m in places. As the helicopter tracked south-west towards Langley Hill its altitude gradually reduced. This might indicate that the cloud base lowered and the helicopter descended to remain in VMC below the cloud. Given the heights the helicopter was flying at before the accident, it was likely to have been in IMC from a point approximately 2 km before the accident site. The accident site ground marks showed that the helicopter was on a track of 020º at impact indicating that the pilot had turned through about 220º and may have been attempting to regain VMC back in the direction the helicopter had originated from, as he was taught in his PPL(H) training. However, the pilot was not qualified to fly in IMC, and would have lacked the practice to fly accurately on instruments. It is probable that the helicopter was travelling at between 90 and 95 kt when it impacted the ground in a level attitude. The recorded data indicated that had the pilot altered course 3 NM west of track along the River Severn valley over lower ground he would have been able to remain in VMC below cloud.

6.5 **Spatial Disorientation or Transfer to Instrument Flight**

6.5.1 The following examples illustrate the case where, although an attempt may be made to become established on instruments, because of the time needed to effect the transfer of attention the aircraft may again be placed in a dangerous position, especially in low-level flight in close proximity to the ground and obstacles.

Example 5 (Squirrel AS355, G-EMAU, 1998):
The aircraft was fitted with auto-pilot/auto-stabilisation equipment and, although the pilot did not have an instrument flight rating, he was trained to have an instrument capability to allow for sudden and inadvertent IMC. The flight was a police air support operation, planned as a night flight in visual contact with the ground. The accident occurred during take-off and transition from the unit's landing pad. During the transition, at an estimated height of around 30-35 ft and speed of 20-25 kt, the aircraft suddenly entered a bank of fog, which rapidly deprived the pilot of external visual references. An attempt was made to recover the aircraft using flight instruments but the aircraft crashed following contact with trees near to the pad; the aircraft was destroyed and one observer killed. The weather was reported as fine with good visibility (up to 10 km) and the pilot noted that the sky was clear above the landing pad. However, the accident investigation report noted that conditions were conducive to the formation of mist and fog, and the most significant factor was the sudden loss of all external visual references and the time needed to transition from visual to instrument flight. From the point of encounter with the fog to contact with the trees, continued flight was only possible using flight instruments. The report concluded that the pilot probably never became fully established on flight instruments and did not detect changes to aircraft motion, the yaw acceleration in particular. In these circumstances, the pilot had no external visual references to warn him of a continued change of aircraft heading as he attempted to climb, which ultimately resulted in contact with the trees. The report also noted that the airspeed was below the aircraft's minimum limit for IFR flight and the pilot's workload would have been extremely high.

Example 6 (Aerospatiale SA365N, G-BLUN, 2006):
The IFR equipped helicopter departed Blackpool at 1800 hrs on a scheduled flight consisting of eight sectors within the Morecambe Bay gas field at night in poor weather conditions. The first two sectors were completed without incident and then the helicopter was positioned to land on the North Morecambe platform. The co-pilot visually acquired the helideck at a range of about 6800 m and the crew flew the approach by reference to visual cues that, because of the dark and prevailing poor weather conditions, did not provide adequate information required for the normal perception of distance. The paucity of instrument cross-checks by the commander did not assist the co-pilot in managing the approach profile and there was no evidence of monitoring by the commander. The co-pilot became disorientated during the approach and asked the commander for help but did not positively call 'going around'. The helicopter attitude reached a maximum of 38º nose down and 38º angle of bank to the right with the IAS passing 90 kt and the radio altitude reducing through 290 ft with a rate of descent of 2000 ft/min. The commander, who appeared not to be mentally primed to take control, did not do so until approximately four seconds after the initial request for help. Having taken control with the helicopter in an extreme and unusual attitude, the commander rolled the helicopter to a wings level attitude and reduced the nose forward pitch angle. During the attempted recovery of the helicopter, the commander was devoid of any external visual cues and was possibly distracted over concerns for the wellbeing of his co-pilot, and did not notice or correct the increasing angle of bank to the right and the helicopter's continuing descent into the sea. The last recorded radio altitude was 30 ft; at this time the helicopter attitude was a 12º nose down, with 20º bank to the right and the IAS was 126 kt. There were no survivors amongst the five passengers and two crew.

6.6 **Loss of Situational Awareness**

6.6.1 This final example illustrates the case where control of the aircraft may be apparently maintained in poor visual conditions but, because of poor situational awareness, it is flown into an unsafe situation where controlled flight into terrain/sea becomes increasingly likely. For example, divided attention between flight instruments and the outside visual scene can lead to a situation where pilots fail to notice a gradual and insidious loss in height, and in consequence fly dangerously close to the surface.

Example 7 (Sikorsky S61, G-BEON, 1983):
The aircraft was on a scheduled public transport flight in daylight over the sea. Following a descent and deceleration manoeuvre on approach to its destination airport, the aircraft gradually descended and flew into the sea. Prior to this, the aircraft had descended 250 ft from its intended height without either pilot noting it. There were only six survivors from the 23 on board. The flight was carried out under VFR in visual contact with the sea, although the aircraft was fitted with a three-axis Automatic Flight Control System (AFCS), with attitude and heading holds. While en-route the crew reported that a thick haze restricted forward visibility with no discernible horizon, and that there was a flat, calm sea. However, their impression that VFR conditions prevailed throughout the flight was supported by the accident investigation report. The report also concluded, however, that the conditions made assessment of height and attitude difficult using only external visual references. It was surmised that whilst flying on visual references, it was likely that the pilot had insufficient visual cues to realise that imprecise co-ordination of collective and cyclic control strategy had resulted in a power and attitude combination that gave rise to a gradual and continuous loss of height. Furthermore, any visual horizon created by the haze would have been inadequate for control of attitude, and this would have been exacerbated by the lack of surface texture on the surface of the sea. Regarding altitude, it was considered that the horizon information would have been of little use in deriving height information. Also, given the apparent lack of texture and structures on the sea surface, the edge rate and looming cues needed for detecting changes in height and height rate would not have been adequate.

7 Risk factors

7.1 When planning a visual reference flight 'with the surface in sight', there are a number of obvious risk factors arising from the foregoing discussion which should be taken into consideration prior to take-off:

1 The aircraft is certificated for VFR flight only;

2 The pilot is not trained/current for instrument flight operations;

3 The pilot is not trained and current in recoveries from unusual attitudes;

4 Navigation will be by map and visual reference, perhaps with GPS back-up;

5 The flight is planned to take place at an altitude of 1500 ft or more above ground level.

6 A segment of the route involves over-flight of a rural, unpopulated area or large expanse of water

7 The flight is at night or in conditions of atmospheric 'gloom';

8 For a flight at night, there is no moon or the stars and moon are obscured;

9 There are, or are likely to be, significant layers of low level cloud en-route (4/8 - 8/8);

10 The visibility is, or is likely to be, limited en-route, i.e. visual range at or close to the minimum permissible (~ 1.5 km);

11 There is a significant probability of encountering mist/fog/haze en-route;

12 There is a significant probability of encountering precipitation en-route.

7.2 If we treat these risk factors as a risk assessment check list, it can be seen that the magnitude of risk increases with the number of risks 'ticked'. If the first four risks were to be ticked, which might be expected with a basic VFR-only qualified pilot and aircraft, this would only pose a normal, acceptable level of risk provided that the flight were to be undertaken in good VMC conditions. Similarly for operational circumstances such as risk factors 5 and 6. However, the more risks subsequently ticked, the greater the overall level of risk. For example, if risks 1 to 9 are ticked, experience indicates that the flight should not be undertaken. In fact, risks 7 to 12 all add to the type of conditions that would make it extremely unlikely that a pilot would be able to maintain control of the aircraft's attitude by visual references alone.

Once a flight is underway other risk factors may come into play:

13 There is a low level of ambient light;

14 There is no visual horizon, or the horizon is only weakly defined at best;

15 There are few, if any, visual cues from the ground plane;

16 Changes of speed and height are not perceivable, or only poorly perceivable by visual reference alone;

17 Reducing height does not improve the perception of the horizon or cues on the ground;

18 The view from the cockpit is obscured due to precipitation.

These factors will add to the inherent risk of the flight already assessed by the risks ticked prior to the flight. For example, even if only risks 1 to 4 were to be ticked prior to flight, the overall risk would increase significantly were any of risks 13 to 18 to be subsequently encountered en-route. Risks 13 to 18 all point to the need for extreme caution (i.e. gentle manoeuvres only!) and serious consideration to concluding the flight as soon as is safely possible.

8 Summary

8.1 This AIC has considered the regulatory requirements concerning flight by visual reference, which stipulate that there must be sufficient cues to enable a pilot to maintain aircraft attitude without reference to flight instruments, and the primary factors that influence the ability to meet this requirement. Firstly, there are the aircraft's basic responses, level of control augmentation and the effect that these can have to either alleviate or exacerbate pilot workload when operating in degraded visual conditions. Secondly, there is the nature and sufficiency of the visual cues needed to maintain safe flight, and these have been illustrated using examples based on information extracted from accident reports. From these primary factors a set of risk factors has been determined that should be taken into account during the planning or conduct of a flight by visual reference.

8.2 The intention of this AIC is to inform pilots of the problems that might occur in order to help them avoid the hazards and to plan and conduct their flying safely. Safety is ultimately the responsibility of the individual and the key to this is to be aware of and make appropriate allowances for the risk factors highlighted at all times. Above all, in light of the information provided, pilots need to be realistic regarding their own and their aircraft's ability to cope safely in the event that the risks were to materialise. Where uncertainty exists, then it would be better not to take off.

9 References and Further Information

Reference 1: CAA paper 2007/03 'Helicopter Flight in Degraded Visual Conditions'.
Find under 'Research' at - http://www.caa.co.uk/pubsearch

Links:

- International Helicopter Safety Team (IHST) - http://www.ihst.org
- European Helicopter Safety Team (EHEST) - http://www.easa.europa.eu/essi/ehest