Surviving a Helicopter Crash in Water – The Way Forward?

Offshore oil rig with helicopter and supply boat.

by SRK Coleshaw

The recent fatal accidents in the North Sea and offshore Newfoundland have put the spotlight once again upon helicopter safety. While considerable improvements have been made over the last thirty years, there is much that could still be done. Occupant survivability is highly dependent upon the nature of the contact with the water, with low rates of fatality associated with controlled landings on water (ditchings), but with many impacts (crashes) considered to be 'non-survivable.' When considering possible improvements, the focus must necessarily be placed on survivable accidents, and look not only at aircraft structures and associated safety equipment, but also at occupant behaviours and training.

It is a well-known fact that a helicopter will capsize and/or sink (often very soon after impact) in a high proportion of water impact accidents. The chance of survival is greatest if the helicopter remains upright at least long enough for occupants to escape, but the chances can still be good if it remains afloat at or near the surface and the consequences of capsize can be addressed. In the case of ditchings, the risk of capsize increases as sea state increases. With current helicopter certification standards, it is recognized that the practical limit for ditching stability is in the region of Sea State 5. However, because this limit is exceeded for a significant part of the year in many areas of offshore activity, a means of preventing and/or mitigating the consequences of capsize is a critical factor in occupant survivability. Certification standards currently focus on the ditching scenario and do not address the greater problems experienced in impacts. Prevention and/or mitigation of helicopter capsize is thus a critical factor in occupant survivability.

Most helicopters transporting workers offshore are required to be equipped with floats to keep the aircraft above water long enough for the crew and passengers to escape. However, there have been a number of water impact accidents where the flotation system was either not activated or the automatic activation had been disabled. Automatic arming and deployment of flotation systems has been recommended in the past but this is not currently covered in the airworthiness (ditching) requirements or in advisory material. When considering what can be done to improve the sea-keeping performance and stability of floating helicopters, there are currently measures that could be adopted much more widely. For example, float scoops that increase righting moment and roll damping are in existence and have been shown to improve the capsize threshold of a helicopter by one sea state (from Sea State 4 to Sea State 5). It is considered that their use would reduce the risk of capsize at minimal cost and weight.

The crashworthiness of emergency flotation systems has also been questioned, given that damage to the flotation units is common. This problem is exacerbated by the fact that the flotation units are conventionally positioned low down on the airframe where they are exposed to high impact loads. However, it has been established that additional floats positioned high on the cabin wall could help to address this problem. In this position the floats would be protected from all but side impacts and thus provide redundancy in the event that the lower floats were damaged. In addition, providing flotation high up on the cabin wall makes it possible for a ditched helicopter, following capsize, to achieve a stable side-floating attitude in waves. This provides an air gap in the cabin as well as ensuring that exits on one side of the helicopter remain above the water, effectively mitigating the consequences of a capsize and increasing the probability of safe escape from a capsized helicopter. The UK Civil Aviation Authority has commissioned work over the past 15 years investigating the so-called side-floating helicopter scheme, and believes that the model studies, human factors research and a type-specific design study have shown that this concept is viable. For such a system to be adopted for new helicopter designs or retrofitted on current designs, the desire to improve stability must be visible, and pressure must be applied to bring about change.

In the meantime, we are left with a situation where the industry knows that helicopters are likely to capsize and/or sink on water impact. There is also recognition of a mismatch between the time required to escape from an inverted helicopter and realistic breath-hold times in cold water. The recent introductions of helicopter emergency breathing systems (EBS) provide a means of mitigating the breath-hold problem and improving survivability. Prevention of complete inversion is the most desirable solution, but in the absence of this, the industry must rely on EBS. As EBS is personal protective equipment, this must always be considered the last line of defence, but for now it provides a solution to the problem.

Helicopter simulation training.

Even with the provision of EBS, escape from a capsized helicopter is not easy and straightforward, as anyone who has completed helicopter underwater escape training, or indeed, who has been involved in a water impact accident, will know. Disorientation, fear, high levels of anxiety, panic and inaction are all human behaviours that may have to be overcome. Escape windows are of a size that larger persons may find difficult to escape through. Exit door mechanisms vary widely, requiring knowledge on the part of the individual about the particular design of helicopter in which they are being flown. It would be good to think that each occupant would have a seat next to an exit or escape window, and that the two would be aligned, but we know that this is generally not the case. Following the recent S92 accident in Canada, concerns were raised about an auxiliary fuel tank that was placed in the passenger cabin in a space normally occupied by three seats. Three optimum passenger seat positions were thus lost, and it was considered that escape would be more challenging for those in the adjacent aisle seats in the event of a ditching. The release of those escape windows would also be much more difficult without someone sitting next to the window, held by their harness while pushing out the window.

For some very valid safety reasons, helicopter underwater escape training tends to focus on escape from an exit/window next to the seat. This means that most trainees now never get the chance to attempt escape from an aisle seat, or escape from a central rear seat, for example. There would be obvious benefits from the provision of optional additional training where individuals had the opportunity to undertake cross-cabin escapes. While this may not have been possible in the past, the use of EBS for training makes this more feasible (as long as any risks inherent in EBS training can be sufficiently mitigated). Such training would not be appropriate for all due to the high levels of stress experienced by some individuals (this group would benefit more from confidence building exercises). However, for those who are confident in water, it could help to counteract the view that further training is much too repetitive when undertaken every three to four years over a working life.

When offshore passengers always fly in a single design of aircraft, it is sensible to provide high fidelity training for that particular helicopter type. However, when a particular offshore workforce flies in a wide range of aircraft types, then training, by necessity, has to be much more generic and cannot be specific to a particular seating arrangement and cabin configuration. In this scenario there is a need for passengers to be made familiar with the layout and exits within the particular helicopter being flown. The individual must then develop a personal escape strategy, taking personal responsibility for assessing the possible escape routes from their seat position to their nearest exit, as well as alternative escape routes if the optimum route is blocked. If this is done, these individuals are likely to have a more positive attitude and be better prepared in the event of a water impact accident.

In conclusion, improvements in occupant survivability could be achieved in a number of areas, with helicopter stability and emergency flotation system crashworthiness, and crew and passenger training seen to be critical issues. While some changes can be implemented by the offshore industry, others may need to have pressure placed on the industry regulators.

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