



Air Accident Investigation Unit Ireland

Executive Summary for Formal Report 2021-008

ACCIDENT
Sikorsky S-92A, EI-ICR
Black Rock, Co. Mayo, Ireland

14 March 2017



An Roinn Iompair
Department of Transport

Foreword

This Executive Summary is being issued due to the detailed nature and length of the Final Report, and contains extracts from Final Report 2021-008. This document is not a replacement for the Final Report, which is the AAIU document of record.

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the Air Accident Investigation Unit (AAIU) regarding the circumstances of this occurrence and its probable and contributory causes.

In accordance with the provisions of Annex 13¹ to the Convention on International Civil Aviation, Regulation (EU) No 996/2010² and Statutory Instrument No. 460 of 2009³, safety investigations and associated safety recommendations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

Extracts from the Final Report or this Executive Summary, may be published providing that the source is acknowledged, the material is accurately reproduced and that it is not used in a derogatory or misleading context.

¹ **Annex 13:** International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.

² **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

³ **Statutory Instrument (SI) No. 460 of 2009:** Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.



AAIU Report No: 2021-008

State File No: IRL00917016

Report Format: Executive Summary for Formal Report

Published: 5 November 2021

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents, on 14 March 2017, appointed Mr Paul Farrell as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report.

Operator:	CHC Ireland DAC ⁴
Manufacturer:	Sikorsky Aircraft Corporation
Model:	S-92A
State of Registry:	Ireland
Registration:	EI-ICR
Serial Number:	920051
Location:	Black Rock, Co Mayo, Ireland (9 nautical miles west of Blacksod)
Date/Time (UTC) ⁵	14 March 2017 @ 00.46 hrs

SYNOPSIS

A Sikorsky S-92A helicopter, registration EI-ICR (call sign Rescue 116), which was being operated by a private operator on behalf of the Irish Coast Guard (IRCG), was en route from Dublin, on Ireland's east coast, to Blacksod, Co. Mayo, on Ireland's west coast. The Flight Crew's intention was to refuel at Blacksod before proceeding, as tasked, to provide Top Cover for another of the Operator's helicopters, which had been tasked to airlift a casualty from a fishing vessel, situated approximately 140 nautical miles off the west coast of Ireland. At 00.46 hrs, on 14 March 2017, while positioning for an approach to Blacksod from the west, the Helicopter, which was flying at 200 feet above the sea, collided with terrain at the western end of Black Rock, departed from controlled flight, and impacted with the sea.

During the immediate search and rescue response, the Commander was found in the sea to the south-east of Black Rock and was later pronounced dead. Subsequently, the wreckage of the Helicopter was found close to the south-eastern tip of Black Rock, on the seabed at a depth of approximately 40 metres. The deceased Co-pilot was located within the cockpit section of the wreckage and was recovered by naval service divers. Extensive surface and underwater searches were conducted; however, the two Rear Crew⁶ members were not located and remain lost at sea.

Forty two Safety Recommendations are made as a result of this Investigation.

⁴ **DAC:** Designated Activity Company.

⁵ **UTC:** Coordinated Universal Time. All timings in the Final Report are quoted in UTC. At the time of the accident UTC and local time were coincident.

⁶ **Rear Crew:** This term is used throughout the Final Report because it was the term predominantly used by personnel who were interviewed by the Investigation. The Investigation notes that the Operator's manuals use the term 'Technical Crew' (TC).

NOTIFICATION

Shannon Air Traffic Control (ATC) notified the AAIU at approximately 02.30 hrs on 14 March 2017 that an Irish Coast Guard helicopter was missing near Blacksod Bay, Co. Mayo, and shortly afterwards that debris was sighted in the sea. Two Inspectors of Air Accidents deployed to Blacksod and arrived at approximately 08.00 hrs. The Chief Inspector of Air Accidents and another Inspector of Air Accidents arrived later that day, and on the following day, to assist with the Investigation.

THE INVESTIGATION

In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010, and Statutory Instrument No. 460 of 2009, the State of Occurrence is obliged to investigate aircraft accidents, and therefore the Investigation was conducted by Ireland's AAIU. An extensive on-site phase was carried out from 14 March 2017 to 10 April 2017. This was followed by a further on-site phase from 22 July 2017 to 25 July 2017.

In accordance with the provisions of Annex 13, several states, agencies and advisers provided assistance to the Investigation.

The Investigation acknowledges the work carried out at Black Rock/Blacksod which involved several Agencies, including: An Garda Síochána; the Irish Coast Guard (IRCG); the Operator; the Irish Defence Forces: the Air Corps, the Army, the Naval Service; the Commissioners of Irish Lights; the Royal National Lifeboat Institution (RNLI); Geological Survey Ireland; and the Marine Institute.

The Investigation also acknowledges the assistance and support provided by the Local Authority (Mayo County Council) and the Civil Defence.

The communities of Blacksod and the surrounding areas, and many persons and organisations from further afield, including mariners who worked in difficult sea conditions, rallied to support the large number of personnel who attended Blacksod to assist in the search operations; this support was invaluable, and proved to be of enormous assistance to all involved.

The AAIU Investigation commenced early on the 14 March 2017, on receipt of notification that an IRCG Sikorsky S-92A helicopter, registration EI-ICR, with a call sign of 'Rescue 116' (R116), was reported missing, followed shortly afterwards by reports of debris being sighted in the sea.

The initial on-site phase of the Investigation lasted approximately one month. Emergency response priority was given to the search for the missing crewmembers. In addition to discharging its investigative responsibilities, the AAIU provided technical assistance in the coordination of the Remotely Operated (underwater) Vehicle (ROV) search operations.



This Safety Investigation is exclusively of a technical nature, is in no case concerned with apportioning blame or liability and is independent of, separate from and without prejudice to, any judicial or administrative proceedings to apportion blame or liability. The sole objective of the Safety Investigation and Final Report is the prevention of accidents and incidents. The accomplishment of this objective relies on the aviation community's professional acceptance of, and confidence in, these tenets. Any attempt to use the Final Report for purposes other than flight safety undermines its fundamental purpose and risks damaging flight safety in the long term.

The Investigation is obliged to report the evidence it finds and to provide its analysis; however, it should be understood that the Investigation is solely concerned with improving flight safety, and to that end nothing written in the Final Report should be interpreted as a criticism of any individual or organisation. The Investigation requests that media activity in relation to the Final Report should take due cognisance of these issues so that flight safety is enhanced rather than damaged.

The Final Report in relation to an aircraft accident investigation is the foundation for initiating safety actions which are necessary to prevent further accidents from similar causes, and introducing improvements in areas which the Investigation identifies as actual or potential systemic safety issues. Therefore, the Final Report into an accident must establish in detail what happened, how it happened and why it happened.

The Final Report is, in accordance with Annex 13 requirements, structured to include: a record of relevant facts (Section 1 - Factual Information, presented under the 19, ICAO-prescribed headings); an analysis of the relevant facts (Section 2 - Analysis); conclusions in the form of findings, probable cause and/or contributory causes (Section 3 - Conclusions); and Safety Recommendations (Section 4 - Safety Recommendations).

In addition to the proximate circumstances and events related to the occurrence, the Final Report deals with systemic safety issues which were identified during the Investigation. This is in keeping with the ICAO Manual of Aircraft Accident and Incident Investigation, which requires reports to *'discuss and analyse any issue that came to light during the investigation which was identified as a safety deficiency, although such issue may not have contributed to the accident.'* It is neither practicable nor necessary to include all factual information gathered and considered by the Investigation. Accordingly, while the Final Report cites particular examples of matters which the Investigation considers necessary to support its analysis, findings and recommendations, it should be understood that the Investigation considered a larger body of evidence of which the examples cited are representative.

As prescribed in Annex 13, Section 7.4, a Preliminary Report, AAIU Report No. 2017-006, was published on the 13 April 2017 which included two Safety Recommendations, one to the Operator regarding Route Guides and one to the lifejacket manufacturer regarding the installation of Personal Locator Beacons (PLBs).

In addition, Annex 13, Section 6.6, requires that if a Final Report cannot be made publicly available within twelve months, the State conducting the investigation shall make an interim statement publicly available on each anniversary of the occurrence. A First Interim Statement, AAIU Report No. 2018-004, was published on the 16 March 2018, which included a further three Safety Recommendations: one to the Helicopter Manufacturer relating to Flight Data Recorder (FDR) position accuracy; one to the Operator regarding a review of its Safety Management System (SMS); and, one to the Minister of Transport, Tourism, and Sport regarding the oversight of Search and Rescue (SAR) aviation operations in the State. A Second Interim Statement was published on 1 March 2019; a Draft Final Report was issued in confidence to interested parties on 13 September 2019; a Third Interim Statement was published on 12 March 2020, and a Fourth Interim Statement was published on 12 March 2021.

During the Draft Final Report comments process, one party invoked Regulation 15 of SI 460 of 2009 and sent a Notice of Re-examination regarding certain Findings, Contributory Causes and a Conclusion in the Draft Final Report to the Minister for Transport, Tourism and Sport. On 23 December 2019, the Minister informed the Chief Inspector of Air Accidents that, in accordance with Regulation 16 of SI 460 of 2009, he was appointing a Review Board to carry out the re-examination requested. On 9 March 2020, the AAIU was advised by the Department of Transport, Tourism and Sport, that a Review Board has been established under SI 460 of 2009 for the re-examination of specific findings of the Draft Final Report into the accident to R116.

The Investigation advised all interested parties, on 9 March 2020, of the Departmental contact details for information relating to the re-examination.

Hearings were held over 44 days in the period from 23 November 2020 to 20 July 2021.

On 1 October 2021, the Chairman of the Review Board provided his Report to the Minister in accordance with Regulation 16(10). On 15 October 2021, the Minister sent a copy of the Chairman's Report to the Chief Inspector, also in accordance with Regulation 16(10), and referred all matters related to the Investigation back to the Chief Inspector to finalise the Investigation report. Regarding the specific Findings, Contributory Causes and Conclusion which were considered by the Review Board, the Investigation has adopted the revised text from the Chairman's Report.

The Investigation acknowledges that addressees of Safety Recommendations may have made progress in addressing those recommendations since the Draft Final Report was issued in September 2019. However, for certainty regarding these matters, the Final Report includes substantially the same Safety Recommendations; addressees can identify any actions taken since September 2019 in their responses to the Safety Recommendations in the Final Report, and these will be included in the updated Safety Recommendations on the AAIU website.



PREAMBLE

The Helicopter, EI-ICR, was owned and operated by a company contracted by the Department of Transport, Tourism and Sport (DTTAS)⁷, to provide Search and Rescue (SAR) helicopter services in Ireland. The Operator of EI-ICR was the holder of an Air Operator Certificate (AOC) issued by the IAA, and is henceforth referred to in the Final Report as *'the Operator'*.

The Operator was also the holder of a Helicopter Emergency Medical Service (HEMS) approval, and the sole holder of an Irish National SAR Approval. Both approvals were issued by the IAA.

Within DTTAS, SAR was managed by the IRCG, under the Maritime Safety Directorate. In addition to operating SAR missions, the Operator commenced HEMS operations in 2013, on an opportunity basis, at the behest of the Irish Coast Guard.

The Operator had four bases in Ireland, situated at Dublin Airport on the east coast, at Shannon and Sligo Airports on the west coast, and at Waterford Airport on the south-east coast. Each base was allocated a rescue call sign as follows: Dublin – *'Rescue 116'*, Shannon – *'Rescue 115'*, Sligo – *'Rescue 118'*, and Waterford – *'Rescue 117'*. EI-ICR was based at Dublin, operating under the call sign *'Rescue 116'* (R116). Flights operated by EI-ICR and its sister helicopters at the other bases are referred to as *'the Operation'*.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 The Call-out

At approximately 21.39 hrs on the night of 13 March 2017, the captain of a Fishing Vessel (FV) contacted Malin Head Marine Rescue Sub Centre (MRSC) to seek medical advice because a crewman on board had suffered an injury. At the time of this call the FV was operating in the North Atlantic Ocean, approximately 140 Nautical Miles (NM) west of Eagle Island, Co. Mayo. At 21.42 hrs, MRSC Malin contacted the Sligo SAR duty pilot, and tasked the Sligo-based helicopter, R118 with airlifting the injured crewman to hospital.

At 22.10 hrs, following consultation with the Dublin-based Commander, who was at home, the Marine Rescue Coordination Centre (MRCC) Dublin alerted the R116 crew via TETRA⁸ radio and tasked R116 to provide Top Cover⁹ for R118. The details regarding the exact nature of the tasking of R116 and R118, and communications between the relevant agencies, are set out in **Section 1.17.13** of the Final Report.

⁷ During the Investigation the title of the Department was changed to *'The Department of Transport'*. Accordingly, where appropriate, such as when making Safety Recommendations, reference is made to *'Transport'* rather than *'Transport, Tourism and Sport'*, and the terms *'the Department'*, *'Department of Transport'*, and *'DTTAS'* are used interchangeably in this Report.

⁸ **TETRA**: Terrestrial Trunked Radio – A European standard for a trunked radio system and two-way transceiver specification.

⁹ **Top Cover**: An aircraft dispatched in support of another (SAR) aircraft which is conducting an offshore mission. The term is also used to denote an air asset used as a SAR Support aircraft.

One of the Dublin Base duty engineers was alerted by a TETRA call at approximately 22.10 hrs, as he was about to leave the Dublin SAR Base for his home. He returned to the operations building and went to the Co-pilot's rest room, to check that the Co-pilot, who was staying on the base, had received the TETRA call. The Co-pilot confirmed that he had, and that he had spoken by phone with MRCC Dublin. When another Dublin Base engineer arrived from home, the Helicopter was towed out of the hangar to prepare it for refuelling.

The Commander telephoned the Sligo SAR Base from her car, while en route to the Dublin SAR Base and spoke to the winch operator of R118; the winch operator recalled that he informed the Commander that the two pilots were at the helicopter preparing for start-up, and that he was about to head out to join them. The Commander advised him that she had received the call for 'Top Cover', that she was making her way to the Dublin Base, and that she wanted to know what the intentions of the crew of R118 were. The Sligo winch operator said that he advised the Commander that they were heading offshore to the west and that he assumed R116 would route to Blacksod.

An engineer at the Dublin SAR Base, who was waiting in the operations room to receive a final fuel load requirement from the Flight Crew of R116, recalled the Commander coming onto the base, followed shortly afterwards by the two Rear Crew. The four Crew Members gathered in the operations room. One of the Dublin-based engineers recalled the Commander commenting that the Blacksod weather was probably not going to be good enough, and that the Helicopter would route to Sligo. At 22.35 hrs, the Winch Operator telephoned MRCC Dublin seeking an updated position for the FV, because they were unable to see the FV on the Automatic Identification System¹⁰ (AIS). The Winch Operator also telephoned MRCC Dublin to enquire if R118 was having trouble getting into Blacksod; he explained that if R118 couldn't get into Blacksod, then R116 would have to head to Sligo for fuel. MRCC Dublin undertook to check with MRSC Malin. MRCC Dublin subsequently rang the Dublin Base to provide the requested position update for the FV.

An engineer at the Sligo Base recalled that after R118 had departed, the Commander of R116 called the Sligo Base phone; he believed that this call was made from a land line. The Commander and the engineer knew each other and briefly exchanged pleasantries before the Commander told the engineer that R116 would be coming into Sligo for a rotors-running refuelling because the weather at Blacksod was unsuitable.

The Co-pilot arrived at the Helicopter at approximately 22.47 hrs, and told the engineer that the Commander had requested a total fuel on board of 5,000 lbs. Technical Log records indicate that a volume of 900 litres (L) of fuel, was uplifted to the Helicopter. The Commander was first heard on the Helicopter's Cockpit Voice Recorder (CVR) recording at 22.53 hrs.

¹⁰ **AIS:** A system used to indicate the positions of maritime assets (Final Report, **Section 1.6.6.**)



1.1.2 The Accident Flight

The Helicopter engines were started at 22.55 hrs, and it commenced take-off from RWY 16, at Dublin Airport, at 23.02 hrs. Shortly after take-off, the Helicopter established on a north-westerly track of approximately 300 degrees in accordance with its clearance. On transfer to Dublin Departures, the Helicopter was instructed to establish on a heading of 270 degrees. The Helicopter continued to climb on the westerly heading, until reaching 3,000 feet (ft), when it was transferred to Dublin Area Control Centre (ACC - Lower North Sector).

At 23.11 hrs, the Rear Crew made contact with R118 on TETRA. R118 informed R116 that it was about to land in Blacksod and that it would contact R116 when it was on the ground in Blacksod¹¹. In addition, R118 informed R116 that *'conditions at the pad are fine eh eh kind of some low cloud eh approximately five hundred feet eh up to the north while we were inbound through Broadhaven bay over.'*

The Helicopter continued to maintain 3,000 ft, and at 23.13 hrs it commenced tracking towards Sligo. Once established on course to Sligo, the Flight Crew conducted fuel calculations to determine if there was a time/fuel advantage in uplifting fuel at Blacksod instead of Sligo. At 23.20 hrs, having cross-checked their calculations, the Flight Crew elected to route to Blacksod.

The Rear Crew informed MRSC Malin of this decision. Shortly after this, the Flight Crew informed Dublin ACC of a change of routing, that they had turned approximately 20 degrees left, and would be routing to Blacksod. Dublin ACC instructed R116 to contact Shannon ACC (Shannon North).

The Helicopter called Shannon Information (ATC) and reported that it was 7 NM south of Kells (located approximately 29 NM north-west of Dublin) at 3,000 ft and that it was en route to Blacksod. Shannon Information asked the Helicopter to confirm that it was operating under IFR (Instrument Flight Rules) and if they were ready for 4,000 ft. R116 responded, confirming that it was operating under IFR and that it would be climbing to 4,000 ft in approximately 20 NM. Shannon Information passed the latest Shannon QNH (atmospheric pressure at sea-level) and asked the Helicopter to confirm if it was routing to Sligo or Blacksod. The Commander read back the QNH and reported that they were routing to Blacksod. Shannon Information informed R116 that R118 was *'just headed off the west coast now, he has no contact with me, if you contact him, can you ask him to give me a call please'*.

At 23.33 hrs, R116 commenced a climb from 3,000 ft, levelling at 4,000 ft three minutes later. Once the Helicopter was level at 4,000 ft, the Commander stated that she was going to select APBSS¹² on the Flight Management System (FMS).

¹¹ The Investigation was informed that R118 approached Blacksod using the SGLOWBS route (Sligo low level route to Blacksod), which is different to the route R116 intended to use.

¹² **APBSS**: A pre-programmed route in the Helicopter FMS (**Section** Error! Reference source not found.).

At 00.04 hrs, as R116 was passing overhead Knock Airport¹³, the Rear Crew made initial contact with Blacksod helipad to request information on the wind, cloud base and visibility. At 00.09 hrs, Blacksod helipad replied to R116 with an estimated cloud base, which was reported as between 300 and 500 ft. The Commander asked the Rear Crew to request wind direction, speed and visibility. This request was relayed to Blacksod helipad; the reply received was that the wind was west-south-west at 25-33 knots, and the visibility was 2 NM.

As the Helicopter approached the Mayo coast, the Flight Crew commenced the '*DVE*¹⁴ Approach' checklist. The Helicopter was at 4,000 ft, tracking towards waypoint '*BLKMO*', the initial waypoint of the APBSS route; BLKMO was almost coincident with Black Rock. At 00.28 hrs, the Helicopter crossed the Mayo coast and flew out over Blacksod Bay, and shortly after this, when the Helicopter was approximately 1.5 NM north of Dugort, Achill Island, Co. Mayo, at 4,000 ft, inter-Crew communications confirmed that the Helicopter was over the water.

The Co-pilot announced that the DVE checks were complete, and at 00.34 hrs, as the Helicopter passed abeam the navigational waypoint '*BKSDA*', '*Alt Pre*¹⁵' was selected and the Helicopter commenced descent. At this time, the Commander commented on the high terrain at Achill, in the Helicopter's '*nine o'clock position*', and the Winchman announced '*all clear ahead*'. The Co-pilot then informed Shannon ACC that the Helicopter was in the descent and that they were making their way into Blacksod for refuelling. Shannon acknowledged this and asked R116 to report again when airborne.

As the Helicopter was passing 2,400 ft, Approach One (APP1) mode (an automatic mode available on S-92A SAR helicopters to descend from 2,400 ft to 200 ft, unless interrupted at a higher intermediate altitude) was selected on the Automatic Flight Control System (AFCS).

As the Helicopter approached BLKMO, in the descent, while westbound, the Commander noted that they were clear to the right on radar and commenced a slight right turn to allow the descent to complete down to 200 ft, prior to a left turn back to BLKMO.

As the Helicopter tracked north-west from BLKMO, and passed approximately 800 ft in the descent, the Commander asked the Co-pilot to '*confirm we're clear ahead on radar and on E GYP WIZZ [EGPWS – Enhanced Ground Proximity Warning System]*'. The Co-pilot responded '*you are...you are clear ahead on ... ten mile range*'.

The Helicopter maintained a north-westerly track until it reached 200 ft, at which point the Commander announced that Approach One was complete and that she was '*[...] just going to help it round the corner ... coming to the left*'. As the Helicopter commenced the left turn back towards BLKMO, the Winchman announced that the Helicopter was '*clear around to the left*'. This was followed approximately 30 seconds later by a further announcement from the Co-pilot that they were '*ah clear ahead on E GYP WIZZ and radar*'.

¹³ **Knock Airport:** Ireland West Airport (EIKN).

¹⁴ **DVE:** Degraded Visual Environment, which OMB defines as visibility less than 4,000 metres or no distinct natural horizon.

¹⁵ **Alt Pre:** Altitude Preselect, a vertical mode selected on the auto-flight system.



At 00.43 hrs, as the Helicopter was turning back towards BLKMO at 200 ft, the *'Before Landing'* checklist was commenced. During this time, the Co-pilot stated: *'starting to get ground coming in there at just over eight miles in the ten o'clock position'*. Just as the Commander was completing the final item of the *'Before Landing'* checklist, she commented that she was visual with the surface of the sea.

At 00.45 hrs, the Co-pilot announced *'okay so small targets at six miles at 11 o'clock ... large out to the right there'*. This was followed approximately 20 seconds later by an Auto Callout *'Altitude, Altitude'*, which the Commander said was *'just a small little island that's B L M O itself'*.

Just prior to 00.46 hrs the Winchman announced *'Looking at an island just eh directly ahead of us now guys...you wanna come right [Commander's name]'*. The Commander asked for confirmation of the required turn, and the Winchman replied *'twenty degrees right yeh'*. The Commander instructed the Co-pilot to select heading (HDG) mode, which the Co-pilot acknowledged and actioned. Within one second of this acknowledgement, the Winchman announced *'come right now, come right, COME RIGHT'*.

Shortly after this, the Helicopter pitched up rapidly and rolled to the right. At 00.46:08 hrs, the Helicopter collided with terrain at the western end of Black Rock, departed from controlled flight, and impacted with the sea. The main wreckage of the Helicopter came to rest on the seabed to the east of Black Rock, at a depth of 40 metres (m).

2. ANALYSIS SUMMARY

The Flight Crew descended the Helicopter to 200 ft and used the FMS to manoeuvre *'Direct To'* the first waypoint, BLKMO, on the APBSS route, unaware that BLKMO was adjacent to a 282 ft obstacle comprised of terrain and a lighthouse.

The Flight Crew did not verbalise the obstacles listed for the APBSS route, although it appears that the Commander had read at least some of the hazards/obstacles information, because she mentioned an obstacle to the west of Blacksod when selecting the escape heading. Accordingly, it seems that the Flight Crew believed that the design of APBSS, one of the Operator's *'Low Level'* routes, if faithfully followed using the FMS, would provide adequate lateral terrain separation. Although the Operator had no formal procedure for designing routes, guidance in OMF about selection of an *'offset'* initial point adjacent to high terrain may have nurtured a belief that routes would provide lateral terrain separation, if vertical separation could not be assured.

Furthermore, both Flight Crew members reviewed the APBSS route separately, but neither identified the presence of Black Rock. The cockpit operating environment appears to have been sub-optimal regarding the combination of cockpit lighting and coloured documents, the size of font used in some documents, the tabulation of a large amount of numerically dense information and the combined portrait/landscape presentation of some routes, including APBSS.

The reasons for selecting a 282 ft obstacle as the starting point for what the Operator described as a 'Low Level' route, with no vertical profile, could not be determined because the origins of the route design itself were unknown to the Operator. It may have been related to previous generation navigation systems, which required in-flight re-calibration by transiting over a known geographic feature such as Black Rock Lighthouse. However, there were a number of other factors which militated against the Flight Crew detecting Black Rock in time to carry out an effective avoidance manoeuvre: Black Rock was not in the EGPWS databases; the BLKMO magenta waypoint symbol and track line likely obscured radar returns from Black Rock (which might have been detected on the 10 NM range); 1:250,000 Aeronautical Chart, Euronav imagery did not extend as far as Black Rock, and the 1:50,000 OSI imagery in the Toughbook did not show Black Rock, but instead showed open water at Black Rock. Furthermore, the Operator did not have formal processes or procedures to approve mapping data/imagery for use in its helicopters.

The operating environment on the west coast would have been more challenging than east coast crews were familiar with, particularly regarding the availability of visual cues in the littoral environment. This meant that it would not have been possible for the Flight Crew to accurately assess their horizontal visibility. However, given that Black Rock was only detected on the FLIR camera when the Helicopter was approximately 600 m from it, it seems that the horizontal visibility to the naked eye was probably less than 600 m. Furthermore, the Flight Crew's night vision may have been compromised due to the Helicopter's external lighting.

Research indicates that if the Flight Crew were awake for the length of time suggested by the Investigation's review (18 hours for the Commander and 17 hours for the Co-Pilot), they would have been more prone to errors in judgement and decision-making. The tempo of the mission was different to east coast missions and furthermore, the SAR support nature of the mission was known to be monotonous, increasing the risk of the Crew succumbing to fatigue.

Routes were generally viewed as base-centric, and a level of local knowledge and familiarity may have been assumed, which was an invalid assumption when an east coast crew was utilising a west coast route, a situation compounded by darkness and poor weather. The Operator said that the routes were merely there as a framework on which to build a plan for entry/exit to a number of known sites. However, there was no formal training in the use of routes; there was no formal procedure for how a route was to be designed; there was no formal procedure for how a crew should use a route guide; routes did not include a vertical profile or minimum altitudes generally, for route legs; and routes were not available for use in the simulator.

The Route Guide was prefaced with the statement that it was '*a work in progress and should be used with the necessary caution until all routes/waypoints are proven*'. Therefore, the routes were unproven, and the Operator did not have a defined process for route proving. Consequently, in the absence of formal, standardised training, design procedure or procedure for how a crew should use a route guide, it is unclear what beliefs/expectations individual pilots may have had regarding routes and how they could be used operationally. Problems with a number of routes had been identified in the SQID system (the Operator's Safety and Quality Integrated Database), however the SQID report was closed after personnel were emailed to resolve the matter, but without checking that the routes had actually been updated correctly.



The closing of SQIDS without checking that effective action had been completed was one of a number of issues identified with the Operator's Safety Management System (SMS). The Investigation also found that safety meetings were not being held as often as called for; minutes were not being uploaded onto SQID; SQID closure was not following the protocols set out in the Safety Management and Compliance Monitoring Manual (SMCMM); the quality of Risk Assessments could be improved; personnel involved in risk assessments could benefit from targeted training; and events in which safety margins had been significantly reduced were not being captured. Furthermore, the Investigation found that important safety information, which should have been captured in the SQID system and followed up, was instead raised in email but not captured or followed up.

The Operator's reliance on a secondary duty model to discharge safety critical tasks meant that matters could arise and be left in abeyance while personnel were on leave, off-shift or otherwise engaged in their primary SAR duties.

Despite the fact that its published reports and Aeronautical Notice said that the IAA SAR operations were classified as a 'State' activity and were to be regulated by the National Aviation Authority, the IAA subsequently expressed uncertainty about its mandate to regulate SAR; however, it neither withdrew nor restricted the Operator's National SAR Approval. The Operator, IRCG and DTTAS all believed that the IAA was regulating SAR operations. Audit reports of the Operator's bases that were submitted to the IRCG by its consultant do not appear to have been critically reviewed. Furthermore, DTTAS lacked the technical expertise to oversee the IAA. In addition, the IRCG did not have a safety management system.

Numerous areas, across several agencies, are explored in-depth in the Final Report. The issues identified demonstrate that the accident was, in effect, what [Professor James] Reason¹⁶ termed '*an organisational accident*'.

The Final Report highlights the importance of robust processes in relation to the following areas: Route Guide design, way point positioning, and associated training; reporting and correcting of anomalies in EGPWS and charting systems; Fatigue Risk Management Systems; Toughbook usage; en route low altitude operation; and the functionality of emergency equipment. It is particularly important that an operator involved in Search and Rescue has an effective Safety Management System, which has the potential to improve flight safety by reacting appropriately to safety issues reported, and by proactively reducing risk with the aid of a rigorous risk assessment process.

The Final Report identifies the importance of the levels of expertise within organisations involved in contracting and tasking complex operations such as Search and Rescue, to ensure that associated risks are understood, that effective oversight of contracted services can be maintained and that helicopters only launch when absolutely necessary.

¹⁶ Reason, J. (1997) '*Managing the Risks of Organizational Accidents*', Ashgate.

Finally, regulatory authorities have a role to play in assuring the safety of aviation operations, including Search and Rescue activities. Within Ireland, the State Safety Programme aims to achieve this by focussing resources in areas that *'present the greatest risk [...]'*. While it was acknowledged by the Authority that the Operator was engaged in *'medium to high risk'* operations, there was no greater oversight at regulatory authority level.

3. CONCLUSIONS

3.1 Findings

The Accident Flight

1. R116 was tasked to provide Top Cover for R118 which was tasked with a MEDEVAC mission, in the Atlantic Ocean, 140 miles from Eagle Island, at night.
2. There were gaps in the way tasking protocols were followed at MRSC Malin.
3. The Flight Crew members' licences and medicals were valid; the Rear Crew members were appropriately qualified.
4. The extent of R116's pre-flight planning could not be fully determined, although it was not unusual for SAR crews to brief for changed plans and destinations whilst airborne.
5. The airworthiness certification for the aircraft was valid.
6. R116's initial intention was to route to Sligo for fuel, but on learning that R118 reported that conditions in Blacksod were good, the decision was made to go to refuel at Blacksod.
7. APBSS was selected in the FMS as the route to be used for the arrival into Blacksod.
8. Both Flight Crew members commented adversely about the quality of cockpit lighting.
9. Neither Flight Crew member had been to Blacksod recently.
10. BLKMO was selected as a *'Direct To'* waypoint in the FMS.
11. The Commander reviewed the route waypoints with the Co-Pilot and took *'*overfly*'* off one waypoint, which the Investigation believes was BKSDC.
12. The Commander did not verbalise the obstacle information from APBSS when she briefed the route but it appears that she did read at least some of the information because she was aware of an obstacle to the west of Blacksod when the Co-pilot asked about an escape heading.
13. The Co-Pilot self-briefed the route and he did not verbalise the obstacle information.



14. It is probable that each pilot believed, as they flew to join it, that the design of the APBSS (waypoint BLKMO to BLKSD as described in legs 1 to 4 of narrative and on the map in FMS Route Guide in respect of APBSS) route would provide adequate terrain separation if the FMS was used to follow the route, and that obstacles need only be considered if going off the route.
15. The FMS Route Guide was commonly referred to as the '*Low Level Route Guide*' although there was no shared understanding of what the term '*Low Level*' meant.
16. There were a number of anomalies in the APBSS route information including an incorrect leg length which had gone uncorrected since at least 1999.
17. Prior to descent from 4,000 ft, DVE Approach checks were completed and all external lights, except the NIGHTSUN which was armed, were selected to '*On*'.
18. As DVE Approach checks had been completed, Approach checks, which included a check of crossing altitudes, were not completed.
19. When the Flight Crew members were satisfied that the Helicopter was over open water, the Helicopter descended from 4,000 ft using ALT PRE to 2,400 ft, and then APP1 was used to descend to 200 ft before manoeuvring to commence the APBSS route.
20. The FDR data did not indicate any technical issues or exceedances during the flight.
21. The CVR recording did not contain any discussion of horizontal visibility in the Black Rock area although the Commander commented that she could see the sea surface.
22. It appears that APBSS was being used as the basis for a SARA although it had not been designed as an ARA.
23. Radar was operated on the 10 NM range throughout the descent and manoeuvring to commence APBSS.
24. GMAP2 mode on the weather radar uses the colour magenta to represent terrain returns – the same colour as the active track and waypoint on the S-92A navigation display.
25. Black Rock was not identified on radar which was likely due to obscuration caused by the magenta BLKMO waypoint marker and the magenta track line to the waypoint marker.
26. Black Rock was not in the EGPWS databases.
27. The 1:250,000 Aeronautical Chart, Euronav imagery did not extend as far as Black Rock.
28. The 1:50,000 OSI imagery available on the Toughbook did not show Black Rock Lighthouse or terrain, and appeared to show open water in the vicinity of Black Rock.

29. The AIS transponder installed on the Helicopter was capable of receiving AIS Aids-to-Navigation transmissions; however, the AIS add-on application for the Toughbook mapping software could not display AIS Aids-to-Navigation transmissions.
30. The Winchman announced that he had detected an island ahead on the EO/IR camera system when the Helicopter was about 0.3 NM from it, travelling at a groundspeed of 90 kts.
31. The Winchman called for a change of heading and the Flight Crew were in the process of making the change when the urgency of the situation became clear to the Winchman.
32. There is no indication on the CVR that the Flight Crew saw Black Rock, although in the final seconds of flight there was a significant, manual input on the Collective Lever, an associated 'droop' in main rotor RPM and a roll to the right.
33. The Helicopter collided with terrain at the western end of Black Rock, departed from controlled flight, and impacted with the sea.
34. At no stage did any member of the Crew comment on seeing, or expecting to see, a light from Black Rock Lighthouse.

Organisational Aspects

35. The IRCG did not have a formal risk assessment process for helicopter missions and SMC personnel were not explicitly trained in risk assessment.
36. The Operator's routes were viewed as base-centric; there was no formal training/testing in the use of route guides, and routes were not available for use in the simulator.
37. The Operator had no formal processes for designing routes, proving routes or selecting waypoints.
38. The Operator's manuals were inconsistent in some areas and did not provide sufficient detail of processes and procedures for the discharge of some safety-critical functions.
39. The Operator relied on a Secondary Duty model for safety-critical support functions, which compromised the reliability and continuity of safety management and oversight.
40. There were anomalies in a number of aspects of the Operator's SMS including safety reporting, risk assessments, the management of meetings and minutes, the apparent non-reporting of serious incidents, and the use of email instead of SQID for safety management.
41. OMF required flight crews to have sufficient visual cues for the task in hand but it did not provide any specific guidance on how crews should carry out such an assessment.



42. There were various terms such as Top Cover, SAR Support, Chase Helicopter and Shadow Helicopter being used without a common understanding, and the efficacy of using a second helicopter of the same type (as the primary SAR helicopter), as a Top Cover asset, given their similar endurance, required further consideration.
43. There were weaknesses in the Operator's document management processes.
44. There was no HFDM programme for the Operator's fleet nor was there a regulatory or contractual requirement for such a system at the time of the accident.
45. There was no published guidance regarding the AFCS SAR Modes SRCH function.

Oversight

46. Neither DTTAS nor the IRCG had aviation expertise available within their own personnel resources, and lacked the capacity to remain an '*intelligent customer*' in relation to contracted helicopter operations or auditing.
47. The IRCG relied on an external contractor to conduct annual audits of the Operator's bases.
48. The IRCG appears not to have appreciated the severity of some of the matters the Auditor raised and it appears that the Auditor's reports and supporting evidence were not scrutinised by the IRCG.
49. The IRCG did not have a Safety Management System, and IRCG management completed their first aviation SMS training in October 2018.
50. From the IAA's Annual Safety Reviews and Aeronautical Notice it appeared that the IAA was responsible for, and carrying out, oversight of SAR helicopter operations in Ireland, but after the accident the IAA questioned whether it had the necessary mandate.
51. The IAA asserted that it was subject to oversight by the State, i.e. DTTAS, but DTTAS informed the Investigation that it did not have specialist aviation expertise within the Department to discharge such oversight.
52. The fact that SAR crews, who could avail of a wide range of exemptions under the National SAR Approval when operating SAR, could also be tasked with HEMS missions, which were operated primarily as CAT flights, was a source of confusion and difficulty for crews.
53. The Investigation is of the opinion that EASA should have a role in the regulation of civil-registered SAR aircraft and AOC operators involved in SAR, but EASA informed the Investigation that it did not have the required legal mandate.

Survivability

54. None of the Crew members survived the accident. Neither the Winch Operator nor the Winchman was recovered, and to date they remain lost at sea.
55. Whilst the Commander did manage to egress the Helicopter and inflate her lifejacket, she was submerged to a depth of at least 10 m, and the cold-water shock, darkness and overall sense of shock militated against her survival.
56. The Co-pilot, who was found secured in his seat within the cockpit wreckage, at approximately 40 m depth, was recovered, and post mortem examination concluded that he had suffered multiple injuries following which death would have ensued rapidly.
57. The SARBE installations in the Flight Crew's Mk44 lifejackets were not in accordance with the SARBE manufacturer's recommendations.
58. The two Flight Crew SARBEs, and one SARBE carried on the Helicopter in a spare lifejacket, had been submerged to at least 10 m depth and rendered unserviceable due to water ingress.

Human Factors

59. Although not all Crew Members had been able to attend a colleague's funeral ceremonies, the Investigation found no evidence that this adversely affected Crew Performance.
60. Both Flight Crew members commented adversely on the quality of the cockpit lighting.
61. EASA has recognised that flight deck systems design can strongly influence crew performance.
62. The Helicopter cockpit lighting had been modified to be compatible with NVIS, although NVGs had not been introduced into service.
63. The CVR recording indicates that there were trapped and un-trapped errors during the accident flight.
64. The roles of PF and PM were swapped after the Commander, as PM, had devised the plan and selected the route for arrival into Blacksod.
65. A sleep study of some of the Operator's SAR Crew members found that they accrued less sleep than that recommended by the US National Sleep Foundation and that this may not be enough sleep for optimal operational duty.
66. The Operator had an FTL scheme variation from the IAA which was predicated on the Operator having an FRMS in place; the Investigation was not provided with evidence that such an FRMS had been implemented.



67. R116 was engaged on a SAR support mission, and the Operator's OMF stated that on SAR support missions there was a potential for fatigue to set in quicker than on primary SAR missions, due to monotony.
68. FAA and CASA information highlights hours of prior wakefulness are correlated with increased error rates and judgment lapses, in personnel who are awake for longer than 10 hours. Based on the information in the 72-hour activity study, at the time of the accident, the Commander had likely been awake for more than 18 hours and the Co-pilot had likely been awake for more than 17 hours.
69. OMA quoted directly from EASA CAT.GEN.MPA.100 c(5) that '*A crew member shall not perform duties in flight if he knows or suspects that he is suffering from fatigue, or feels unfit to the extent that the flight may be endangered.*'; however, in the absence of an FRMS as required by EASA ORO.FTL.120, and given the Operator's 24-hour roster pattern, this advice is at odds with the scientific findings that individuals are notoriously poor judges of their own levels of fatigue.
70. OMF required crews to make maximum use of automation but it did not warn crews about the dangers of automation bias.
71. The Flight Crew cross-checked EGPWS with radar as required by OMF, although this had the potential to introduce bias, as the absence of Blackrock from the EGPWS could have adversely affected the likelihood of the Crew detecting Black Rock on the Radar.

3.2 Probable Cause

The Helicopter was manoeuvring at 200 ft, 9 NM from the intended landing point, at night, in poor weather, while the Crew was unaware that a 282 ft obstacle was on the flight path to the initial route waypoint of one of the Operator's pre-programmed FMS routes.

3.3 Contributory Cause(s)

1. The initial route waypoint, towards which the Helicopter was navigating, was almost coincident with the terrain at Black Rock.
2. The activities of the Operator for the adoption, design and review of its Routes in the FMS Route Guide were capable of improvement in the interests of air safety.
3. The extensive activity undertaken by the Operator in respect of the testing of routes in the FMS Route Guide was not formalised, standardised, controlled or periodic.
4. The Training provided to flight crews on the use of the routes in the (paper) FMS Route Guide, in particular their interface with the electronic flight management systems on multifunction displays in the cockpit, was not formal, standardised and was insufficient to address inherent problems with the FMS Route Guide and the risk of automation bias.
5. The FMS Route Guide did not generally specify minimum altitudes for route legs.
6. The Flight crew probably believed, as they flew to join it, that the APBSS (waypoint BLKMO to BLKSD as described in legs 1 to 4 of narrative and on the map in FMS Route Guide in respect of APBSS) route by design provided adequate terrain separation from obstacles.
7. Neither Flight Crew member had operated recently into Blacksod.
8. EGPWS databases did not indicate the presence of Black Rock, and neither did some Toughbook and Euronav imagery.
9. It was not possible for the Flight Crew to accurately assess horizontal visibility at night, under cloud, at 200 ft, 9 NM from shore, over the Atlantic Ocean.
10. The Flight Crew members' likely hours of wakefulness at the time of the accident were correlated with increased error rates and judgment lapses.
11. There were serious and important weaknesses with aspects of the Operator's SMS including in relation to safety reporting, safety meetings, its safety database SQID and the management of FMS Route Guide such that certain risks that could have been mitigated were not.
12. There was confusion at the State level regarding responsibility for oversight of SAR operations in Ireland.

-END-

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

Extracts from this Report may be published providing that the source is acknowledged, the material is accurately reproduced and that it is not used in a derogatory or misleading context.

Produced by the Air Accident Investigation Unit

AAIU Reports are available on the Unit website at www.aaiu.ie



An Roinn Iompair
Department of Transport

Air Accident Investigation Unit,
Department of Transport,
2nd Floor, Leeson Lane,
Dublin 2, D02TR60, Ireland.

Telephone: +353 1 604 1293 (24x7): or
+353 1 241 1777 (24x7):

Fax: +353 1 604 1514

Email: info@aaiu.ie

Web: www.aaiu.ie

Twitter: @AAIU_Ireland