Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

ACCIDENT
EC135P2+, 270
Near Borrisoleigh, Co. Tipperary
19 June 2012

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

FINAL REPORT

AAIU Report No: 2013-004
State File No: IRL00912068
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In accordance with the provisions of S.I. 460 of 2009, the Chief Inspector of Air Accidents, on 21 June 2012, appointed Mr Thomas Moloney as the Investigator-in-Charge to carry out an Investigation into this Accident and prepare a Report. The sole purpose of this Investigation is the prevention of aviation Accidents and Incidents. It is not the purpose of the Investigation to apportion blame or liability.

Aircraft Type and Registration:	EC135P2+, 270
No. and Type of Engines:	2 x Pratt and Whitney PW206B2
Aircraft Serial Number:	0425
Year of Manufacture:	2005
Date and Time (UTC[1]):	19 June 2012, 13.15 hrs
Location:	Near Borrisoleigh, Co. Tipperary
Type of Operation:	Air Ambulance
Persons on Board:	Crew - 3 Passengers - 0
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft: Substantial Third Party: Power lines severed and localised damage to agricultural field
Commander's Licence:	Military and CPL(A) and (H)
Commander's Details:	Male, aged 32 years
Commander's Flying Experience:	2,148 hours, of which 1,094 were on type
Notification Source:	Station Manager, Shannon Air Traffic Control (ATC)
Information Source:	AAIU Report Form submitted by Pilot AAIU Field Investigation

[1] UTC: Coordinated Universal Time, which is used throughout the Report, unless stated. Add one hour for local time.

SYNOPSIS

EC135P2+ 270, call-sign 'Ambulance 270', an air ambulance equipped Air Corps helicopter, was tasked by the National Aeromedical Co-ordination Centre (NACC) to collect a patient from a Health Service Executive (HSE) road ambulance near Borrisoleigh, Co Tipperary, and transfer him to Limerick Regional Hospital for treatment. The weather en route from its base, Custume Barracks Athlone, to the intended pick up point was good. On approach to landing in a field and shortly before touchdown, the helicopter's main rotor blades struck ESB[2] 20 kV overhead wires and severed them. This wire impact caused severe airframe vibration and a momentary oscillation of the helicopter, forcing the Pilot to carry out an immediate forced landing, which was heavy. He shut down the engines and the crew exited safely and uninjured. As there was substantial damage evident to the helicopter, the patient was transferred to hospital by road.

NOTIFICATION

The AAIU Inspector on Call (IOC) was notified of the accident by the Station Manager at Shannon ATC shortly after it had occurred. Following consultation with the Chief Inspector and with Air Corps senior management, the IOC travelled to the accident site that afternoon to provide appropriate assistance to Air Corps personnel. Subsequently, the Minister for Transport, Tourism and Sport and the Minister for Defence, in accordance with Regulation 23 (2) of S.I. No. 460 of 2009, jointly directed that the accident would be investigated under the Regulations set out in S.I. No. 460 of 2009 and that the AAIU would take the lead role in the Investigation. Two suitably qualified Air Corps officers were appointed as temporary Inspectors of Air Accidents to participate in the Investigation.

1. FACTUAL INFORMATION

1.1 History of the Flight

The flight departed at 12.45 hrs from Custume Barracks, Athlone, with Currabaha crossroads on the Nenagh to Borrisoleigh road, Co. Tipperary, as the planned destination. The crew consisted of the Pilot, an Air Corps crewman and a HSE National Ambulance Service (NAS) Advanced Paramedic (AP), who is designated as AP1 throughout this Report. Coincidentally, AP1 held a Private Pilot (Helicopter) Licence and had in excess of 200 hours flying experience. The necessary pre-mission planning including weather, fuel, weight and balance, air traffic service (ATS) and crew briefings had all been carried out after the crew had come on duty earlier that morning. It was the first day of a 4-day duty period for the crew.

The NACC had tasked this Emergency Aeromedical Support (EAS) service mission with a call to AP1 on the Tetra[3] radio system (introduced by the emergency services in 2010) giving details of the landing area's latitude/longitude (lat/long) coordinates and the patient's clinical details, for which the duty EAS AP is solely responsible for liaising with the NACC. The Pilot completed his mission planning and then delayed the take-off for a short period since the lat/long provided by the NACC was inaccurate and needed to be rechecked. Further map checking was required by the crew during the flight. The 20 minute flight to the Currabaha cross-roads area was otherwise uneventful; the weather en route was good.

[2] ESB: Electricity Supply Board
[3] Tetra: A digital private mobile radio system designed for use by government agencies and emergency services

They arrived on scene at approximately 13.13 hrs, identified the waiting ambulance and a NAS support vehicle manned by another AP (AP2), which were parked near a gate leading into a large agricultural field. There was also a Garda car in attendance. The crew carried out an aerial reconnaissance of the area which consisted of the pattern shown in **Photo No. 1**. In the photograph, the numbers annotated RA show the height in feet above ground level (AGL) while the numbers annotated TTR are the number of seconds to the end of the available data.

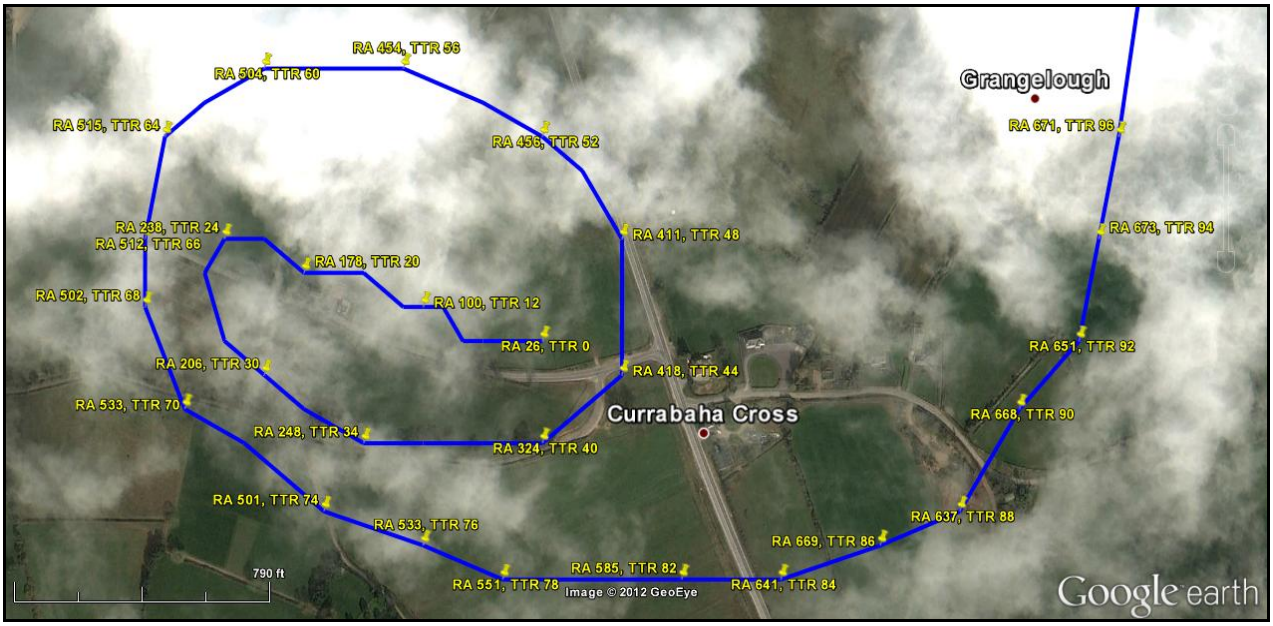

Photo No. 1: Reconnaissance Pattern Flown Prior to Landing

The Pilot selected a landing site close to the gate to facilitate the patient transfer as the weight of an equipped ambulance, over 4 tonnes, precluded it from entering the field. In his brief to the crew, the Pilot noted two parallel sets of wires, one crossing infield and the other alongside the minor road where the vehicles were parked. He elected to make an approach along an avenue between these parallel sets of wires which were approximately 80 m apart, and he flew a long shallow approach to land in an easterly direction. There was a slight tailwind component. The Pilot stated that standard cockpit drills and checks were carried out during the reconnaissance, including the *"5 S's"* brief of Surroundings, Size, Shape, Surface and Slope of the landing area and the *"3 E's"* of Entry, Exit and Emergencies. All crewmembers agreed that the intended site was suitable from their respective viewpoints.

The Pilot stated that he asked the Air Corps crewman, who was sitting in the left hand front seat by the left forward door, to watch the wires to his left, while the Pilot monitored those to his right. In addition, he also mentioned keeping a watch for any other wires when he said to the crew, "*And just make sure as we're coming in that there's no wires transversing across the area itself"* to which the crewman replied, "*Roger*". AP1, sitting behind the Pilot's seat, could not see to his immediate front but was monitoring out the side window to his right.

The Pilot recalled that, as the helicopter speed slowed while reducing height preparatory to landing, suddenly "*out of nowhere*" he saw wires to his front and he stated that he instinctively applied power and pitched the nose up in an attempt to avoid them. The crewman simultaneously called, "*Steady, steady, steady*[4]" as he too saw the wires. However, the main rotor blades struck the wires and severed them, causing what the Pilot described as *"severe vibration and momentary wallowing"* of the helicopter. The Pilot's stated main objective at this point was to get the helicopter safely onto the ground. He recalled lowering the collective pitch lever and that the nose pitched forward and rolled to the left. AP1, who was wearing a floor harness but was not strapped into his designated rear seat, was thrown to his left onto an empty stretcher. The Pilot informed the Investigation that he was unaware that AP1 was not secured in his seat, and that this was contrary to Standard Operating Procedures (SOPs).

The Pilot stated that, before the landing, he managed to level the helicopter and it touched on heavily. He shut down the engines, checked that the other crewmembers were unhurt and all exited the helicopter safely. Once outside, he noted extensive damage to the helicopter. AP1 discussed the situation with AP2 from the ground support vehicle and it was agreed to transfer the patient by road ambulance to hospital in Limerick. The accident site is shown in **Photo No. 2**.

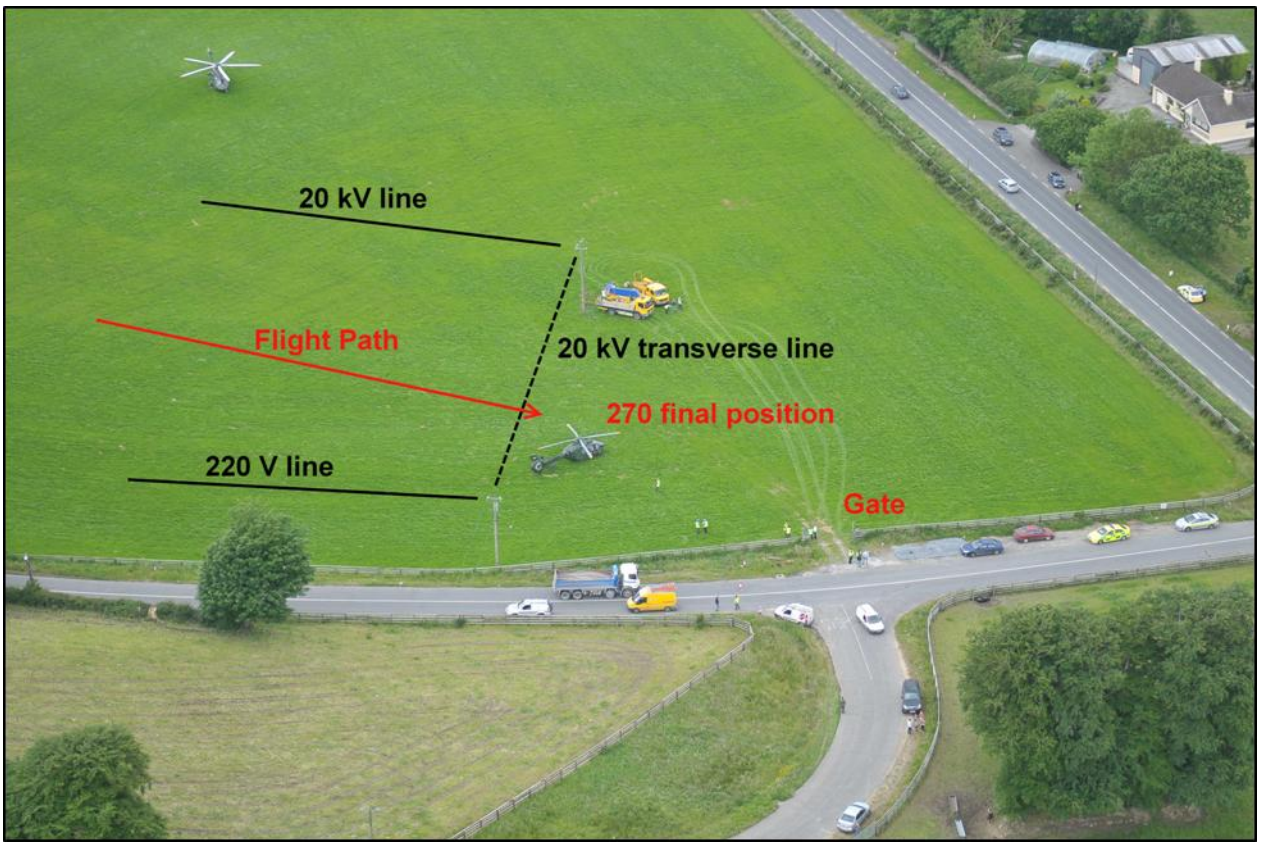

Photo No. 2: Aerial View of the Accident Site

[4] Steady: Helicopter crew patter for "hold position"

During the Investigation, the Pilot stated that he had been unaware that the ambulance crew had decided, with local knowledge, to move the patient by road to Currabaha crossroads. He said that had he known this, he *"would have been in a position to suggest a more appropriate lower risk area for the pick-up."*

1.2 Eye Witness Reports

A Member of An Garda Síochána[5], who was on scene at Currabaha crossroads for traffic control and security duty, witnessed the accident. He had arrived at about 13.00 hrs and had immediately updated himself with the road-ambulance personnel and AP2 in the support vehicle. Coincidentally, AP2 was also a qualified member of the EAS roster but he had no means of direct communications with AP1 in the helicopter on the day. The Garda witness recalled that he thought AP2 was there to check the area for fields suitable for landing (this was an incorrect assumption on his part). He stated that, as the helicopter came into view over the mountains, he stopped all road traffic and the helicopter circled overhead a couple of times in a clockwise direction. He was asked by the Investigation if he observed the landing. He replied that he had done so, and before that he had asked AP2 if the helicopter would be able to land in a field with the wires. He stated that AP2 had replied yes, that they would know about these things and would see the wires. The Garda witness said that he asked the same question again and got the same answer. He then saw the helicopter come in and hit the wires. He said, "*There was a bang and the helicopter came down on its belly*, *pretty well straight down"*. This witness continued, *"The pilot did some job because the back rudder started to spring up and down, moving before or when it hit the ground, I'm not sure*. *He did seem to lose control but, thankfully, he did some job to land it"*. He added that "*Everything seemed fine on the approach, until they hit the cable and the bang…..it seemed to be shaking….the job to get it down was something else*". He talked to the three crewmen afterwards when they walked away from the helicopter. They were shocked, he recalled, as, indeed, he was himself after the event.

AP2 who was accompanying the patient also witnessed the accident. He stated that he, along with an ambulance crew, had been dispatched to a house near Borrisoleigh following an emergency call to the ambulance service. When they arrived at the house, they found that the elderly patient was quite ill and AP2 determined that he needed to be transferred immediately to Limerick Regional Hospital. He considered that a request for the EAS helicopter was appropriate as the journey by road would take approximately one hour, whereas the EAS activation criteria included travel time by road in excess of 45 minutes. Furthermore, he was aware that the EAS helicopter was available on immediate standby in Athlone.

The house was on a hill-side so one of the ambulance crew, who knew the locality, suggested that the area around Currabaha crossroads would be more suitable for the helicopter as it was flatter and there were large fields there. The patient was loaded onto the road ambulance and the two vehicles travelled approximately two km to Currabaha crossroads, where they parked alongside the main Borrisoleigh to Nenagh road.

[5] An Garda Síochána: The Irish national police service.

The procedure for call-out of the helicopter was for the on-scene AP or Paramedic to call his Regional Ambulance Control Centre in Limerick, which in turn made contact with NACC in Townsend Street in Dublin. NACC would then task the helicopter through the duty AP in Athlone. AP2 informed the Limerick Control Centre that they would rendezvous with the helicopter at Currabaha crossroads.

While AP2's primary responsibility was to the patient, he stated that he carried out a quick reconnaissance of the area around the crossroads prior to the helicopter's arrival. He saw the wires in the large field to which the helicopter made its approach, and he considered that the field was, in his opinion, not suitable because of the wires. He also saw a smaller field slightly to the south where there were no wires although there were some trees around. AP2 thought that the helicopter might land in this field. There was another field across the main road to the east but there were livestock in it which made it unsuitable as a landing area. He stated that, in any case, he had no direct means of communication with the helicopter, and he considered that the helicopter crew, with their *"bird's eye view"* would select the most appropriate landing site.

AP2 watched the helicopter carry out its reconnaissance orbits of the area and he stated that it then did a long, shallow and slow approach. He recalled wondering whether they would land before or after the transverse wires, which he described as *"small and thin"*. He saw the helicopter strike the wires, then impact the ground, the tail struck the ground and the skids collapsed. He stated that it *"looked terrible"* and he feared for the welfare of the crew. But then he could see them moving inside, he could see the Pilot shutting down the engines and he heard the rotor brake operating. He entered the field to see if he could assist but the crew exited the helicopter safely.

1.3 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	3	0	

1.4 Damage to Aircraft

The helicopter came to rest with its tail directly between the two poles supporting the wires which had been severed. Marks created on the ground by the skids indicated that it had moved forward by approximately 50 cm from its initial impact to its final position.

The helicopter was substantially damaged in the accident. The lower structure of the fuselage including the bottom shell sustained considerable damage, several cross frames and the left-hand (LH) and right-hand (RH) keel beams were deformed and/or cracked. The bottom shell was fractured on its LH side and the helicopter's RH side panel sustained severe buckling damage.

The tail-rotor drive shaft was found to have moved forward and the six drive shaft bearing support brackets were all bent forward. The bumper structure beneath the tail-rotor shroud was damaged. The two landing gear cross-tubes were both fractured at the forward and rear points where they are attached to and support the fuselage.

The cabin area retained its structural integrity throughout the heavy ground impact, in accordance with its design criteria. One of the four main rotor blades suffered deep slash damage while another had a length of the struck wire's core embedded in its trailing edge.

1.5 Other Damage

The main rotor blades struck and severed an ESB 20 kV "spur line", comprising two wires, which connected a 20 kV line to a 220 V local distribution line. The consequent power outage lasted until 19.30 hrs (local time), and affected 23 customers in the immediate area. The agricultural field in which the helicopter impacted suffered some surface damage during the recovery operation.

1.6 Personnel Information

1.6.1 Pilot

The Pilot joined the Defence Forces as a Cadet in 1998, and he was awarded his Pilot's Wings in November 2000. He was assigned to helicopters during his Wings Course and the advanced stage of that course was carried out on the SA.342L Gazelle. Following award of Wings, he flew the Cessna 172 for a short time and then returned to No. 3 Operations (Helicopter) Wing for type conversion onto the Alouette 111. He was a member of the first group of Air Corps pilots who underwent type training on the EC135P[6] when two new helicopters of that type were delivered to the Air Corps in late 2005.

He was assigned to the Garda Air Support Unit (GASU) in May 2006 flying EC135T2[7] and remained there until March 2010. Following a period back in No. 3 Operations Wing, he was re-assigned to GASU between June 2011 and February 2012. On his next return to No. 3 Operations Wing, he was selected as one of the initial group of EAS pilots, which took into account his experience profile as one of the highest EC135 flying time pilots in the Air Corps. He also held a current type rating and instrument rating (IR) on the larger Air Corps helicopter type, the AW139.

During the morning of 22 May 2012 the Pilot carried out an EC135P2+ type rating flight, followed directly by a transit to the EAS base in Athlone which incorporated the Ad-hoc Landing Site Selection module of the EAS flying training syllabus along with simulated emergencies at the Athlone base. This flight was carried out under the supervision of an Air Corps Instructor. In the afternoon he performed his EAS Operational Proficiency Check (OPC) with the same Instructor. The simulated mission was a scramble to a road traffic accident. The mission report noted that, *"Site selection was done in a slow and methodical fashion. There were wires running parallel to the landing site selected but they were identified as a crew in the low recce[8]. Good co-ordination and emphasis on "eyes-out" on finals."*

[6] EC135P: Original designation of EC135P2+ on delivery to the Air Corps prior to engine upgrades
[7] EC135T2: EC135 with Turbomeca engines
[8] Recce: Reconnaissance

The report concluded, *"An excellent detail overall and very safe.* (Pilot's name) *needs to go out and practice a few simulated call outs prior to taking up duty."*

The Pilot carried out two simulated EAS call-out missions on the 24 and 25 May, both of which were from Athlone and had Air Corps and NAS EAS crewmembers on board. He also carried out a check flight on 31 May to ensure that the Tetra radio installation in the EC135 did not have any EMI[9] effects on the helicopter systems.

On the date of the accident, the Pilot did not hold an Instrument Rating (IR) on the EC135. He had completed one recent instrument training flight on the EC135 on the 11 April 2012.

The Pilot had carried out one previous 4-day EAS duty period prior to taking up duty on 19 June 2012. During that earlier duty period, he had carried out successful EAS missions from near Kilkee to Limerick and from near Portumna to Limerick. In both of those cases, the helicopter had landed at ad-hoc sites in large fields close to the patients' houses. In the duty period he also carried out four training flights, three to the new NACC-designate site in Tullamore and one to a mass casualty exercise in Foynes, Co Limerick.

Personal Details: Male, aged 32 years

Licence: Military Wings. CPL(A) and CPL(H)

Last Type Rating: 22 May 2012

Last Air Medical Certificate: 22 September 2011

Flying Experience:

Total all types:	2,148 hrs
Total all types P1:	1,519 hrs
Total on type:	1,094 hrs
Total on type P1:	994 hrs
Last 90 days:	31 hrs
Last 28 days:	13 hrs
Last 24 hours:	0

Duty Time:

Duty Time up to accident:	6 hrs 45 min
Rest period prior to duty:	96 hrs 00 min

[9] EMI: Electromagnetic Interference

1.6.2 Air Corps Crewman

Personal Details:	Male, aged 35 years
Last Air Medical Certificate:	16 July 2011
Total Flying Hours:	1,385 hrs
Hours on Type:	350 hrs (estimated)
Last 90 days:	34 hrs
Last 28 days:	16 hrs
Last 24 hrs:	0 hrs
Duty Time up to accident:	6 hrs 45 min
Rest period prior to duty:	96 hrs 00 min

1.7 Aircraft Information

The Eurocopter EC135P2+ is a light multi-purpose twin-engine helicopter with a maximum take-off weight of 2,910 kg. It is powered by two Pratt & Whitney PW206B2 engines, with a digital engine control system. The main transmission is a two-stage flat gearbox mounted on the transmission deck above the cabin. The helicopter is equipped with a four-bladed hingeless and bearingless main rotor, 10.20 m in diameter. The overall height of the Air Corps variant is 3.51 m. The tail rotor is known as a fenestron, and consists of 10 blades rotating in a housing integrated in the tail boom.

The primary structure is manufactured mainly of sheet metal whereas the cabin frame, bottom shell, doors, engine cowlings, nose access panel and the entire tail boom are fabricated from composite material. The cabin is accessible through six doors, two hinged doors for the front occupants, two sliding doors for the rear occupants and two aft clamshell doors for the rear compartment.

The landing gear consists of two cross tubes and two skids, one on either side of the fuselage. The cross tubes are designed to bend during touchdown to absorb the resultant forces.

The Air Corps EC135P2+s are equipped with a Wire Strike Protection System (WSPS).

Photo No. 3 shows the helicopter in its final position in the field following the accident. The upper and lower cutter assemblies of the WSPS are indicated in the photo.

Photo No. 3: Final Position of 270 in Field

The Flight Manual Supplement for the WSPS contains the following system description:

"The cable cutter basic kit consists of an upper cutter assy[10] mounted on the roof, a lower cutter assy mounted below the nose and two skid gear deflectors mounted to the skid tubes. The cable cutter windshield wiper kit consists of a protector to prevent threading of wires at the driveshaft of the windshield wiper.

The wire strike protection system is designed to provide a measure of protection against horizontally strung wire impact between cockpit roof and main rotor blades and between bottom shell and skid tubes. The protection can be achieved by deflecting or cutting the wires. Cutting the wires is done by rigidly mounted converging blades using the kinetic energy of the flying helicopter. Deflecting the wires is done by skid gear deflectors, the windshield wiper deflector and the SX-16 kit[11]."

WSPS systems are considered to be most effective when the helicopter impacts nearly perpendicular to wires at level attitude and at flight speeds of more than 30 knots. In the subject accident, as the main rotors were first to strike and sever the wires while in a nose-up attitude at low speed, therefore the WSPS did not come into use.

In the EC135P2+ helicopter, forward visibility through two large windscreens, one in front of each pilot's seat, is not obstructed by the presence of any structural members other than a narrow vertical central bar.

[10] assy: assembly
[11] SX16: A nose-mounted searchlight which was not installed on 270.

Examination of the technical records for 270 showed that the helicopter had flown 4,082 hrs 40 mins prior to the accident flight. It was being maintained in accordance with the approved Military Airworthiness Authority Maintenance Programme. The Certificate of Release to Service prior to the accident flight recorded accomplishment of AD 2012 0085E, an Emergency Airworthiness Directive requiring repetitive pre-flight visual inspections of the main rotor blades attachment area. The aircraft documentation recorded no defects on the helicopter at the time of dispatch on the accident flight.

1.8 Meteorological Information

The Met Éireann service, '*Met Self Briefing System'*, for 19 June 2012, was routinely downloaded by the Pilot preparatory to the start of that day's operations. The METAR (a meteorological aviation report) for the main airports, Dublin, Shannon and Cork, showed good visibility of 10+ km, some scattered cloud and generally slack winds. A similar situation was reported for the other airports at Ireland West (Knock), Donegal, Kerry (Farranfore), Sligo and Waterford. Air pressure was uniform across the country at 1016 hPa[12].

The Met Éireann aftercast provided to the Investigation stated that the wind in the area of the accident site was approximately 200° at 5 kts (with significant potential variability in terms of direction due to the weak flow). Visibility was given as 30 km in dry conditions with no significant weather. Cloud was reported as *"FEW/SCT 2000-3000 ft with nearby reports showing ceilings at 4000-5000 ft"*.

1.9 Flight Recorders

1.9.1 Cockpit Voice Recorder (CVR)

The CVR was successfully downloaded by the Investigation using the facilities of the Operator. This provided a high quality recording from three microphones, Pilot, Crewman and Cockpit area. The recording ended at the moment that the helicopter impacted the ground, due to the operation of a "G" switch which removed the electrical supply to the recorder, a design feature to protect recorders from being overwritten in the event of an accident.

The CVR recording showed that, during the initial part of the flight from Athlone to Borrisoleigh, the flight was normal other than a degree of confusion which arose from the co-ordinates for the landing site, which had been passed to the crew from the NACC. The Air Corps crewman, who is assigned navigational duties to assist the pilot when the helicopter is in the EAS role, determined that the north co-ordinates appeared to be 30 minutes in error. When a correction was applied, the location of the landing area outside Borrisoleigh became clearer to the crew.

At 2 minutes and 8 seconds before the end of the recording, the Pilot stated, *"OK have it"* as he saw the ambulance parked on the road at the junction. The crewman confirmed that he also had the ambulance in sight.

[12] hPa: hectoPascal, a unit of pressure

2 minutes and 1 second before the end of the recording the Pilot said, *"OK so we'll slow things down pick our site"* and 4 seconds later he continued, *"Looking where that road ambulance is there's an obvious field to pick but it does have wires in it"*, to which the crewman responded, *"Roger"*. The Pilot went on, *"But we can work around those wires because if we've got access which we do so you've got the ambulance the response car a red car and then access to that field happy enough with that"*, to which the crewman responded, *"Affirm"*.

At 1 minute and 42 seconds before the end of the recording the Pilot said, *"We've got lights that looks or wires that seem to be leading along the edge of the road itself and then we've got wires across that field wind is calm so entry will be from the house in the distance in a straight line down towards the corner of the field yeah",* to which the crewman replied, *"Roger"*. The Pilot continued, *"So the field lights in the field or wires in the field will be on your side",* to which the crewman replied, *"Affirm"*. The Pilot continued, *"The ditch and the wires on the other side will be on my side"* and the crewman responded, *"Roger"*.

At 1 minute and 21 seconds before the end of the recording the Pilot said, *"Area looks eh exit out of it will be up and back with the wires on your side again and transit towards Limerick and any emergencies on the way in SOP*[13] *in the area SOP and on the way out SOP also do you want to do a quick brief there on the area itself"*. The crewman responded, *"Roger OK size big enough to get into it's a triangular shape that we're going in there the slope looks nice and flat… Grassy surface and we have the wires as already described surrounding and a small fence… And just to finish the landing checklist cockpit is secure maps aircrew eyes out autotrim"*.

At 44 seconds before the end of the recording the Pilot said, *"Site brief complete everyone happy where we're going"* to which the crewman and AP1 both responded in the affirmative. The Pilot continued, *"We're going to have a slope I would imagine from left or from right to left just looking at the rest of the ground in the area so what we'll do is I might end up turning my nose up to the area and we can deal with that when we get in there so wires on your side now* (crewman's name)." The crewman responded, *"Roger wires in sight"*.

The Pilot continued, 26 seconds before the end of the recording, *"And just make sure as we're coming in that there's no wires transversing across the area itself",* the crewman replied, *"Roger"* and the Pilot continued, *"I don't think there is so we'll just keep an eye on that if there is you can call go around"*.

The Pilot cleared the crewman to open the door 16 seconds before the end of the recording and the crewman continued to call his normal patter, *"Forward five descending clear port forward four descending."* Four seconds before the end of the recording the crewman called, *"Forward three descending"*.

At 2.6 seconds before the end of the recording, the Pilot said, *"Oh"* while at almost exactly the same moment the crewman called, *"Steady steady steady"*. 0.8 seconds later a slashing sound is clearly audible on the recording, followed a further 0.8 seconds later by an exclamation from the Pilot. This was one second before the recording ended.

[13] SOP: Standard Operating Procedure

1.9.2 Flight Data Recorder (FDR)

The FDR was downloaded using the facilities of the Operator. The State of Manufacture (the German air accident investigation agency, the BFU) was consulted by the Investigation and provided the files necessary for the decoding of the downloaded data.

Analysis of the FDR data throughout the accident flight revealed no anomalies and all recorded aircraft systems were operating correctly.

Figure No. 1 shows selected FDR parameters for the final 10 seconds of the recording. It should be noted that the data for all the parameters is sampled at certain defined time intervals. The sampling frequency for all the parameters shown in the Figure is 2 Hz, i.e. once every 0.5 secs, with the exception of radio height which is sampled once every 2.0 secs. The yellow vertical line is a nominal reference scale inserted 1.1 secs prior to the end of the recording which enables a snapshot of parameter values to be shown on the Figure. The data indicates that the helicopter was travelling at a very low airspeed on a generally easterly heading and descending steadily in a controlled fashion from 75 feet above the ground.

The data for the position of the cyclic stick in the longitudinal axis indicates that in the final second there was a rearward movement of the stick and an associated increase in pitch angle (i.e nose-up). The data for the position of the cyclic stick in the lateral axis indicates that in the final second there was a movement of the stick to the right with an associated right rolling motion. The data for the collective lever position shows no significant increase during the final two seconds whereas there is a notable decrease during the final second of recorded data.

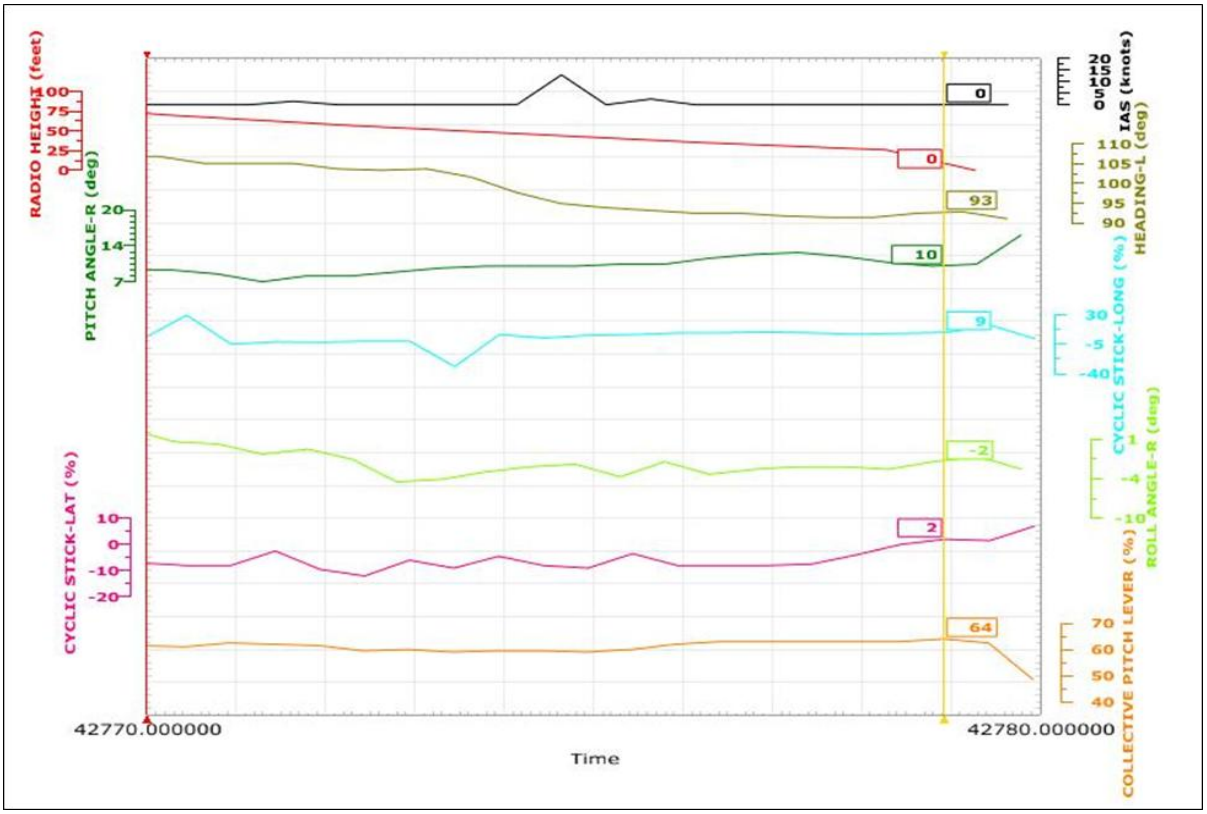

Figure No. 1: FDR Trace of Final 10 Seconds of Recorded Data

1.10 Organisational and Management Information

1.10.1 Regulation of Air Corps Flying Activity

As a military organisation, the Air Corps is governed by the Defence Acts as amended. Section 26 of the Act and Paragraph 20 of the Fourth Schedule to the Act state that the flying, certification and maintenance of service aircraft are matters in respect of which regulations may be made by the Minister for Defence. Such regulation is authorised by Defence Force Regulation A.8 and is promulgated through the issue of the Air Regulations Manual (ARM) by the General Officer Commanding (GOC) Air Corps.

Under the terms of Paragraph 3 of Part 1 of the Irish Aviation Authority (IAA) Act 1993, this Act does not apply to military aircraft such as Air Corps 270.

Thus the operation of Irish military aircraft is regulated by GOC Air Corps as authorised by the Minister for Defence and is independent of the IAA. Similar arrangements exist in many foreign states.

1.10.2 Establishment of the EAS Pilot Project

The August 2011 Health Information and Quality Authority (HIQA) Report of the Inquiry into a failed liver transplant air ambulance mission made a number of Recommendations including one in **G7**, **Governance**, as follows:

'The HSE should establish a National Aeromedical Coordination Group with the relevant State agencies and service providers. This Group should oversee and evaluate the implementation of the agreed process to ensure its effectiveness on an on-going basis. It should develop, audit and monitor a series of key performance indicators for the provision of aeromedical and land logistics for patients, review the effectiveness of the information management systems, undertake root cause analyses of adverse events and continually review the quality and safety of the service. This Group should meet within four weeks from the publication of this report and then at a minimum every two months for the first year'.

In parallel with this Recommendation, the Department of Health and the HSE had identified a requirement to gain data about the need for a dedicated EAS service in the west of Ireland. Such a service would have the principal objective of providing rapid patient transport to an appropriate hospital in cases where the land transit time, given the patient's condition and its severity, would not be clinically acceptable.

The Air Corps had been providing a hospital to hospital air ambulance service to the Department of Health/HSE for nearly 50 years and, under a Service Level Agreement between the Departments of Defence and Health, for the past eight years. A series of meetings was held between the Departments of Health and Defence along with the HSE NAS and the Air Corps with a view to putting a pilot EAS project in place.

Within the Air Corps, a project team consisting of six pilot officers of Captain rank, all with considerable EC135 experience and directly supervised by Air Corps senior management, was put in place to develop the concept of the EAS air mission.

The most senior of these officers was designated as Project Manager / OIC[14] EAS. The product of this concept development process included the ARM Part B Amendment which was required to regulate the aviation related aspects of the new EAS service, the syllabi of EAS role training for pilots, aircrew and APs, and the construction of an EAS aviation risk register. As the operational concept firmed up during May 2012, this team was also tasked with the establishment of the Athlone EAS base. This included identifying and sourcing operational and logistical equipment and services in support of the operation.

A launch date for the EAS pilot project was not finalised until May 2012. The Air Corps, in consultation with the HSE, set a commencement date of 4 June 2012. That date was provided to the Ministers for Defence and Health and on 21 May they jointly announced that the launch date for the new service would be 4 June 2012.

An intensive series of training flights was carried out during the period 22 May until 1 June, when the six designated EAS pilots and the other crew members carried out role training in the mission area in addition to the pilots' EAS OPCs. This period coincided with the final preparation phase on the ground in Athlone, as well as the completion of drafting and approval of the ARM Part B Amendment and the risk register. Additionally, the members of the EAS project group were tasked with other military duties, including in some cases, participation on the AW139 air ambulance roster.

The dedicated 12-month EAS pilot project was formalised by the signing of a Memorandum of Understanding (MOU) between the Department of Defence and the Department of Health on 31 May/1 June 2012. An inter-agency Operational Working Group was set up before commencement of the pilot project to address key operational issues. The MOU stated that the EAS would operate *"with particular emphasis on the west of Ireland"*. The Air Corps was tasked by the Minister for Defence with the air operation. The provision of clinical crew, medical equipment and supplies as well as the tasking of missions, ground operation and communications were assigned to the HSE, which had set up NACC to coordinate the various aeromedical missions at a single point of activation in response to the HIQA Recommendation. The MOU established an inter-service audit and evaluation group, with representatives of the Air Corps, the Departments of Defence and Health and the HSE. It was tasked with meeting every two months or at the request of one of the parties. It was also tasked with carrying out a full evaluation of the service, three months prior to the end of the pilot project, using the operational data gathered, with a view to agreeing recommendations for the future.

The MOU stated that the tasking of aeromedical support, including destinations, would be decided solely by the NACC. Decisions on accepting the mission, its destination and its feasibility rested solely with the captain of the aircraft.

Annex 2 of the MOU contained the EAS Activation Criteria and Protocol. In general, the Protocol required a road ambulance transit time from leaving scene until arrival at hospital of greater than 45 minutes, the presence on scene of an AP and/or Paramedic and stated clinical conditions.

[14] OIC: Officer in Charge

Arising from the MOU, which was still in draft at the time, Defence Force Headquarters (DFHQ) Operation Order (Opord) 09/2012, "*Defence Forces Support to Health Service Executive Emergency Aero-Medical Service*" was issued by the Deputy Chief of Staff (Operations) on 21 May 2012. Subsequently, the GOC Air Corps issued Opord 03/12, entitled "*Air Corps Support to Health Service Executive Emergency Aero-Medical Service*" on 1 June 2012.

The new pilot service commenced from Custume Barracks Athlone on 4 June 2012. NACC was initially located in the HSE Ambulance Control facility in Townsend Street, Dublin 2. HSE personnel received specialist training in the roles they would be required to perform in NACC. The Investigation was informed that, shortly before the EAS operation was due to commence, industrial relations issues arose with trained NACC personnel in Dublin. In the event, it was decided that NACC would be relocated to Tullamore and a new group of personnel was trained for that location. NACC subsequently came into operation at its new location in Tullamore on 20 June 2012.

In the interim period the roles of NACC were carried out by NAS management personnel, who themselves had been involved in the training of the NACC personnel.

In practice, on receipt of a 999 call, an Ambulance Controller inputs the answers to pre-determined questions into the Advance Medical Priority Dispatch System (AMPDS) for patient triage. The System then displays a determining colour code on screen which will indicate the level and availability of response for a given emergency call-out. In the most serious cases, an ambulance will be dispatched accompanied by a Paramedic or AP (if available for dispatch) on board or in a support vehicle, if available. Once on site, the Paramedic/AP makes a dynamic risk assessment as to the optimum mode of transport to a specific receiving hospital, taking into account time and distance to travel and other medical parameters as set out in the MOU. If the Paramedic/AP recommends a helicopter transfer or EAS AP assistance, then the request is routed via the dispatching regional Ambulance Controller to NACC and onwards to the EAS AP in Athlone.

1.10.3 EAS Pilot Operational Conversion Course

A DFHQ Syllabus of Training dated 11 May 2012 set out the qualifying criteria for entry of pilots to the EAS operational conversion course. Pilots were selected by management primarily on the basis of their EC135 experience profile. These were the same six pilots who formed the original EAS project team. The Syllabus required pilots to have, inter alia, a current valid EC135 Aircraft Type Rating and IR, to have completed Crew Resource Management (CRM) training in the previous 12 months and to have been recommended by Officer Commanding (OC) No. 3 Operations Wing for the EAS roster. The minimum experience requirement was 1,500 flying hours Total Time (TT), with 1,000 hours on helicopters. Phase 1 of the Course was 18.30 hours ground/classroom training, which included lectures titled '*Landing site selection and considerations*' and *'Landing site departure and arrival profiles'*.

Phase 2 consisted of flying training with 9 sorties over 8.45 hours, culminating with an OPC. Of the 8.45 hours, 4.45 hours were designated to SPIFR[15] training. The Investigation was informed that, at a meeting of No. 3 Operations Wing management on 21 May 2012, it was decided that the SPIFR element of the syllabus was not essential to the EAS operation since it was designated as a purely VFR[16] mission. A revised Syllabus of Training was then issued which did not include the SPIFR flying training. The Air Corps informed the Investigation that it was their intention to complete the EC135 SPIFR training during the summer months with a view to issuing SPIFR ratings to the EAS pilots before the onset of adverse weather conditions as autumn and winter approached.

The ARM Part A Section 5 states that SPIFR training is required *"only when the operational role has been specifically approved by GOC AC for single pilot IFR[17] operations."* The ARM Part B EC135 Section 8.36.4 states that the EAS is a daylight only VFR operation.

In the revised Syllabus, the qualifying criteria for entry to the course were amended to require a current valid EC135 or AW139 Aircraft Type Rating and IR.

The flying training element of the revised Syllabus stated that in Phase 2 of the Course, "*The students will conduct three flying sorties, to include one proficiency check with a suitably qualified pilot*". Sortie A/F1 was an EAS Sample Mission as was A/F2 and A/F3 was the OPC. The Syllabus set out detailed activities for these sorties including *"Departure and Transit to 'incident' Landing Site, Landing Site selection Procedure, Landing and Departure from 'incident' Landing Site"*. Each sortie was to be "*supervised by a suitably qualified pilot assigned by Chief Pilot EAS.*" The EAS project team, consisting of two instructors and four type rated pilots, underwent the training, which was conducted internally with the two Air Corps instructors carrying out the instructional flights and OPCs. The four EC135 type-rated pilots formed the core group appointed to the EAS roster, with the two instructors providing on-going supervision of the operation and supplemental roster cover.

1.10.4 Visits to U.K. EAS Operators

In tandem with the EAS Ground and Flying Courses, the Air Corps Project Manager made arrangements through the HSE/ UK NHS[18] to visit two commercial helicopter companies in the UK specialising in Air Ambulance operations. The purpose of these trips was to gain first-hand knowledge from established air ambulance operators of the positive and negative factors influencing such operations, and to learn from them. While visit dates and times were agreed, these visits were cancelled at short notice by the host organisations for reasons outside the control of the Air Corps. Subsequent to these cancellations, a third and successful visit attempt was made by the Project Manager and he and two other EAS pilots, together with a senior NAS project member, visited a commercial Air Ambulance facility in North Wales, where useful information on EAS operations was willingly provided.

[15] SPIFR: Single Pilot Instrument Flight Rules
[16] VFR: Visual Flight Rules
[17] IFR: Instrument Flight Rules
[18] NHS: National Health Service

1.10.5 EAS AP Training Programme

Following a rigorous selection process from the existing pool of HSE APs, six were selected to undergo the Air Corps led EAS Personnel Training Programme in advance of going operational on 4 June 2012. The course commenced on 14 May 2012 and lasted two weeks, emphasising training in basic helicopter procedures and safety. Week 1 of the Course took place in Baldonnel and incorporated aviation 'soft skills' training for the new trainees to introduce them to their new environment. Week 2 of the Course took place in Custume Barracks, Athlone, where the service was to be based. This incorporated some flying training and culminated in written tests and a flying line check for the trainees. Topics covered included CRM and aviation hazard awareness.

1.10.6 Role and Area Competence Training

The Air Corps ARM Part D sets out the requirements for role and area competence training in Section 2.7. In respect of role competence training, the ARM states,

"Prior to being tasked with specific roles or operations that require specialist knowledge and/or flying skills pilots will undergo a course of instruction tailored to meet the operational requirements. Therefore, in addition to undergoing basic type conversion, pilots will undergo specific operational conversion as appropriate to type."

In respect of area competence training, the ARM states,

"Prior to an operational deployment for an extended period into an unfamiliar location, including overseas locations, pilots and crews will operate in the environment on a non-operational basis in order to work-up to the necessary local area expertise required for maximum operational effectiveness. If this is not possible for security or environmental reasons, then pilots and crews will receive such training in a similar type environment. Should the deployment require specialist local area knowledge or flying disciplines not readily available in the Air Corps, GOC AC may consider the employment of external experts for a period of time to facilitate the operational work-up. No extended operational detachment or deployment will proceed without the following

- *The above training having been completed.*
- *An operational risk assessment analysis conducted by ACHQ[19] Operations.*
- *A safety audit by the ACFSO[20], who may consider a follow-up audit necessary when and if the detachment is in place."*

1.10.7 ACHQ Operations and Flight Safety Audits

The Investigation was informed that, in conformance with the ARM requirement, an initial audit of the EAS service was conducted by ACHQ Operations at Custume Barracks, Athlone on 01 June 2012 and a verbal briefing was held with No. 3 Operations Wing management on that afternoon.

[19] ACHQ: Air Corps Headquarters
[20] ACFSO: Air Corps Flight Safety Officer

The purpose of the audit was to confirm, as far as was possible given that the operation had not yet commenced, compliance with the regulations pertaining to the EAS and to provide approval for EAS operations to commence.

The Operations audit found that the new EAS mission was generally in compliance with Air Corps regulatory requirements and that it was evident that significant effort had been made by the personnel involved to meet operational deadlines. The audit noted that, although the EAS pilot training syllabus required an EC135 IR as a criterion to qualify for the training course, three of the six EAS pilots did not hold an EC135 IR. The audit recommended that IRs for all EAS pilots be completed as soon as possible.

The audit considered that there was an issue with respect to the determination of accurate weather conditions at Athlone. This was due to difficulties which had been encountered by the EAS personnel in procuring a weather station for the location. The audit recommended that the weather limits for the EAS should be increased, pending delivery of a weather station and greater familiarity with the operation out of Athlone.

Following a similar recommendation from the Flight Safety Section audit (see below), GOC Air Corps issued a Flying Directive increasing weather limits on 1 June 2012.

An initial safety audit was carried out by Air Corps Flight Safety Section (ACFSS) on the 31 May and 1 June. Verbal briefings were provided to No. 3 Operations Wing and EAS management on both of those days. The audit found that the Wing had a very good flight safety culture with all personnel proactive in the promotion of flight safety. The audit also commended all the work which the Wing had put into the development of the new mission.

The audit had concerns about the work-up period for the EAS mission and recommended that the mission be kept at a low tempo until a sufficient work-up period for each flight crew had been achieved. Unit management was satisfied that, given the experience of the pilots selected for the roster, additional restrictions would not be required.

The ACFSS audit also had concerns about the seating arrangements in the EC135 for the EAS mission profile. No. 3 Operations Wing had authorised the Air Corps crewman to sit in the left hand front seat and to assist the pilot with en-route navigation, whereas the standard practice for all other Air Corps EC135P2+ mission types continued to be for the helicopter to be crewed from the rear. ACFSS considered that if the crewman was seated in the co-pilot's seat, he would not be in a position to properly crew the helicopter, especially when it was landing at a non pre-designated landing site, as would occur on certain EAS missions. The audit recommended that the change from the alternative standard practice needed to be carefully monitored. Wing management remained strongly of the view that utilising the crewman in the co-pilot seat was the optimum use of resources for EAS operations. They stated that it was the industry standard configuration. They also considered that, since the EC135 Flight Manual prohibits Category A[21] performance take-offs and landings when a door is opened, placing the crewman at a position where he could open a sliding door and "*clear the tail*" would be futile in situations when Category A performance was required.

[21] Category A: Performance criteria which enable a helicopter to land or fly away safely from an adequate designated surface area in the event of an engine failure at a critical point during take-off or landing

The ACFSS audit made similar comments regarding weather limitations as did the Operations audit, which lead to the issue of the Flying Directive as noted above. The audit also commented on flight following, especially during the phase when the helicopter was positioning back to base following completion of the medical transfer part of the mission.

Neither audit found any non-conformance with Air Corps Regulations which would have required a recommendation to management that the commencement date should be postponed.

1.10.8 ARM Part B Amendment

A new Section 8.36 was developed by the Air Corps EAS project team and introduced into the ARM Part B for EC135P2+ to cover the commencement of EAS operations on 4 June 2012. This document covered a wide range of topics relevant to the EAS operation including crew composition, rostering, CRM, weather limits, flight planning, dealing with emergencies, landing at EAS sites, hazards, communications, etc.

The ARM defines EAS as a daylight only VFR operation. Paragraph 8.36.12 "Qualifications" states that, inter alia, pilots will hold a type and instrument rating on the EC135P2+.

Paragraph 8.36.42 states that, *"Pilots landing in non PDLZ[22] landing sites will conduct a thorough recce before selecting and initiating the safest approach which the crew deems appropriate for the landing site in question. All personnel on-board the aircraft will maintain due vigilance in relation to hazard identification and obstacle avoidance. Pilots will log details of the landing site for future inclusion in the PDLZ folder."*

1.10.9 Air Corps Risk Management Procedures

In the weeks prior to the commencement of the new EAS mission, the Air Corps project team compiled a risk register under the procedures set out in the ARM and No. 3 Operations Wing Safety Statement 2012. A total of 69 Flight Risks were identified as being relevant for the EAS operation. These included "Wire Strike", a copy of which is attached at **Appendix A** and "Blade Strike" which is attached at **Appendix B**.

The risk assessment narrative for the wire strike hazard states, *"In the unlikely event that a pilot and the crewman miss wires on their brief the aircraft is equipped with wire cutters.* It continues, "*Pilots will not fly into an area without conducting a full and detailed brief to ensure any potential dangers are spotted prior to approach. EAS pilots have been selected with a high experience level through the Unit's HRM[23] plan.*" Under the Safe Equipment heading the document states, *"The aircraft is equipped with wire cutters which will cut through wires were the aircraft to fly into any wires"*. Under the Safe Practice heading the Form states, *"EAS pilots when under instruction in confined areas will be challenged into places where wires may exist to highlight the importance of the brief prior to landing. The crew will highlight the wires and elect to land in an alternative site."*

[22] PDLZ: Pre Designated Landing Zone, i.e. a landing site which has been identified and reconnoitred at an earlier date
[23] HRM: Human Resource Management

The document continues, *"The Wicklow hills have plenty of challenging areas with wires that could be picked for landing to test EAS pilots on regular basis"*. The risk frequency was assessed as 5, the highest point on the scale, while the risk severity was assessed as 1, or "*negligible*". The risk rating was arrived at by multiplying the frequency by the severity, giving a risk rating of 5, which was deemed to be an acceptable moderate risk.

The risk assessment narrative heading for the blade strike hazard states, *"A blade strike is where a blade of the aircraft strikes another object"*. It continues, *"The EAS pilot and crewman will be responsible for clearance from all obstacles when flying"*. Under the Safe Equipment heading the document states, *"The Recce brief will help to identify any potential dangers of blade strike".* Under the Safe Practice heading the Form states, *"The crew will conduct a full recce and brief of each landing area prior to landing to include Shape, Size, Surface, Slope and Surrounding (crewman). Also briefed will be Entry, Exit and Emergencies (pilot). This brief will help to identify any potential obstacles that could be hit"*. The Safe Place heading states, *"ARM Part C contains a list of Hospital LZ[24]'s, DF[25] Barracks and other commonly used LZ's. This document provides details on obstacles, best approach angles, etc.*

The Wicklow Mountains contain many suitable confined areas for training/ops. Regular updates will be required on hospital LZ's and this could be done as part of a training regime for crew". The risk frequency was assessed as 1, unlikely, while the risk severity was assessed as 5, or catastrophic. The risk rating was arrived at by multiplying the frequency by the severity, giving a risk rating of 5, which was deemed to be an acceptable moderate risk.

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The Investigation discussed the risk register and the specific flight risks associated with wire strike and blade strike with No. 3 Operations Wing senior management. While it was acknowledged that the risk analysis was in need of revision, management stressed that all of the EAS crews had been specifically trained in how to carry out a reconnaissance of a landing site. They had completed exercises on high and low recce, hazards and obstacles and approach and landing profiles. They had also completed simulated EAS missions with landing site identification and selection as key elements. Wing management also stressed the experience profile of the pilots selected for the EAS mission, all of whom had in the region of 2,000 flying hours with extensive rotary experience.

The EAS Project Manager also informed the Investigation that they had been in discussions with the ESB for several months regarding the provision of overhead power line mapping data for incorporation into the Euronav navigation system which is fitted on the EC135. There were many issues to be resolved including those of a technical nature, as well as legal and data protection issues. The Investigation learned that the ESB mapping data was provided to the HSE for incorporation into their Health Atlas system during July 2012. This system, which is available to EAS crews at Athlone, illustrates on a map overlay format the locations of the majority of, but not all, ESB overhead lines in the State.

[24] LZ: Landing Zone
[25] DF: Defence Forces

1.10.10 Flight Watch/Mission Following

As part of NACC SOPs, the EAS AP, who logs the details of the mission before briefing the pilot, is required to call NACC on the Tetra system with the lift-off time and estimated time of arrival at the patient's location. The AP also notifies NACC of the departure time from that location and estimated arrival time at the receiving hospital. Finally, s/he notifies NACC of the lift off time from the hospital and time due back at base. An additional safety requirement for the NACC controller is to inform Air Operations at Baldonnel if the helicopter's notified arrival time at the patient's location or receiving hospital is exceeded by 15 minutes. In tandem with these AP generated calls, the pilot routinely files a flight plan for a mission with Shannon ATC and is in normal VHF communications with Shannon or the appropriate Regional Airport ATC. The pilot also keeps a listening watch on the appropriate radio frequencies. S/he also notifies the helicopter technician of the ETA in Athlone by mobile phone, prior to departing the receiving hospital. Finally, in turn, this helicopter technician is tasked with making three phone calls to designated officers in Baldonnel on the helicopter's return to base.

This system relies on the proactive, timely and accurate manual input of information by NAS and Air Corps personnel and is in place only for the daylight EAS mission. Several crewmembers expressed their reservations to the Investigation regarding the level of flight following available during helicopter operations in general and aeromedical missions in particular.

There are several automatic flight following systems available on the commercial market. In general, these operate by obtaining aircraft position information from the GPS[26] satellite constellation, and then automatically transmitting this data to a ground station. Air Corps helicopters are not fitted with automatic flight following tracking devices.

1.10.11 Meetings with EAS Stakeholders

The Investigation held a series of meetings with the various stakeholders of the EAS operation. This was done to determine the concept of the operation as understood by each agency. While there was a general commonality of understanding on most aspects, the interpretation of landing points as mentioned in the MOU, was not uniform. Paragraph 8 of the MOU states that an inter-agency operational working group would be set up before commencement of the pilot project to address key operational issues including inter alia, *"designated rendezvous points and landing sites"*. Paragraph 15 of the MOU states, *"Retrieval will be made from designated landing points for incidents outside the range of the aircraft or where the incident site is not suitable for landing"*.

Both the DFHQ and the Air Corps Operation Orders contain, inter alia, the following statement in Paragraph 3, Execution,: *"The helicopter will operate on a 5 minute response time from Custume Barracks Athlone during daylight hours only, to pre-designated Landing Zones (PDLZ's) where it will RV[27] with National Ambulance personnel or an incident location where a suitable landing site is available, thereby facilitating the rapid transmission of seriously ill patients to pre-arranged receiving hospital emergency departments".*

[26] GPS: Global Positioning System
[27] RV: Rendezvous

Between the operation commencing on 4 June and 18 June, the EAS helicopter had been tasked by NACC and despatched from Athlone on twelve missions, eight of which culminated in the transfer of a patient to hospital. None of these missions had utilised PDLZs. The Investigation was informed by the Department of Defence (DOD) that the DOD considered that the exclusive use of non-PDLZs was at complete variance with the understanding reached with the Department of Health. The DOD's understanding was that the use of non-PDLZs would occur only in exceptional cases. At the time of the accident, it was the understanding of the EAS pilots and aircrew that suitable landing sites could be selected and utilised.

The Department of Health's understanding was that the helicopter would utilise appropriate and safe landing sites as close as possible to the incident. They considered that the key factors were that the landing site would be safe and that the mission would produce reduced transit times for the patient.

Following the accident, the EAS service resumed on 3 July 2012, initially based at Casement Aerodrome, Baldonnel. The Minister for Defence directed that EAS missions should utilise PDLZs or alternatively sites which were described in two published landing site directories. EAS missions were permitted to land at non-PDLZs or at sites that were not included in the landing site directories only in very exceptional circumstances.

At that time, there were approximately 70 PDLZs in the Air Corps inventory. The Air Corps embarked on an intensive programme of increasing the number of PDLZs in the area of operations and, at the time of writing, this had risen to in excess of 800 sites. In addition, from 25 September 2012, the Minister permitted the use of suitable sports pitches for the EAS service.

All of the stakeholders were agreed that the EAS pilot project was not a "full-blown" Helicopter Emergency Medical Service (HEMS) but rather a 7-day secondary response service with the primary objective of reducing transit times for appropriate patients to designated hospitals.

It is noted that the EAS has been utilising the larger two-pilot AW139 helicopter since the service resumed on 3 July 2012, due to the reduction of the Air Corps EC135 fleet to a single unit. While the service was based at Baldonnel for a short period, it subsequently resumed operations from Athlone.

1.11 Additional Information

1.11.1 Risks Associated with Certain Helicopter Mission Profiles

Helicopter operations, such as SAR[28] or HEMS, are by definition high risk undertakings. In the United States alone between 2002 and 2005, the U.S. National Transportation Safety Board (NTSB) investigated 55 HEMS accidents that resulted in 54 fatalities and 18 serious injuries. 2008 was the worst year on record for the HEMS industry in the USA, where there were 12 HEMS accidents recorded, 8 of which involved a total of 29 fatalities.

[28] SAR: Search and Rescue

As a result, the NTSB conducted a 4-day public hearing in 2009 to critically examine safety issues concerning this industry. The NTSB's work in endeavouring to improve flight safety in this particular field continues through their Investigations and Safety Recommendations (SRs) to the Federal Aviation Administration (FAA) and other agencies.

One such Recommendation (A-09-103) from the public hearing, called on the Federal Interagency Committee on Emergency Medical Services (FICEMS), created in 2005 by the U.S. Congress, "to develop national guidelines for selection of *appropriate* emergency transportation modes for urgent care". Correspondence from FICEMS in 2010 indicated that the guidelines were close to being finalised and distributed to members. Such guidelines will help hospitals and physicians assess the appropriate mode of transport of patients in the USA.

1.11.2 European Helicopter Safety Team (EHEST)

A Training Leaflet on methods to improve Helicopter Pilot Safety entitled '*HE3 Helicopter Off Airfield Landing Site Operations'* has been produced by EHEST, a component of the European Strategic Safety Initiative (ESSI). This useful and informative brochure covers the:

- Planning and Preparation
- Landing Site Identification
- Landing Site Recce
- Types of Approach
- Manoeuvring in the Landing Site
- Departure
- Pilot Errors

It states, inter alia, that landing sites that are remote from an airfield offer various challenges to the pilot and consequently have resulted in a significant number of accidents. Unlike at an airfield, there is generally little or no assistance in the assessment of wind, guidance on appropriate approach directions or information on other traffic. Hazards not normally experienced at an airfield such as wires, obstructions, uneven landing ground, trees, foreign object damage, livestock and pedestrians are quite likely to be found and require a heightened degree of situational awareness by the pilot who needs to "*expect the unexpected*", the Leaflet cautions.

1.11.3 Wire Strikes

The inherent dangers of flying in a wire-rich environment have been recognised worldwide for decades.

For helicopters engaged in approved low-level high risk type operations, such as SAR, power line inspections, forestry operations, fire fighting and emergency aeromedical missions, the threat is constant. Detailed planning and crew situational awareness are required from mission commencement to engine shut-down.

Impact with overhead wires have been a regular feature of AAIU Investigations in the last number of years. There were six such events during 2009 and 2010 and a further two in 2012. The IAA launched a wire strike awareness campaign during 2010 following a Safety Recommendation from the AAIU.

Measures such as reconnaissance of the wire environment before ingress, the mounting of coloured warning spheres on power lines and the installation of WSPS on helicopters, do reduce the danger and mitigate the risk from a strike during such operations.

However, for the majority of helicopter operations the threat of a wire strike is generally only present during the take-off and landing phase. Once the helicopter climbs above the minimum safety height (500 ft. AGL) such threats no longer exist. However, where a helicopter descends in open country and below the safety height, perhaps due to deteriorating weather or its mission profile, it once again exposes itself to the risk of having a wire encounter.

It has been noted in various AAIU / NTSB / FAA Reports that most helicopter wire strikes occur during daytime with good visibility and with experienced pilots in charge.

Wires are difficult to see, partly because of the way the human eye functions and partly because of the effects of background camouflaging. In this accident, the background to the transverse wires consisted of agricultural fields bordered by trees in the foreground, with rising hills as a backdrop during the final approach.

The movement of wires in sunlight and changing sunlight patterns can also obscure wires. Whether a pilot sees a wire or not, is the product of a complex relationship between wire visibility, human limitations, topography and situational awareness. Visibility of suspended wires is notoriously variable. The same wire that clearly stands out against a bright homogeneous background (such as the daytime sky) may be virtually invisible when viewed against a darker and more heterogeneous background (such as a forest or bog land). In the dynamic realm of low-level flight, even small changes in helicopter position or attitude can precipitate such a background shift. Thus, for any given wire strike, the wire may be virtually undetectable right up to the point of contact, or it may be shifting from visible to invisible rapidly and unpredictably.

The human eye has physical limitations in its performance. One such limitation is its power of resolution - that is, the minimal size of an object that can be registered - due to the construction of the sensor (retina). In some respects the retina resembles the grain in black and white photographic film. The grain in the eye is determined by the finite size of the sense organs, the cones. The size of grain limits the detail that can be obtained. The periphery of the retina is coarse grained and picks up movement but not detail. The central part is fine grained and registers detail. Under specific conditions, i.e. against a plain contrasting background such as the sky, the eye has a compensating mechanism that relies on this contrast. In effect, we perceive the break in continuity of the background rather than 'seeing' the wire itself. The brain translates this into seeing. However, if contrast is reduced and the plain background is broken up, then the basic visual mechanism becomes limited by the grain (cone) size. The wire literally disappears as it is simply beyond the limits of the eye to see it.

These physiological facts have obvious and important implications for pilots. As such, pilots need to use a variety of skills/options to assess the presence of wires. This can be done by viewing local maps, carrying out a local ground inspection, looking for poles or pylons where the likelihood is that wires would be attached. Finally, and prior to commencing descent for an approach/landing, the assessment can be done by carrying out an aerial reconnaissance at an adequate safety height and airspeed above the intended operating or landing site.

1.11.4 ESB Power Lines – Local

The ESB Area Engineer provided the following information to the Investigation. There were three power supply lines in different parts of the 5 hectares (13 acres) accident field: the main three-phase 20 kV lines were to the left hand side of the helicopter (as seen on the flight approach), approximately 80 m infield from the boundary fence. A 220 V line approximately paralleled this main line and was situated alongside the minor roadway approaching the junction with the main road. Between these two lines and interconnecting them, were two 20 kV spur wires approximately 80 m long and strung between two poles, each of which was part of the respective parallel lines.

These two interconnecting wires were brought down approximately in mid span by the helicopter strike. They were replaced expeditiously by ESB emergency crews later that evening, following consultation with the Investigation.

The severed 20 kV wire construction is of steel core aluminium (SCA), i.e. a steel core surrounded by 7 woven aluminium strands. It is 8 mm in diameter and its height above ground was approximately 8.5 m.

1.11.5 ESB Power Lines – General

An ESB Networks document entitled “Key Statistics 2011” shows that there was in excess of 36,000 km of 20 kV overhead lines and in excess of 45,000 km of 10 kV overhead lines in the State at the end of 2010. In addition there was another 57,000 km of low voltage (i.e. 220 V) overhead lines. There was a further 7,000 km approximately of high voltage transmission overhead lines.

In the late 1960’s and early 1970’s, there was a spate of helicopter high voltage wire strike accidents and fatalities in Continental Europe, resulting in electricity providers placing coloured high visibility ‘*aircraft warning spheres*’ on selected high voltage power lines, initially in mountainous regions to highlight lines strung on pylons across valleys and, subsequently, across various national motorways. In Ireland, following representations by the then Air Corps Helicopter Squadron through the Department of Defence to the ESB, a number of suitable main road high voltage overhead power lines (normally 220/400 kV) crossing sites were identified and red/white high-visibility spheres were attached to the cables at those sites.

2. ANALYSIS

2.1 General

Certain helicopter mission profiles are by definition high risk activities. The NTSB statistics relating to HEMS accidents in the United States bear out this fact.

Helicopter operations, which may be required to be flown at low level over land and away from aerodromes or recognised and approved landing sites, constantly run the risk of exposure to wire encounters.

As with all accidents, there are lessons to be learned which the Investigation addresses as Safety Recommendations (SRs) to this Report.

2.2 The Reconnaissance

The success of any helicopter mission is dependent on many diverse factors such as the prevailing weather conditions, the operating environment on sea or land, the efficiency and effectiveness of crew training, flight risk evaluation programmes and technical back-up, among others.

If all these factors are evaluated and answered positively then a mission is launched and the onus is on the pilot to operate the aircraft safely from take-off to landing and engine shut-down.

In the subject event, the Pilot was assisted by the Air Corps crewman and an AP. Having dealt with the initial difficulties regarding the incorrect lat/long which had been passed to the crew, the helicopter approached from the north towards the area where the ambulance and support vehicle had parked. The Pilot made visual contact with the vehicles and the crewman quickly also saw them.

The helicopter then commenced a clockwise orbit of the intended landing site commencing at a height of approximately 600 ft AGL and gradually descending to 400 ft AGL. Having passed just to the east of the intended landing site at a height of approximately 400 ft, the helicopter then flew an ‘outbound’ leg continuing the gradual descent followed by a right turn onto the slow final approach towards the corner of the field close to the gate and the ambulance which was waiting on the roadway outside the gate. The Pilot had identified at an early stage that the selected field contained overhead wires but he only saw what he described as two sets of parallel wires and neither he nor his crew colleagues saw the transverse wires during their reconnaissance of the landing site or during the final approach.

The Pilot knew that the road ambulance could not enter the field. This influenced his decision to make an approach with the intention of landing as close as possible to the gate, near to where the vehicles were parked. This landing point obviated the need to carry the patient on a stretcher over a considerable distance between the ambulance and the helicopter.

The fact that the site reconnaissance was carried out with the proposed landing site constantly to the helicopter's right meant that the crewman, seated in the LH forward seat, would have had a less than optimal view of the landing site. The Investigation considers that the short amount of time required for an additional left hand orbit over a proposed site, and perhaps a dummy approach towards the selected landing site, could be beneficial to a crew's situational awareness. A Safety Recommendation to the Air Corps is made in this regard.

2.3 The Accident

Following the reconnaissance of the landing area, the helicopter commenced its approach to land along an easterly heading. Sixteen seconds before the end of the recording, the Air Corps crewman was cleared to open his door, indicating that the approach was not being conducted as a Category A approach, which is permissable for EAS operations.

Analysis of the FDR data for the final ten seconds of the recording indicates a controlled descent with a low indicated airspeed and constant heading. All recorded parameters are consistent with a stabilised approach. In the EC135, when making an approach to an open site, pilots tend to use a relatively shallow approach technique, which tends to be stable and to require minimum power fluctuations.

Although the Pilot advised the crew to watch out for any transverse wires on the relatively flat final approach, both he and the other crewmembers failed to see the interconnecting wires to their immediate front, until it was too late to avoid them. The Pilot thought, when interviewed shortly after the accident, that he had instinctively applied power and pitched the nose up in an attempt to avoid the wires. The FDR data indicates that while there was a pitch-up manoeuver, there is no recorded data indicating that the collective lever was raised appreciably in the moments before the wire strike. The recording on the CVR indicates that there was only an interval of approximately 0.8 seconds between the moment that both of the front seat occupants saw the wires and when the main rotor blades made contact with them. The Investigation considers that the crew saw the wires so late in the sequence that there was no chance of avoiding them.

The FDR data indicates that the collective lever was lowered during the final second of recorded data and this concurs with the Pilot's memory of lowering the lever and getting the helicopter onto the ground immediately. This action was consistent with the training the Pilot would have received for dealing with an emergency situation so close to the ground. The short period during the accident sequence, less than 2 seconds between blade strike and ground impact, meant that there was very little time available for a final application of collective with consequent cushioning of the impact. The helicopter's tail came to rest directly beneath where the severed wires had been. The indentations created by the skids during the impact sequence were very short. These facts indicate that, following the wire strike, the helicopter had dropped almost vertically onto the ground with very little forward velocity. The wire height of 8.5 m when compared to the main rotor head height of 3.51 m, gives an indication of the height the EC135 dropped.

AP1, who was seated behind the Pilot, was wearing a floor harness and was not secured into his seat by his four-point harness. In the sequence between the blades striking the wires and the helicopter impacting the ground, he was thrown out of his seat and landed on the stretcher which was to his left. The Pilot stated that he was unaware that AP1 was not strapped into his seat during the approach. If there is no operational requirement to the contrary, then the four-point harness should always be utilised.

Although the Garda and AP2 on the ground saw the transverse wires and discussed their potential risk to the helicopter, AP2 had no means to directly advise the helicopter crew of the hazard. While the known factor of 'wire camouflage' in this rural area of green fields, hedges and trees may have obscured the wires to all three sets of searching eyes from above, those on the ground clearly saw the wires against a background of clear blue sky. Therein lay the difference of perception of the same wires by five people, as viewed from above and from below in broad daylight.

The lessons learned from this accident can be put to positive use by raising the wire strike hazard awareness of pilots whose flying profile requires them to operate close to the ground away from aerodromes or well reconnoitred landing sites. The AAIU has had cause in recent years to carry out investigations into a multiplicity of similar accidents and it is clear that wire strikes remain a serious threat to aviation in Ireland. There are in excess of 140,000 km of ESB overhead wires in Ireland and to that must be added many thousands of km of overhead telephone lines and other miscellaneous services.

This accident should serve to raise the aviation hazard awareness of APs/Paramedics working on the ground once on site so that s/he can pass on any safety observation(s) to the crew in the helicopter. This could be facilitated by the inclusion of an aviation hazard awareness module on AP/Paramedic upgrading or refresher courses with a training input from the Air Corps, as necessary. It would also require that the AP/Paramedic on the ground has a means of direct communication with the flight crew. The Investigation therefore makes two SRs to the HSE NAS in relation to AP/Paramedic training and communication capabilities.

In this event, however, the ultimate responsibility for the safe operation of the helicopter lay with the Pilot.

2.4 Mission Selection

The inter-Departmentally agreed purpose of the EAS is to facilitate the rapid transmission of seriously ill patients to pre-arranged receiving hospitals emergency departments. The MOU refers '*to designated rendezvous points and landing sites'* which the Investigation understands to refer to landing at pre-designated sites (PDLZs) or at other 'suitable' landing sites in certain cases. An example of such a case might be a serious head or spinal injury, where any movement of the patient must be absolutely minimal. Early EAS operational statistics indicate that all missions until the date of the accident were to 'other' sites and this raised questions at the Department of Defence as to the direction the service was taking.

It should be pointed out that it is the NAS which tasks the Air Corps helicopter with its mission and that it is the aircraft commander who accepts or rejects it, having regards to the weather and other risk factors involved. The Investigation notes that the NAS AMPDS determines the appropriate reaction to 999 calls for assistance, with a road ambulance staffed by two Paramedics or a Paramedic and an AP when available. In some cases the AP may be dispatched in a support vehicle. However, it is only when the Paramedic or AP is actually on site that he or she can make a dynamic clinical assessment as to the next step to take and this primarily relates to the patient's condition and what mode of onward transport to use.

2.5 Organisational Issues

2.5.1 Pilot Training for the EAS Mission

The ARM sets out the requirements for role and area competence training, requiring that pilots undergo a course of instruction tailored to meet the operational requirements. In this case, a Syllabus of Training for EAS pilot operational conversion was developed and put in place for the six members of the project group. The Investigation notes that the flight training was all carried out internally, in that there were two instructors among the six selectees and those instructors oversaw all of the training flights and OPC rating flights. The instructors had no personal experience of EAS flying prior to developing and facilitating the operational conversion training, although the Investigation acknowledges the amount of research that was put into the course and the other essential activities required to put the EAS operation into place.

The ARM states that, in cases such as these *"GOC AC may consider the employment of external experts for a period of time to facilitate the operational work-up."* The Air Corps did make arrangements to visit a commercial EAS operator in Wales where useful information was gathered. In this case, taking into account that the EAS service was a new role based at an unfamiliar location, the Investigation considers that an external input to the operational flying training would have been beneficial. An instructor with personal experience of EAS flying would have been in a position to pass on the benefit of his/her experience to the cadre of EAS pilots. The Investigation makes a Safety Recommendation to the Air Corps in this regard.

The original Syllabus of Training which was provided to the Investigation required that pilots entering the operational conversion course would have an EC135 type rating and IR. The ARM also required that EAS pilots hold an IR on type. The revised Syllabus of Training required that pilots would have a current, valid EC135 or AW139 type rating and IR. However, the revised Syllabus did not address how those pilots who did not hold an EC135 IR on entry to the course would achieve this qualification, as required by the ARM, before commencement of the EAS operation. In the event, three of the six EAS pilots did not hold an EC135 IR on the date that the EAS mission commenced and the Pilot of 270 did not hold an EC135 IR on the date of the accident.

The original Syllabus contained a module for SPIFR training, which was subsequently dropped in the revised Syllabus. As the EAS mission was designated as a purely VFR operation, the decision to drop the SPIFR module complied with the ARM Part A Section 5.

While the Investigation acknowledges that the absence of an IR did not contribute to this accident which occurred in good weather conditions, possession of a current IR on type can only be of benefit to pilots involved on EAS missions. Whilst the operation is designated as VFR only, given its emergency nature along with the weather conditions prevalent in Ireland, there is always the possibility of inadvertently encountering IFR conditions.

The revised Syllabus included three flying exercises, designated as sortie numbers A/F1, A/F2 and A/F3. Sorties A/F1 and A/F2 were both titled "EAS Sample Missions" to be "*supervised by a suitably qualified pilot assigned by Chief Pilot EAS*", while sortie A/F3 was the EAS OPC. The Investigation notes that the Pilot carried out an EC135 type rating flight on the morning of 22 May 2012, which included EAS training sortie A/F1. His next flight on the afternoon of 22 May 2012 was A/F3, the EAS OPC. He subsequently carried out two further EAS training flights with EAS crew on board. Although the Pilot completed four EAS training flights prior to taking up EAS duty, the fact that his OPC flight followed directly after his initial EAS training sortie was not in compliance with the revised Syllabus of Training.

In the context of the issues identified in the areas of training and compliance with ARM requirements, the Investigation makes a Safety Recommendation to the Air Corps.

The intensity of the activities being undertaken by the six man project group increased significantly from the 21 May onwards, the date on which the launch date of 4 June was officially announced and the DFHQ Opord was signed. These activities included flying training in the operational theatre, OPCs and operational work-up.

These were in addition to the group's other activities including the development of the ARM Part B Amendment and the risk register. This significant increase in tempo with the consequent pressures placed on the project team at this late stage may have contributed to some administrative procedures, such as risk management, not being carried out as comprehensively as desirable.

2.5.2 EAS Risk Register

The Air Corps developed an EAS risk register prior to the commencement of the service. A total of 69 flight risks were identified including wire strike and blade strike.

The wire strike risk assessment placed much emphasis on the fact that the EC135P2+ is fitted with a WSPS, stating that the wire cutters would cut through wires were the aircraft to fly into any.

However, operation of a WSPS is more applicable to situations where the helicopter has a reasonable forward velocity. As the Flight Manual states, wires are cut by the converging blades using the kinetic energy of the moving helicopter.

Furthermore, in the accident scenario the wires were struck by the main rotor blades before the WSPS ever came into play. Thus there are a considerable number of instances where a WSPS will provide limited or no protection from a wire strike event.

The wire strike risk frequency was assessed as being 5, the highest point on the scale while the risk severity was assessed as being 1 or negligible, presumably in line with the analysis that the WSPS would protect the helicopter. On the other hand, the risk frequency for a blade strike, i.e. a situation where a rotor blade strikes another object, was assessed as 1 or unlikely, while the risk severity was assessed as 5 or catastrophic. Both events had the same risk rating of 5, or acceptable moderate risk, which is arrived at by multiplying the risk frequency by the risk severity.

The Investigation considers that the analysis used to arrive at the same acceptable moderate risk rating was flawed and that it should be re-visited. A Safety Recommendation to the Air Corps is made in this regard.

2.5.3 Interpretation of EAS Service by the Interested Parties

The Department of Defence had considerable concerns regarding the exclusive use of non PDLZs during the initial weeks of the service and, following the accident, the Minister for Defence directed that the service would use PDLZs or sites described in two published landing site directories. EAS missions were authorised to utilise non-PDLZs or sites other than those listed in the two published directories only in very exceptional circumstances.

The Investigation considers that while paragraph 15 of the MOU is somewhat vague, it caters for landing at suitable incident sites other than PDLZs. This is the interpretation as understood by the NAS as the tasking agency and the Air Corps as the service provider, at the time of the accident.

The Investigation also considers that the almost exclusive use of PDLZs implies that the database of such landing sites must be kept updated, in case of a change of use or the installation of obstructions such as wires, masts, buildings, etc. The Investigation notes that since 25 September 2012, the Minister has permitted the use of sports fields for EAS pick-ups.

2.5.4 Flight Following

On EAS missions flown by the EC135, the on-board AP maintains regular contact with the NACC utilising the Tetra system. In addition, the pilot files a flight plan and is in regular communication with ATC. There is no automatic flight following system on Air Corps helicopters.

This accident was witnessed by ambulance personnel and a Garda and thus in this case flight following was not an issue. However, there are other scenarios where the availability of flight following data at a ground base could prove very valuable in the rapid deployment of assistance to an accident site. There are a number of commercially available options which would provide automatic flight following for aircraft involved in helicopter aeromedical missions. The Investigation makes a Safety Recommendation to the Air Corps in this regard.

3. CONCLUSIONS

(a) Findings

1. The intended EAS mission was tasked in accordance with NAS procedures. There was confusion regarding the co-ordinates of the landing site which were passed from the NAS to the aircrew. The crew resolved this confusion en route to the landing site.

2. The Pilot accepted the mission as all technical and weather parameters were suitable for its safe conduct.

3. The Pilot held a Type Rating for the EC135P2+ but he did not hold a current Instrument Rating on type as required by the ARM. However the lack of an IR is not considered to have been a contributory factor in the accident.

4. The helicopter was serviceable and had been properly maintained in accordance with the approved Air Corps Maintenance Programme for the type.

5. The Pilot flew a clockwise reconnaissance pattern over the landing site, which was one of the options available to him in accordance with EAS training and SOPs. The Pilot identified two parallel sets of overhead wires in the selected field. However, the Pilot and other crewmembers did not identify a pair of wires which traversed their final approach to land although the Pilot had raised the possibility of their existence.

6. The clockwise reconnaissance pattern flown over the landing site provided the Pilot with an optimum view of the site. The Air Corps crewman, seated in the left hand front seat, did not have an optimum view. This could have been remedied had a second counter-clockwise pattern been flown.

7. While the approach to land was in an easterly direction and thus not into the sun, a lack of movement of the wires in the very light breeze and rural background may have obscured them from the aircrew's scan.

8. During the final stages of its approach to land, the helicopter's main rotor blades struck 20 kV overhead lines suspended at a height of 8.5 m above the ground.

9. The Pilot and the crewman who was seated in the front LH seat simultaneously saw the overhead wires 0.8 seconds prior to the main rotor blades impacting the wires. This was insufficient time for the Pilot to successfully avoid the obstacle.

10. AP1 who was a member of the helicopter crew was wearing a floor-strap but was not secured into his seat by his four-point harness. Consequently he was thrown out of his seat onto an adjacent stretcher during the accident sequence.

11. AP2 and a Garda who were on the ground awaiting the arrival of the EAS helicopter saw and commented on the transverse wires which the helicopter struck, prior to its arrival. However they had no means of direct communication with the helicopter crew to alert them to the potential hazard.

12. Damage to the helicopter was substantial. The cabin area maintained its structural integrity, as designed, and the crewmembers were able to vacate the helicopter uninjured.

13. An MOU was signed by the Department of Health and the Department of Defence to establish the EAS pilot project.

14. As the project developed, the Air Corps set up an internal EAS project group which consisted of the six pilots selected for the EAS roster.

15. The tempo of the activities being carried out by the Air Corps EAS project group increased significantly after the public announcement on the 21 May of the commencement date of the EAS operation.

16. The risk register in place at the time of the accident contained deficiencies in its analysis of the risks posed by wire strike and by blade strike.

17. Operational conversion training for the EAS mission was carried out internally by Air Corps Instructors, who themselves had no particular experience of EAS missions but who were experienced military helicopter pilots.

18. There were considerable differences in the interpretation of "landing sites/points" as mentioned in the MOU between different stakeholders in the EAS pilot project.

(b) Probable Cause

1. The helicopter struck a pair of electrical wires crossing the final approach path as it was about to land in a field.

(c) Contributory Cause(s)

1. The Pilot or crew did not see the wires until it was too late to avoid a collision with them.

2. The AP on the ground who had observed the wires prior to the approach of the helicopter had no means of direct communication with the helicopter crew to alert them to the potential hazard.

4. SAFETY RECOMMENDATIONS

No.	It is Recommended that:	Recommendation Ref.
1.	The HSE NAS should expand the issue of Tetra radios to Paramedics and APs in the EAS operational area as a priority, in order to provide direct communications with the helicopter crew, thus enhancing aviation safety at the patient pick-up point. Where an EAS helicopter is not fitted with a Tetra system, then other means of direct communications should be explored.	IRLD2013001
2.	The HSE NAS should include an aviation hazard awareness module for both Paramedics and APs with a view to ensuring that any NAS staff at a landing site are in a position to provide information on potential hazards to helicopter crews.	IRLD2013002
3.	The Air Corps should review the procedures for the approval, amendment and supervision of training syllabi and regulations related to flying qualifications.	IRLD2013003
4.	The Air Corps should review the methodology of compiling the risk register for operational missions. *The Defence Organisation has informed the Investigation that the Air Corps has completed a full re-assessment of the risk register for the EAS mission.*	IRLD2013004
5.	The Air Corps should re-evaluate the extent of the requirement for drawing on external expertise during the setting up of a new mission type.	IRLD2013005
6.	The Air Corps should consider a review of SOPs regarding EAS landing site reconnaissance patterns. *The Defence Organisation has informed the Investigation that the SOPs regarding site reconnaissance have been reviewed and an enhanced reconnaissance procedure is in place.*	IRLD2013006
7.	The Air Corps should consider the installation of automatic flight following systems on helicopters involved in aeromedical missions.	IRLD2013007

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- END -

Appendix A – Wire Strike Risk Assessment Form

Air Corps Activity Risk Assessment Form

Unit	No 3 Ops Wing	*Aircraft Type*	EC 135 P2
Activity	EAS		
Hazards	Wire Strike		
Risk Assessment Narrative	In the unlikely event that a pilot and the crewman miss wires on their brief the aircraft is equipped with wire cutters.		
Safe Person	Pilots will not fly into an area without conducting a full and detailed brief to ensure any potential dangers are spotted prior to approach. EAS pilots have been selected with a high experience level through the Unit's HRM plan.		
Safe Equipment	The aircraft is fitted with wire cutters which will cut through wires were the aircraft to fly into any wires.		
Safe Practice	EAS pilots when under instruction in confined areas will be challenged into place where wires may exist to highlight the importance of the brief prior to landing. The crew will highlight the wires and elect to land in an alternative site.		
Safe Place	The Wicklow hills has plenty of challenging areas with wires that could be picked for landing to test EAS pilots on regular basis.		
Risk Frequency	5	*Risk Severity*	1
Risk Rating	5	*Risk Acceptable?*	Yes Moderate
Additional Controls			
Residual Risk Freq		*Residual Risk Severity*	
Residual Risk Rating		*Residual Risk Accept?*	
Name OIC Activity		*Name Unit Comd*	
Rank OIC Activity		*Rank Unit Comd*	
Appt OIC Activity		*Appt Unit Comd*	

Appendix B – Blade Strike Risk Assessment Form

Air Corps Activity Risk Assessment Form

Unit	No 3 Ops Wing	Aircraft Type	EC 135 P22
Activity	EAS		
Hazards	Blade Strike		
Risk Assessment Narrative	A blade strike is where a blade of the aircraft strikes another object.		
Safe Person	The EAS pilot and crewman will be responsible for clearance from all obstacles when flying.		
Safe Equipment	The Recce brief will help to identify any potential dangers of blade strike.		
Safe Practice	The crew will conduct a full recce and brief of each landing area prior to landing to include Shape, Size, Surface, Slope and Surrounding(crewman). Also briefed will be Entry, Exit and Emergencies(pilot). This brief will help to identify any potential obstacles that could be hit.		
Safe Place	ARM Part C contains a list of Hospital LZ's , DF Barracks and other commonly used LZ's . This document provides details on obstacle's, best approach angles etc. .The Wicklow Mountains contains many suitable Confined Areas for training / Ops . Regular updates will be required on hospital LZ's and this could be done as part of a training regime for crew.		
Risk Frequency	1	Risk Severity	5
Risk Rating	5	Risk Acceptable?	Yes Moderate
Additional Controls			
Residual Risk Freq		Residual Risk Severity	
Residual Risk Rating		Residual Risk Accept?	
Name OIC Activity		Name Unit Comd	
Rank OIC Activity		Rank Unit Comd	
Appt OIC Activity		Appt Unit Comd	

GLOSSARY

AAIU	Air Accident Investigation Unit
AC	Air Corps
ACFSO	Air Corps Flight Safety Officer
ACFSS	Air Corps Flight Safety Section
ACHQ	Air Corps Headquarters
AGL	Above Ground Level
AMPDS	Advanced Medical Priority Dispatch System
AP	Advanced Paramedic
ARM	Air Regulation Manual
ATC	Air Traffic Control
ATS	Air Traffic Services
BFU	Air Accident Investigation Agency of Germany
CPL (A)	Commercial Pilot Licence (Aircraft)
CPL (H)	Commercial Pilot Licence (Helicopter)
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DF	Defence Forces
DFHQ	Defence Force Headquarters
DOD	Department of Defence
EAS	Emergency Aeromedical Support
EHEST	European Helicopter Safety Team
EMI	Electromagnetic Interference
ESB	Electricity Supply Board
ESSI	European Strategic Safety Initiative
FAA	Federal Aviation Administration (US)
FDR	Flight Data Recorder
FICEMS	Federal Interagency Committee on Emergency Medical Services (US)
GASU	Garda Air Support Unit
GOC AC	General Officer Commanding Air Corps
GPS	Global Positioning System
HEMS	Helicopter Emergency Medical System
HIQA	Health Information and Quality Authority
HRM	Human Resource Management
HSE	Health Service Executive
IAA	Irish Aviation Authority
IFR	Instrument Flight Rules
IOC	Inspector on Call
IR	Instrument Rating
LH	Left Hand
LZ	Landing Zone
MOU	Memorandum of Understanding
NACC	National Aeromedical Co-ordination Centre
NAS	National Ambulance Service
NHS	National Health Service (UK)
NTSB	National Transportation Safety Board (US)
OC	Officer Commanding
OIC	Officer In Charge

OPC	Operational Proficiency Check
Opord	Operation Order
PDLZ	Pre Designated Landing Zone
RH	Right Hand
SAR	Search and Rescue
SOP	Standard Operating Procedure
SPIFR	Single Pilot Instrument Flight Rules
SR	Safety Recommendation
TT	Total Time
TTR	Time to Run
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
WSPS	Wire Strike Protection System

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.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

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