

Sikorsky S61N, G-BCLC, 19 November 1997 at 1456 hrs

AAIB Bulletin No: 4/98 Ref: EW/C97/11/4 Category: 2.1

Aircraft Type and Registration:	Sikorsky S61N, G-BCLC
No & Type of Engines:	2 General Electric CT58-140-2 turboshaft engines
Year of Manufacture:	1974
Date & Time (UTC):	19 November 1997 at 1456 hrs
Location:	Bressay, Shetland Islands
Type of Flight:	Search and Rescue
Persons on Board:	Crew - 4 (including the winchman on the vessel) - Passengers - 10
Injuries:	Crew - 1 fatal - Passengers - None
Nature of Damage:	Winch cable partially severed; winch jammed
Commander's Licence:	Airline Transport Pilots Licence
Commander's Age:	49 years
Commander's Flying Experience:	5,800 hours (of which 2,800 were on type)
Information Source:	AAIB Field Investigation

History of flight

At 0836 hrs the Search and Rescue (SAR) crew at Sumburgh were brought to a standby because the Motor Vessel (MV) Green Lily had suffered an engine failure and was drifting. Her position was 10 nm south east of Bard Head, the southernmost point of Bressay, one of the Shetland Islands. She had a crew of fifteen. By 1218 hrs, the vessel was under tow to Dales Voe; the SAR standby was to remain until the vessel arrived at Dales Voe. At 1239 hrs, the tow broke and at 1258 hrs the SAR crew, in helicopter 'LC', were scrambled to a position 2.7 nm south east of Bard Head; the helicopter was airborne at 1309 hrs and on scene at 1319 hrs. The Marine Accident Investigation Branch are carrying out an Inspector's Inquiry into the accident and consequently this Bulletin will be confined to the events which are directly related to the SAR helicopter and the loss of the winchman. The sequence of events was determined, in the main, from crew reports and replay of the Combined Voice and Flight Data Recorder (CVFDR).

When the helicopter arrived on scene, the MV Green Lily was lying with her starboard beam to the wind and swell. The surface wind was estimated as 150°/50 to 70 kt, the sea state 8 and the visibility

5,000 metres. The tug Tystie was in attendance and the Maersk Champion and the Lerwick Lifeboat were proceeding to the scene. It was decided to winch off two injured crewmen as soon as possible. It proved difficult to select a suitable winching area as the smooth deck surfaces were overhung by cranes and cables. The preferred area was the forward part of the aft raised hatch cover and, based on this, a dummy approach was made. The ship's master was briefed on the Heaving-in line (Hi-line) transfer method. The commander positioned 'LC' on the ship's leeward side and the Hi-line was lowered. The deck crew took the Hi-line and moved to the well between the raised hatch and the bridge structure, a less than ideal position from the helicopter crew's viewpoint. However, the ship was now only about 1.5 nm from the shore and the rolling motion had worsened to the extent that the commander decided to abort the rescue attempt until one of the tugs could stabilise the ship by hauling its head into wind.

The Tystie eventually managed to get a line to the MV Green Lily but the tow parted before it had any effect on the ship's orientation. The master was then advised to slip the ship's anchors; after some time, the starboard anchor lowered but the port did not. The ship's head was now about 45° off the wind and the Lerwick Lifeboat came alongside, on the port, and managed to take off five crewmen. The Maersk Champion managed to grapple the MV Green Lily's anchor and started to turn the vessel before the lifeboat had to abandon the attempt. Although the ship was now very close to the shore the situation appeared to be more stable and the helicopter commander decided to start winching operations.

At about 1441 hrs, the helicopter was manoeuvred into the winching position and the Hi-line was lowered. The winchman was lowered onto the deck with two strops to recover the ten remaining crewmen, two at a time. At about 1443 hrs, it was reported on the radio that the anchor cable had parted and the Green Lily started to drift stern first towards the coast. The situation now became more critical and winching started at 1444 hrs. Large and rapidly varying flight control positions were recorded as the commander maintained the helicopter's position; the radio height varied between 40 and 90 feet and, as the ground speed was zero, the values recorded as airspeed gave an indication of wind speed. This was of the order of 35 kt with several gusts exceeding 50 kt.

As the third lift was taking place, the master was told to go onto the deck immediately to be winched off. The fourth lift had started, leaving the master, one crewman and the winchman still on board. The master reported at 1450 hrs that the vessel was aground. The ship was now rolling violently and the commander reported that, to maintain hovering references, the helicopter was about 30° out of wind and holding about 10° of left bank. He was having difficulty keeping clear of the vessel's superstructure. It was decided to get the winchman to 'hook on' with the last two crewmen; winching three people at a time is within the capability of the equipment but would only be used in an emergency situation such as was deemed to exist at the time. The winch operator recalled seeing all three people on the deck engulfed by a large wave as he prepared to lift them off; as the ship rolled back he winched the last two crewmen off. The winchman was not in radio contact with the helicopter and despite the winch operator's hand signals, he had not attached himself to the hook.

Once the last two crewmen had been pulled into the cabin, the hook was immediately sent down to the winchman. At 1456 hrs the ship was rolling violently and huge waves were breaking over the deck. At this time, as the cable was being winched out, the winch operator became aware that the Hi-line appeared to have become snagged in the ship's superstructure. Thirty seconds later, while still trying to release the Hi-line, the winch operator noticed that the winchman was no longer on the deck. Five seconds later the helicopter momentarily rolled 80° to the right and, to avoid further endangering it and its occupants, the winch operator decided to activate the cable shear system. The noise of the cartridge firing was audible to the crew and was recorded on the CVFDR. The winch

operator advised the commander that the cable had not sheared and that the Hi-line was still attached. There can be no doubt that the winchman had already been washed overboard when the cable shear system was operated. Fortunately the Hi-line became unsnagged and was now clear of the ship's structure. The winch operator managed to raise the hook to about two feet of the winch mechanism. He could now see that the top end of the Hi-line had wound itself round the hook, effectively bypassing the weak link. He was able to cut the line free using the bolt-cropper provided as part of the back-up equipment. At about 1458 hrs, the commander advised Shetland Coastguard that they had lost the winchman overboard.

The winchman had been swept overboard and was dashed repeatedly against the side of the ship. He was last seen in the sea with his lifejacket inflated. His helmet was missing, he was covered with oil and there appeared to be no sign of life. The winch was no longer usable so there was no way the helicopter crew could attempt a rescue and the location and conditions were such that it was not possible for the lifeboat to approach. Even if the helicopter winch had still been available a rescue would not have been feasible. The commander decided to take the survivors to hospital and then to return to Sumburgh where a replacement winch could be fitted.

The ten crewmen who had been rescued from the MV Green Lily were flown to the Gilbert Bain Hospital at Clickimin and were disembarked at 1505 hrs. The helicopter was then flown to Sumburgh where it landed at 1523 hrs. The back-up aircraft with a serviceable winch took off again at 1550 hrs, with a replacement crew, to continue the search for the winchman.

Flight Recorders.

The CVFDR was removed from the aircraft and replayed at Farnborough. The recorder had retained data from the whole flight and the last 61 minutes of crew audio. Throughout the operation the crew of the aircraft were in radio communication with all vessels taking part and with Shetland Coastguard. The winch operator was connected via the aircraft's intercom to the crew and his speech was also recorded on the CVFDR. The quality of the recording was excellent.

Failure of the cable cutting mechanism

The Lucas Air Equipment Hoist, part no 76378-100, includes a cable cutting device (see Appendix A), which is operated by an electrically fired squib. The winch cable passes down through a vertical hole in the cylindrical shearing knife holder. The fixed anvil is situated on one side of the cable and on the other side there is the chisel (or guillotine), the cutting edge of which should be horizontal and at right angles to the cable. A drilling in the chisel blade is aligned with a horizontal drilling in the shearing knife holder and a shearing pin is force fitted. This not only keeps the chisel back from the cable but should also ensure its correct alignment. When the squib is fired the pin is sheared, the chisel is driven forward against the anvil and the cable is cut. There are two gas exhaust holes in the shearing knife holder. These are slightly larger than the shearing pin drillings but are in the same vertical plane and at right angles to them, i.e. they are in the same alignment as the cable.

The cable cutting mechanism was dismantled at the company's facility at Aberdeen. The following observations were made:

1. The squib had fired correctly.
2. The chisel had sheared the retaining pin and had impacted the anvil. A groove had been cut into the anvil by the chisel.

3. The cable had been partially sheared along its vertical axis.

The drilling in the chisel blade had been aligned with the gas exhaust holes rather than with the horizontal drilling in the shearing knife holder and a shearing pin had been fitted through the gas exhaust holes; the blade was aligned with the cable axis and did not sever the cable when operated.

An across the fleet inspection revealed one other case where the mechanism had been assembled in exactly the same way. In another case the shearing pin had been fitted through the correct drilling in the shearing knife holder but had passed in front of the chisel rather than through the drilling in it; the blade was again aligned with the cable axis and would not have severed the cable if operated.

The hoist is an on condition maintenance item and is returned to the Aberdeen workshop at approximately 18 month intervals for replacement of part of the clutch/brake assembly. The opportunity is taken to clean and inspect the cable cutting mechanism; there is no formal servicing requirement for this item. The helicopter company's Quality Assurance department carried out an immediate and comprehensive audit of the system and identified the following shortcomings:

1. The layout of the maintenance manual, with text and related illustrations widely separated, made it difficult to use. An unofficial rearrangement of the manual pages to aid clarity was evident in one copy examined.

2. It was physically possible to assemble the guillotine and retaining pin in three different ways:

a. With the retaining pin inserted into the correct set of body holes and through the guillotine.

b. With the retaining pin inserted into the incorrect set of body holes and through the guillotine.

c. With the retaining pin inserted into the correct set of body holes and with the guillotine trapped between it and the end plug.

3. The maintenance manual did not include any specific instruction on the orientation of the guillotine blade or on the correct set of holes to use for pin insertion.

4. The company hoist worksheets did not include any specific instruction on the orientation of the guillotine blade or on the correct set of holes to use for pin insertion.

5. Contrary to the impression given in the maintenance manual, the guillotine retaining pin was a loose fit and required care to ensure that it remained in place during subsequent stages of assembly. Should it fall out, the concentration required to replace it may have reduced the attention given to correct positioning of the guillotine.

6. The company hoist worksheets did not require a verification of correct guillotine blade orientation after assembly.

As a consequence of these several pertinent recommendations were made by the Quality Assurance Department. These included the acceptance and introduction of a locally designed tool for setting the position of the guillotine prior to inserting the retaining pin, and a duplicate inspection to confirm the correct installation.

The helicopter company also issued a Temporary Manual Revision (TMR) dated 3 December 1997 which contained the following caution:

"Ensure that shearing pin is fitted horizontally and correctly located in the chisel: ie at right angles to the hoist and not through the exhaust gas holes."

It has been agreed to include this caution in the next revision of the maintenance manual. However, it is recommended that the manufacturer of the winch reviews the design and/or assembly, including the use of tooling, of the mechanism to ensure that it is physically not possible to assemble the guillotine incorrectly and, in the interim, issues more comprehensive guidance in the form of a procedure which may alleviate the problem.

Hi-line transfer

The Hi-line is a 150 foot nylon line with a karabiner on each end. There is a 150 lb 'weak link' between the line and the karabiner, which is attached to the winch hook. Weighted bags (10 lb each) are attached to the karabiner at the other end; the number of bags attached depends on the wind strength. The Hi-line used was manufactured by the operator.

The Hi-line can be used whenever lack of visual reference or obstacle clearance between the helicopter and the vessel, is such that undue workload is placed on the crew to execute the transfer. The appropriate weights are attached to the lower end of the Hi-line, the top end is attached to the winch hook and it is then lowered from the cabin door. The line is hand lowered until the weights land in the transfer area. Once the Hi-line is safely in hand on the deck, the helicopter is manoeuvred into the transfer position, normally to the left of the vessel. From a low hover, at about deck height, the winchman is winched out. As he is lowered the helicopter climbs to a higher hover and the winch cable is run out to keep the winchman's height above the surface (about 20 to 30 feet) and his position relative to the vessel, constant. Once sufficient height has been attained, the deck party will haul in the Hi-line to bring the winchman towards the vessel. This procedure is reversed to effect the transfer from vessel to helicopter. It is important that the deck crew maintain control of the Hi-line at all times and particularly that they do not secure it to, or allow it to become entangled with, any part of the vessel's structure.

On this occasion the Hi-line had wrapped around the winch hook, effectively bypassing the weak link. Had the lower end of the line not fortuitously become unsnagged after the cable cutting mechanism had failed, the helicopter and its occupants would have been put in an extremely hazardous position. It is therefore recommended that the helicopter operator gives urgent consideration to a review of the design of the Hi-line to minimise the risk of it becoming entangled with the winch hook and rendering the weak link ineffective.

Communications

In the conditions prevailing, the winch operator was unable to communicate effectively with the winchman on the deck. Had he been able to, the winchman would undoubtedly have been transferred with the last two survivors, and would not have lost his life.

It is therefore recommended that the operator, in conjunction with HM Coastguard and the CAA, urgently address the feasibility of radio communication between the winchman and the

helicopter, and that the CAA should require the operator to address the communication between the winchman and the operator within the operations Manual.

Safety recommendations

98-28 It is recommended that the manufacturer of the winch reviews the design and/or assembly, including the use of tooling, of the mechanism to ensure that it is physically not possible to assemble the guillotine incorrectly and, in the interim, issues more comprehensive guidance in the form of a procedure which may alleviate the problem.

98-29 It is recommended that the helicopter operator gives urgent consideration to a review of the design of the Hi-line to minimise the risk of it becoming entangled with the winch hook and rendering the weak link ineffective.

98-30 It is recommended that the operator, in conjunction with HM Coastguard and the CAA, urgently address the feasibility of radio communication between the winchman, and the helicopter and that the CAA should require the operator to address the communication between the winchman and the operator within the operations Manual.