THE HELICOPTER IN SEARCH AND RESCUE AT SEA

A REVIEW OF ITS POTENTIAL AND ITS LIMITATIONS

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ABSTRACT

This paper examines the many aspects to which the helicopter may be used in search and rescue (SAR). Its role for search, recovery and evacuation are examined together with the specialised equipment necessary for these operations.

The structure of responsibilities within the UK to meet the requirements of International Conventions is explained and the part played by the declared units of the RAF and RN are dealt with together with what may be obtained from civil helicopter operators. Helicopter types and their deployment around the UK shores are examined and their suitability in terms of performance, operating limitations and equipment are discussed.

Finally, a review is made of a number of disasters and emergencies in which helicopters have played a major role in rescue operations. A large part of the information given in this paper has been derived from studies made by the author for the Department of Energy and their permission to use such information is gratefully acknowledged.

1 INTRODUCTION

The helicopter has a number of unique features which make it admirably suitable for use on search and rescue operations over the sea, and its use in any incident or major disaster offshore is now accepted as normal.

In looking at the part the helicopter plays in such incidents and disasters it is first advantageous to look at the organisation which controls SAR around the UK shores. The climatic conditions around these shores are probably as demanding as anywhere else in the world and therefore are most demanding in requirements necessary for any helicopter to be used for SAR. Helicopters have been called upon to save life under most extreme conditions and mention must be made of the crews who man the helicopters on these missions, for their bravery frequently goes well beyond all normal limits.

2 INTERNATIONAL OBLIGATIONS FOR SEARCH AND RESCUE AND A REVIEW OF THE SITUATION AROUND THE UK

In order to comply with international agreements for SAR at sea, the UK has a 'Declared' organisation coming under the authority of the Department of Transport (DTr) and within this Department the control of SAR is vested in HM Coast Guard (HMCG). Details of this organisation may be obtained from the UKSAR Handbook (Ref I). Although the Coast Guard provide some rescue facilities, mainly a limited number of civil helicopters under contract to the DTr, it relies mainly on the SAR facilities provided by HM Forces (RAF and RN). While these units of the RAF and RN are set up primarily for military duties they are made available for any emergency situation and by reason of their command facilities would normally control air rescue operations through one of their two Rescue Co-ordinating Centres (RCC's) at Plymouth and Edinburgh. These units of the RAF and RN, together with any civil helicopters under contract to the Department of Transport form part of

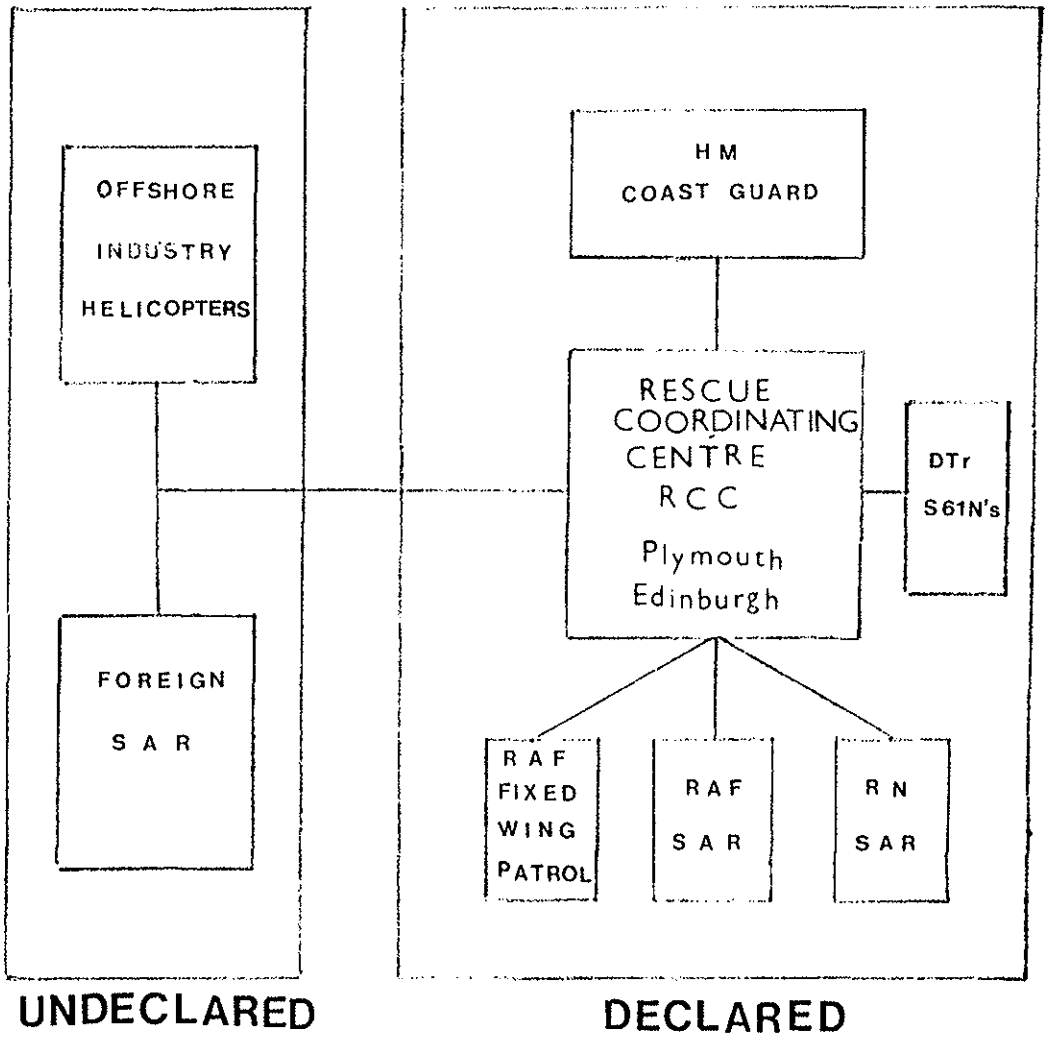
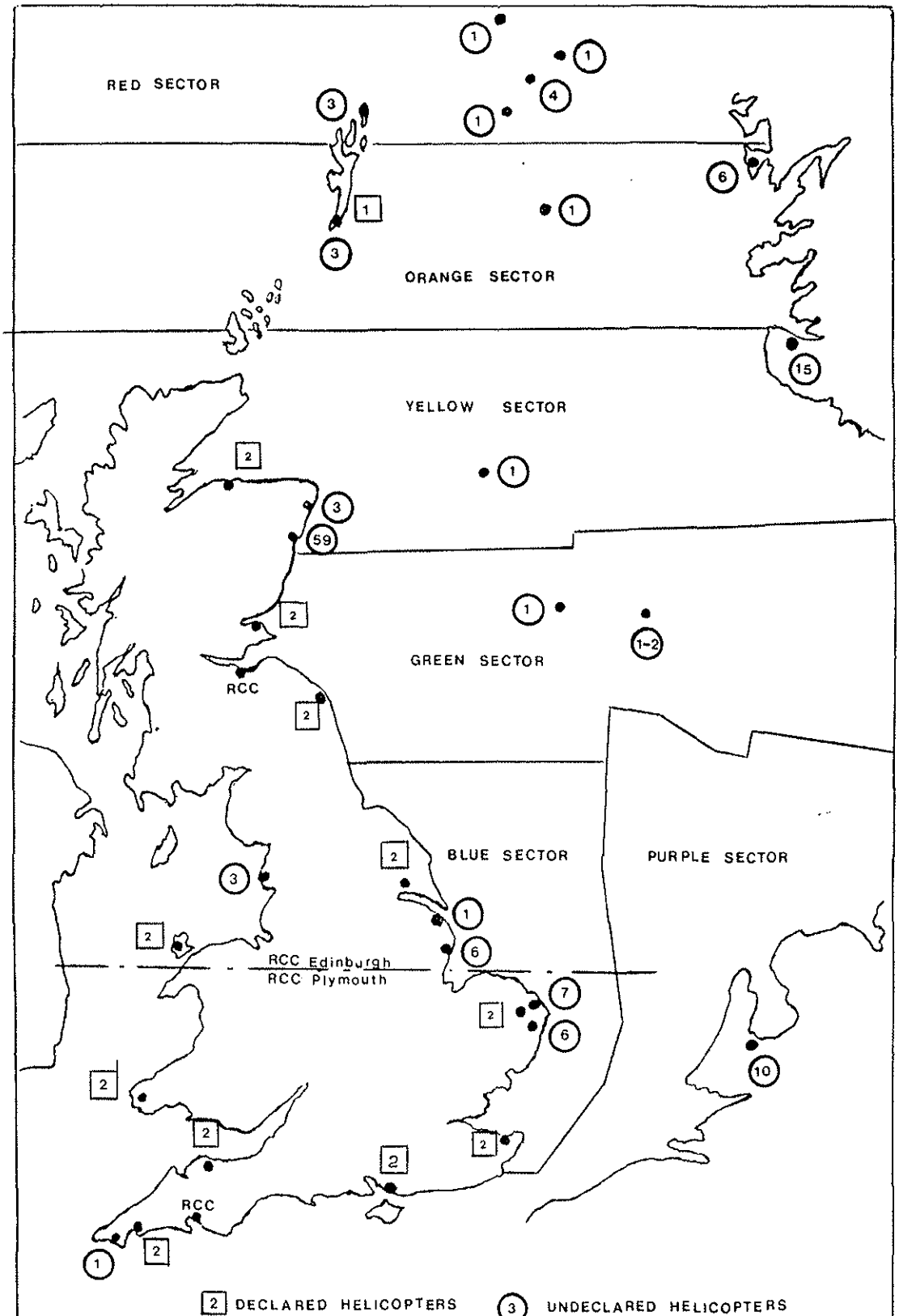


Figure 1

what is known as the Declared SAR Organisation within the UK. There are other units and civil helicopters which may be called upon in a serious SAR operation which form part of what is known as the Undeclared SAR Organisation. This undeclared facility would be made up of civil helicopters normally used for support operations to the offshore gas/oil industry and SAR units drawn from the forces of neighbouring countries ie Norway, Denmark, Germany, Holland, Belgium, France and units of the USAF stationed in Europe. The offshore gas/oil industry, by reason of the nature of its operations, has set up its own SAR organisation which would deal with an emergency arising on any one of its installations. The North Sea has been divided into a number of sectors, each sector being under the control of a major company who would be responsible for the emergency facilities within its sector. In an incident arising on an offshore installation the, offshore installation manager (OIM) by reason of being "on



Sector Clubs & Distribution of Helicopters

Around UK Shores

FIGURE 2

the spot", would take control initially of the situation. Should this incident develop into a major disaster, then he would hand over control of the situation, through HMCG, to either of the RCC's. Details of the organisation within the offshore industry for dealing with emergencies are given in the Offshore Emergencies Handbook (Ref 2). The structure of the SAR organisation around the UK and the chain of command is shown on Figure 1. Figure 2 shows the distribution of helicopters stationed around the UK shores and also shows the areas covered by the various sectors set up by the offshore industry. The nature of the offshore industry entails constant changes in the distribution of its support helicopters and that shown in this figure represents the distribution at a particular point in time. As a general rule, there are anything up to 150 helicopters of various sizes stationed around the UK shores.

3 THE HELICOPTER FOR SEARCH AND RESCUE

The three principal aspects of a helicopter which define its suitability for search and rescue are:

i The ability to hover over a rescue operation

ii A wide range of operating speeds from zero to anything up to about 150 knots

iii The ability to take off and land from a confined space.

Consider the first aspect - the ability to hover. Hovering a helicopter over a vessel or for that matter over a person or persons stranded on rocks, for the purpose of lifting them off and recovering them to a safe place has become an accepted operation for SAR helicopters. The normal procedure, if that term may be used, for every operation has its own peculiar problems, is for the helicopter to be brought into a hover over the vessel or the rocks and a crew member to be winched down to the person or persons to be rescued, attach a sling to the person and then be winched back to the helicopter. In the case of rescuing a number of persons from a vessel, the crew member may stay on the desk to supervise operations until the last person has been winched off.

Regarding the second aspect - a wide range of operating speeds. From the hover, the helicopter can take the rescued person or persons direct to a place of safety at speeds of up to 150 knots.

Of the third aspect - the ability to land in a confined space. If the rescued person has suffered injury, that person may be taken direct to hospital, a most important aspect if the injury is such that medical attention is urgently required.

4 A REVIEW OF HELICOPTERS USED FOR SAR

4.1 Westland Wessex

The Westland Wessex has done noble service on SAR operations both with the RAF and RN. Although now considered obsolescent it is still in use by both services. Its limitations are its slow cruising speed, limited range and its lack of an automatic flight control system (AFCS). The latter means the pilot needs a visual reference to hover and therefore limits its use on night operations.

4.2 Westland Sea Kings

The Westland Sea King is used by both the RAF and RN. With a cruising speed of 110 knots and a still air radius of operation (no reserves) of 300NM it forms the mainstay of that part of the UK Declared SAR organisation. It has extensive avionic equipment including radar, a simplex AFCS system together with the necessary winch.

4.3 Sikorsky S6IN

Two Sikorsky S6IN are under contract to the Department of Transport and form part of the UK Declared SAR

organisation. They are specially equipped for SAR. Apart from what might be termed normal avionic fit for all weather operations, they are also fitted with a Duplex Flight Control System, a Flight Path Control System (FPCS), a FLIR thermal imaging system, a 'Night Sun' airborne searchlight and a rescue basket. While all S6IN operating offshore have all weather avionic equipment, there are available with some operators, winches which may be fitted in an emergency.

4.4 Bell 212

Several Bell 212's normally operating inter rig shuttle services and based offshore, have been fitted with winches to enable them to be used for SAR operations in an emergency. Also these particular helicopters have been equipped with a Flight Path Control System.

4.5 Aerospatiale AS332L

This helicopter, more generally known as the Super Puma (or 'Tiger' with one Company) is now extensively used offshore and has a good power margin for hovering. Some winches are available for fitment and use in an emergency.

4.6 Aerospatiale AS365

Several variants of this type are in operation over the North Sea and they may be equipped with winches and other equipment for SAR.

4.7 Bolkow B105

The Bolkow B105 is the smallest of the helicopter types operating offshore and is also used for lighthouse relief work. It has a normal seating capacity for 5 persons. In lighthouse relief operations winching is sometimes the only method for carrying out crew changes.

4.8 SAR Helicopters of Other Countries

Most other countries have variants of the above types equipped to their own requirements. The Sea King is probably the most popular with the military forces but Holland also use the Westland Lynx for SAR. A variant of the AS365 is used extensively by the US Coast Guard and while the US Forces use the Sikorsky Sea King, they also use the large Sikorsky CH53 and its extensive range makes it suitable for long range SAR operations.

5 SPECIALISED EQUIPMENT FOR SAR HELICOPTERS

While the inherent characteristics of the helicopter make it suitable for SAR, its ultimate usefulness depends on the fitting of specialised equipment in order to enhance its full potential for such roles.

Essential for all SAR work are suitable communication and navigational aids. Such aids are fitted as standard on military helicopters and civil helicopters on offshore support operations. Communications are maintained using VHF and HF, while aids such as ADF, VOR, Decca, RNAV, ILS, Weather Radar, etc enable the helicopter to navigate from base to a precise area over the sea and then return to base and make an instrument approach and land under all weather conditions.

The primary item of equipment fitted to any SAR helicopters is the winch, which must have a suitable length of cable to permit a recovery from a safe hovering height with a sling fitted to the end of the cable. Winches may be driven by a hydraulic or electric motor or by bleed air from one of the engines. A dedicated SAR helicopter would have the winch fitted near the main compartment door as a permanent installation. Offshore support -helicopters would not carry such winches as standard, (other than those based offshore on dual support/ SAR duties) but some operators have available as kits winches which may be quickly fitted in an emergency. Several other items are needed in association with the winch such as draught shields and cabin floor drip trays to protect the cabin floor from

sea water which would drain off the survivors' clothes.

Once a survivor has been located, the helicopter is brought into a hover over the survivor in order that a recovery can be made. For such a manoeuvre to be carried out successfully in day or night when no visual reference is possible, the helicopter needs to be fitted with an Automatic Flight Control System (AFCS). Such equipment is now considered as standard and while the military helicopter such as the Sea King has a single or Simplex AFCS as do existing civil helicopters, on offshore support operations, the latest civil requirements call for a double or Duplex system.

A helicopter so equipped has the ability to fly to a given area, hover and execute a rescue and return to base. However, in the time between a briefing for the SAR mission and reaching the given area, currents and wind can lead to changes in the precise location of the person or persons to be rescued and therefore a search is often required over a given area. It is possible to plot a given search pattern over an area using navigational aids, but this does increase the pilot's work load at a time when particular vigilance is required. This requirement has led to the development of what is known as a Flight Path Control System (FPCS) which automatically flies the helicopter on a pre-selected search pattern over a given area. Such a system may be fully automatic and coupled directly into the AFCS or it may be operated through commands fed into a Flight Director display in the cockpit, thereby leaving the pilot in the control loop. In the fully automatic case, the system is able, once a survivor has been located, to automatically fly the helicopter into a hover at a pre-determined height over the survivor.

To identify a small vessel, or dingy, or maybe a single person in the water can be very difficult particularly at night or in bad weather conditions. Such identification may be assisted by the use of radar and/or infra red scanning devices and at night by the use of a special airborne searchlight. While weather radar now forms part of standard avionic equipment for IFR flight, the use of the Flight Path Control System and infra red scanning devices are both fairly recent innovations and as yet not widely used.

The success of any SAR operation depends to a large extent on the controlling body knowing exactly the location of the units involved in the operation. The use of an RAF fixed wing LR reconnaissance aircraft, with its highly sophisticated avionic equipment can provide this, but some areas of the North Sea are now covered by what is known as Flite Track, which is a positioning monitoring piece of equipment. Its use involves the fitting of a small piece of avionic equipment in the helicopter. Plans are under way to increase the coverage of this equipment.

6 LIMITATIONS OF HELICOPTERS IN SAR

Like all vehicles whether on land or air the helicopter has certain limitations.

The helicopter is a highly complex piece of machinery, gearboxes, complex control systems, transmission shafts and so on, with the result that its mechanical failure rate is relatively high. The accident failure rate of helicopters is about 5 times greater than that of comparable fixed wing aircraft when expressed on a per hour basis and this rate is about halved if taken on a per flight basis. In operations over water, the probability of having to make a forced landing and ditching is therefore much greater than with a fixed wing aircraft. Unfortunately, some helicopters have very poor ditching and floatation characteristics, therefore a ditched helicopter would itself require a quick SAR response. Its mechanical complexity results in the helicopter being relatively costly to operate.

While a greater part of the declared organisation relies on service aircraft, these aircraft are primarily for military use and therefore always come under the scrutiny of the Treasury looking for cuts in expenditure.

While the helicopter itself is a costly machine to operate, that cost is only part of the story, for the specialised equipment used and the nature of SAR operations means there has to be a high level of training required by the crews which operate them. In the North Sea, certain oil companies have seen the need for SAR and finance the equipment and the training costs for a small number of helicopters which in normal conditions are able to carry out rig and platform support duties.

A limitation of helicopter operations -over many years has been their lack of clearance to fly in forecast icing conditions. Much development work has been carried out over the last 20/30 years and a number of helicopter types are now permitted to fly in specified forecast icing conditions. If it is of any consolation, operating experience has shown that the occasions when a particular flight has had to be cancelled due to forecast icing has been small.

A limitation applicable to a number of helicopters is the maximum wind speed at which the rotors may be started. Such limitations, when applicable are usually referred to in the Flight Manual as "maximum wind speed at which the starting and stopping rotors has been demonstrated". Therefore, not being an absolute defined limit, it is sometimes possible to start the rotors in high winds by taking advantage of a sheltered spot such as in the vicinity of a hangar or other large building. The reason for this limitation is largely due to the fact that over the years the most common rotor system has been the articulated type in which the blades are hinged in the vertical and longditudinal planes. The hinge in the vertical plane, the flapping hinge, is able, once the stops are disengaged when the rotor starts, to sail up and down and a gust in a high wind could lead to a blade sailing up and down and possibly strike the tail cone. Other rotor systems are in use today which have a rigid or semi rigid rotor which to a large extent, eliminates this problem.

The general way in which persons are lifted from the sea or deck of a ship is time consuming, lifting them up either singly or two at a time. Devices have been developed in which a ring with a net or a basket is attached to the hoist cable or to a strop from the helicopter and a number of persons may be lifted at any one time. Two such devices are known as (a) the Billy Pugh net and (b) the EMPRA basket. Although approved in certain countries their use has not been universally adopted.

7 THE EXTENT OF THE POTENTIAL OF HELICOPTERS IN SAR

Helicopters have been used on very diverse forms of SAR operations and to illustrate the extent of their capabilities reference is made to a number of operations in which helicopters have played a significant part. The "Antrim Princess" went aground off the Irish coast in December 1983 and it became necessary to evacuate the passengers and certain members of the crew. Weather conditions were bad and the only way such a rescue could be made was to winch the passengers and crew members from the deck of the ship by helicopter and taking them safely to land. Some 8 helicopters of the Declared SAR organisation carried out the rescue and altogether took off 139 men, women and children. The flight time from the ship to shore was in the order of 8 minutes and the 8 helicopters ran what could well be described as a SAR shuttle service.

A rather different type of operation was carried out by the USAF Aerospace Rescue and Recovery Group (ARRG) between 3rd and 6th May 1981. On 3rd May; SS "Maralanga" steaming some 1200 NM from the Californian coast reported having a woman passenger

having severe abdominal pains and in need of urgent medical attention. The ARRG sent out a HC 130 fixed wing aircraft and parachuted two medical specialists to render aid to the sick passenger. After treatment, the specialists considered an operation was necessary if the patient's life was to be saved and immediately plans were made to recover the patient and carry out the operation on shore. A Sikorsky H53 helicopter was dispatched to recover the patient. A C130 tanker was also dispatched, for the ship was well beyond the normal operating range of the helicopter and would therefore need to be refuelled in the air. Altogether some 6 air re-fuellings were made on the outward journey to the ship which by now was some 675 NM from the coast. The patient was suitably strapped to a stretcher and winched aboard the helicopter together with the medical specialists and the helicopter returned to base at Moffett Field California having a further mid air refuelling on the return journey. Altogether 12 air refuellings were made on a total flight of 1300 NM which lasted 11½ hours.

On 2nd May 1984, a Boeing Vertol 234LR was forced to ditch in the North Sea some 8 miles North West of the Cormorant Alpha Platform due to control difficulties. After ditching the helicopter began to ship water and order was given to evacuate the helicopter. Fortunately a rescue Bell 212 was in the vicinity and commenced rescue operations. The weather was not bad, with visibility about 8 miles and a slight swell of about 2-3 feet. This enabled the somewhat slow procedure of winching up survivors either singly or in pairs to proceed unhindered.

On the 6th November 1986 a Boeing Vertol 234LR crashed into the sea 2.5 miles east of Sumburgh. Fortunately for the 2 survivors of the crash a Department of Transport S61N was on a training mission in the vicinity. It was able to immediately go to the scene of the crash and was able to winch the two survivors aboard and fly them direct to a hospital in Lerwick.

A rescue operation of a different nature occurred on the 8th November 1989. The jack up rig "Interocean II" broke adrift during repositioning from one location to another. With winds of up to 85 mph and high seas with 25 ft waves, a decision was made to evacuate the 51 workers aboard. Two Sikorsky S76's of Bristow Helicopters set off for the drifting rig guided by a RAF Nimrod reconnaissance aircraft circling overhead at 17,000 ft. RAF Sea Kings in the area were unable to take part as being larger helicopters they could not safely land on the Interocean II's helipad which was tilting some 10° at the time. The first landing by the S76 took off 10 workers and took them to a nearby platform. The second S76 took off a further 10 workers. Both helicopters then returned and took off a further 10 workers each. One S76 then returned to take off the remaining 11 workers. On making their approach to the rig, its electricity failed and all lights went out, so a rather perilous landing had to be made using the helicopter's landing light. Ten minutes after the rescue of the last 11 workers, the rig capsized.

8 CONCLUDING REMARKS

The helicopter is now an accepted part of the SAR service. While it has certain limitations, its potential is enormous. Of the future, new helicopters are under development which it is hoped will improve some or even eliminate some of the current limitations. But whatever future developments in helicopters materialise, the helicopter as we know it today has a big part to play in SAR. It is now complimentary and works alongside the lifeboat. Both have a service to perform in rescue and recovery at sea. There is though a common factor in both. Both are crewed by dedicated personnel, who when called upon, and without any thought for personal

safety, give all their devotion to saving life at sea.

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