1 INTRODUCTION

1.1 Background

The National Audit Office referred, in their February 1998 **Report on HM Coastguard: Civil Maritime Search and Rescue** (para 2.42), to the Ministry of Defence (MoD) strategic review of defence requirements, which was to include an examination of the provision of military search and rescue (SAR) services. It stated that the HMCG bases at Lee on Solent and Portland relied to some extent upon backup from military helicopters based at RNAS Culdrose and RAF Wattisham. The Report suggested that following that review "*…it would be appropriate to assess the implications for HM Coastguard's helicopter coverage, so that any rationalisation could be implemented when the contracts for the Solent and Portland helicopter bases come up for renewal …"*

The UK SAR Operators' Group, on behalf of the UK SAR Strategic Committee, tasked a Helicopter Provision Working Group to undertake a review of all UK SAR helicopter provision since it was considered impractical to review HMCG helicopters in isolation.

The membership of the Working Group is detailed at Appendix 1 to this report. The Terms of Reference of the Working Group were as follows. The aim was to review the UK's SAR helicopter provision, focusing primarily on the Department of the Environment, Transport and the Regions (DETR) and MoD facilities but taking into account facilities provided locally by UK emergency services (the Police and Ambulance Service) and to make recommendations to the UK SAR Strategic Committee. Its objectives were to complete a risk assessment of potential military and civil SAR populations in order to determine future SAR requirements; to consider current declared SAR helicopter coverage criteria and that of adjacent international SAR Regions and propose, as and if necessary, changes to the criteria; to consider current basing arrangements for declared MoD and Maritime and Coastguard Agency (MCA) SAR helicopters and propose operational improvements.

The Group were to assume that military SAR would remain a military function; that RAF SAR helicopters would continue to be crewed wholly by RAF crews with the employment of reservists where appropriate; civil maritime and aviation SAR policy would remain the responsibility of the DETR; inland SAR would continue to be supported by UK SAR helicopters; Police helicopters, subject to operational availability, would assist in search for missing persons but, as a general rule, would not become involved in actual rescue activities, subject to individual chief police officer's discretion.

The Group were keenly aware that the daytime and night-time criteria circles, depicting the 40 nms and 100 nms ranges from helicopter bases, had proven to be very confusing to those not intimately aware of helicopter operations. The depiction of these time circles had led some to believe that the arcs displayed the radius of action of those aircraft instead of the range from base they were able to achieve within an hour and two hours of being called.

Having operated Sikorsky S61(N) and GKN Westland Sea King Mk3, Mk3A and Mk5, respectively, for a number of years both MCA and MoD considered it appropriate to look forward towards replacement aircraft during the coming 5 years. Both sides were content that their aircraft were capable of providing a very high standard of SAR operation at the present time but as new aircraft, suitable to the SAR role, came on line it was considered timely to replace its fleet. The

Working Group recognised the importance of, firstly, completing a risk assessment in order to analyse the requirements upon which decisions on new equipment might be based. It was not, however, the role of this Working Group to recommend which new equipment might best meet that requirement.

Whilst a formal risk assessment had not been completed previously, it was accepted that it was not by some stroke of luck that basing arrangements appeared, in the main, to meet the requirements. The UK has had many years of experience in the operation of SAR helicopters and operational changes have been made over the years to meet the various demands placed upon the UK SAR force in the most effective manner. The risk assessment has been based upon historical SAR incident statistics for civilian overland and maritime risks and on military aircraft activity and military training areas for military risk.

1.2 Project Objectives & Scope of Work

The objectives of this work were to undertake a risk assessment of potential military and civil SAR populations in order to determine future SAR requirements, considering:

- Declared SAR Helicopter coverage criteria.
- Adjacent International SAR Regions and SAR resources
- Consider current basing arrangements.
- Propose any operational improvements.

1.3 Search & Rescue (Helicopter) Requirement

The UK Government is committed to a number of international agreements (Convention on the High Seas 1958, the Convention on Safety of Life at Sea (SOLAS) 1974, the Maritime SAR Convention 1979 and the Convention on International Civil Aviation (Chicago 1944)) which require a national framework of SAR resources to be available to the seafarer and aviator in times of difficulties. The SAR helicopter forms an essential part of that framework.

The helicopter requirement for maritime SAR includes the capability to reach all high risk areas within the UKSRR as quickly as possible. Once on scene, the aircraft is required to lift, by means of a hoist, any casualties in need of assistance.

The following section discusses the specific military requirement for SAR.

1.3.1 Military Requirement

The Military requirement for a SAR Helicopter stems from an obligation to provide rescue and medical assistance to all servicemen and women in need of aid whilst performing their duties under a ‘Duty of Care’. Military training, exercises and operations introduce additional risks over and above those normally expected in civilian life and as such additional facilities must be provided.

- Military activities, because of their nature, usually take place in remote or sparsely populated areas over land and at sea. Consequently, it is difficult for conventional civilian emergency services to access these areas easily and therefore it is unlikely that they would be the first major assets to arrive on scene. Helicopters, on the other hand, have the capability to reach remote overland and maritime incidents rapidly and the ability to place a winchman alongside the casualty in any situation. Whilst the primary task of a SAR helicopter is to transfer

casualties from a hostile environment to a higher-grade medical establishment, it also has the ability to advance the recovery of the patient because of the medical equipment and personnel carried on board.

- In urban areas, where there is a proliferation of emergency services, it would not be an efficient solution to supply in-depth SAR for military personnel; they would undoubtedly receive rapid and adequate treatment from the civilian emergency services. This does not restrict SAR helicopters from being tasked into an urban area, rather it implies that a boundary exists between those areas covered adequately by civilian emergency assets and those which require military SAR cover.

- Therefore, to ascertain where military SAR is required, it is first necessary to ascertain where the majority of military activity occurs. Initially this military activity was broken down into 3 environmental areas; air, sea and land. Then, to gain an appreciation of the total air activity, it was further broken down into 3 further activities: low flying, areas of intense flying activity i.e. flying training and high-level air-defence activity. The results of these evaluations are shown in Section **Error! Reference source not found.**.

- Multiple Ejectees. The highest identified risk is to military aircrew in low-level flight. Although military flying is highly regulated, fast-jet crews face the highest risk as they work either alone or more commonly as a 2-man crew. This particular facet is crucially important to military SAR requirements. If the aircrew have to leave their jet, their escape is by means of an ejection seat. Considering the speed that fast-jet aircraft travel, in the region of 7 miles per minute, the 2 crew may be separated by some considerable distance once they have parachuted to the surface. For this reason it is imperative that two helicopters are tasked to attend multiple ejection incidents. As an ejection is, in itself, a traumatic experience, there is a laid down protocol for the treatment of ejectees that must be strictly adhered to. Timely medical treatment is essential and hence military SAR crews are specifically trained to deal with ejection injuries.

1.4 Advantages of Using Helicopters for SAR

Helicopters are tasked by rescue co-ordinators to operate either alone or in co-operation with other rescue agencies to assist towards the successful culmination of a Search and Rescue Operation (SAROp). Helicopters are generally called because they are fast, efficient, amphibious and ubiquitous. Consequently, they can usually assist the casualty quicker than other rescue assets. Indeed, their ability to search large areas quickly by using the third dimension of height is often crucial to the success of the SAROp. A helicopter's ability to rescue casualties is usually only restricted by very bad weather conditions or the length of the hoist cable.

Speed. Speed of response is vital for any SAROp. Helicopter response times are generally faster than most other assets and transit times are shorter due to the straight-line approach and greater speed than surface-based rescue assets. Once on scene, the speed can be varied from a maximum of 110 knots for Sea King/S-61 to the hover, allowing the crew to optimise the speed relative to the task; search parameters are dependent on light levels, sea-state, terrain and visibility. Unlike a fixed-wing aircraft, the helicopter can stop to make detailed investigations of any area of interest.

Height and Efficiency. The quicker a comprehensive search can be done the better, as the circle of uncertainty expands rapidly with time. From the viewpoint of a rescuer at ground level, undulations in the ground or anything more than a moderate sea state will render much of the surface out of sight. Additionally, in rough seas, if a target is sighted, it can be very difficult to maintain visual contact with it. A helicopter, however, adds the extra dimension of height. The crew can choose the optimum search height for greatest visibility, dependent upon terrain, sea-state and weather conditions. At any one time during the search, there is no area within the bounds of the track spacing that is out of sight of at least one member of the crew. Therefore, the helicopter can quickly complete its search with a high percentage coverage factor.

Detection Range. In addition to advantages of height for visual searches, increased height also improves radio signal detection distances. The theoretical maximum line-of-sight distance between a transmitter and a receiver able to communicate with each other, measured in nautical miles is:

$$\textit{Max. LoS Dist} = \sqrt{H_1}+\sqrt{H_2}$$

where H_1 is the height of the transmitter in feet and H_2 the height of the receiver in feet. It therefore follows that the higher the receiver, the further the transmissions will be detected. Helicopters, being able to adjust height rapidly can quickly extend communication distances considerably, thus adding another dimension to the rescue efforts. This is particularly important when trying to establish the position of lost persons or rescue beacons.

Amphibious. Helicopters are not confined to either land or sea operations, being very capable over all types of surface. Hence, in the terms of SAR area coverage, helicopters can attend incidents almost anywhere, including high mountainous regions, lowland and inland waterways, the seashore and deeper waters.

In summary, rapid response, short transit times and the ability to use height to search and detect make helicopters a key SAR asset. Their unique ability to operate over land or water coupled with the ability to hover precisely over a casualty for rescue can also be a crucial factor in the preservation of life. With only the worst of weather conditions restricting operations, helicopters are therefore essential for large area SAR cover.

1.5 UK SAR Region

The following figure presents the United Kingdom Search & Rescue Region (UKSRR) which extends out to 30 degrees West.

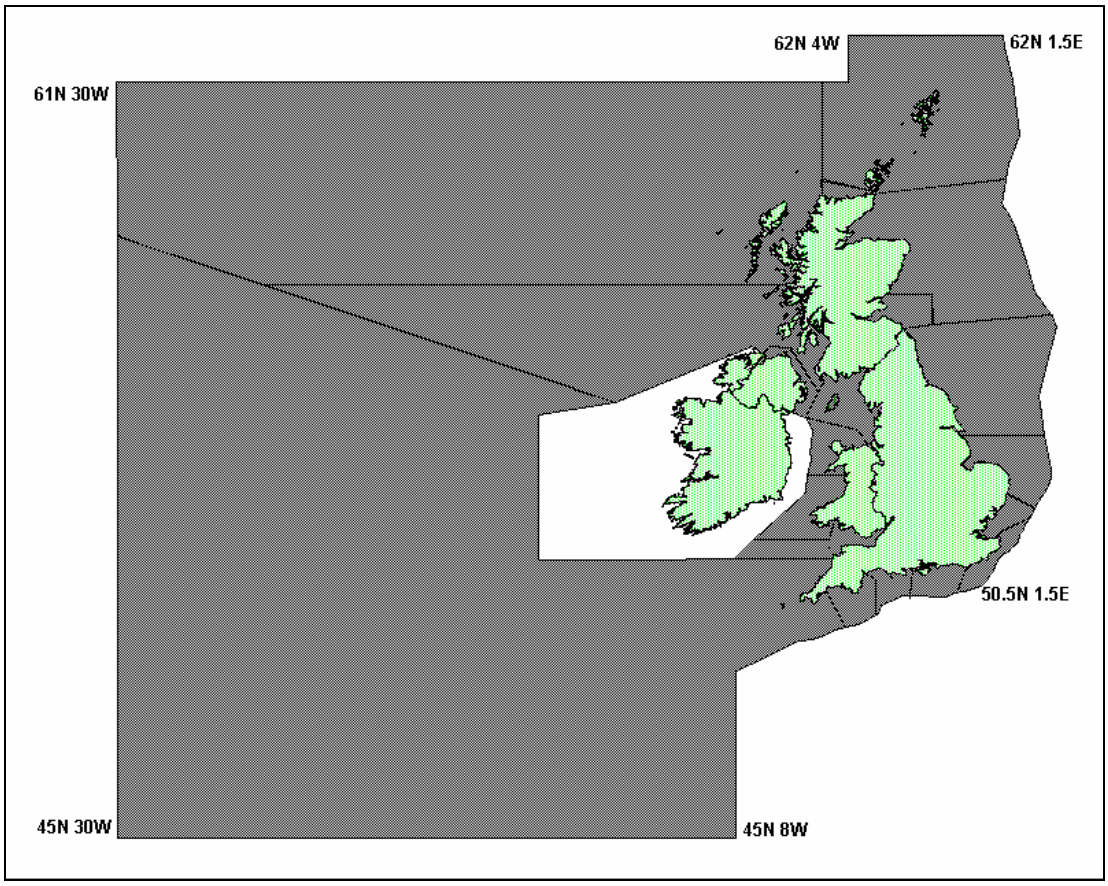

Figure 1 UK Search & Rescue Region

In order to carry out a quantitative analysis within a Geographical Information System, the UKSRR region has been subdivided using a grid system, with each grid square measuring approximately 17.5nm (East/West) by 30nm (North/South). The following figure presents the grid system utilised in the analysis.

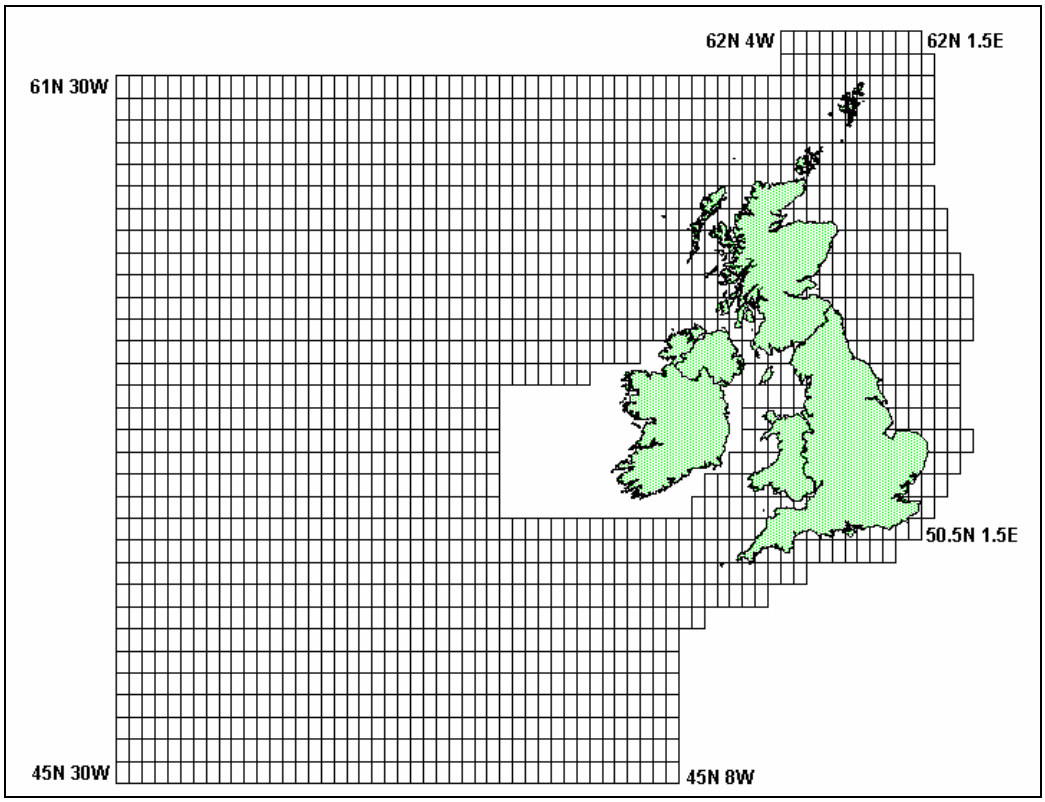

Figure 2 UK Search & Rescue Region (Grid Utilised in Assessment)

1.6 General Assumptions & Limitations

This section presents the assumptions and limitations associated with the work.

- In the analysis work carried out, response times and distances are considered as being linearly related (i.e. still air Model has been utilised). No consideration has been given to the difficulties that can be encountered in different environmental conditions, which in the case of helicopters is wind.

- Distances to the coverage areas are calculated from the centroid of each grid square.

- Data on Civil Aviation Aircraft movements have not been included in the assessment. This is related to the complexity in predicting where incidents involving light aircraft (which are the most likely to involve SAR resources) would take place.

- In terms of maximum range depicted (**Error! Reference source not found.** & **Error! Reference source not found.**), helicopters are assumed to return to base, this is conservative as they can refuel at offshore platforms or other locations (e.g. West of Ireland).

- It should be noted that all areas (cells) depicted as white on the SAR grid in the analysis of incidents mean that no incidents have occurred in these cells over the time period analysed.

- It is not possible to distinguish between incidents where another form of SAR may be faster or adequate. e.g. RNLI responding to incidents very close to the coastline.

- In the assessment, it is not possible to quantify effect of new technology on SAR, all of which tend to make it easier to locate a casualty e.g.:

    - GMDSS on ships,
    - Walkers using GPS
    - Mobile telephones
    - Personal locator beacons in the offshore environment

1.7 Abbreviations

The abbreviations used throughout the report are presented below:

ALSAR	Association of Lowland Search and Rescue
ARCC	Aeronautical Rescue Co-ordination Centre
BCRC	British Cave Rescue Council
DASA	Defence Analytical Services Agency
DETR	Department of the Environment, Transport and the Regions
FRC	Fast Rescue Craft
GIS	Geographical Information System
GMDSS	Global Maritime Distress System
GPS	Global Positioning System
HEMS	Helicopter Emergency Medical Services
HMCG	HM Coastguard
LFAs	Low Flying Areas
MCA	Maritime and Coastguard Agency

MoD	Ministry of Defence
MR	Mountain Rescue
MRC	Mountain Rescue Council for England & Wales
MRCC	Maritime Rescue Co-ordination Centre
MRC of S	Mountain Rescue Committee of Scotland
MRSC	Maritime Rescue Co-ordination Sub Centre
MRT	Mountain Rescue Teams
NVGs	Night Vision Goggles
nm	Nautical Mile
RAF	Royal Air Force
RCC	Rescue Co-ordination Centre
RN	Royal Navy
RNAS	Royal Naval Air Station
RNLI	Royal National Lifeboat Institution
SAR	Search & Rescue
SAROp	Search and Rescue Operation
SBVs	Standby Vessels
SOLAS	Safety of Life At Sea
UHF	Ultra High Frequency
UKCS	UK Continental Shelf
UKSRR	United Kingdom Search & Rescue Region
VHF	Very High Frequency
VTS	Vessel Traffic Services