FATHOMS' GUIDANCE NOTE 4

SEABED SEARCHES

1 INTRODUCTION

Searches of the seabed may be required for a number of reasons. These vary from locating a specific object that has been lost on the seabed to a general search of an area for development e.g. a proposed windfarm to the disproving of a seabed feature i.e. disproving the existence of a marked 'ED' on a chart.

2 WHAT IS BEING SOUGHT?

The first issue is what is being looked for? This will be very important in determining how the search is conducted.

If a specific object on the seabed is been sought, full details of that will be needed. As much detail about its position, the nature of the surrounding seabed and time of loss (if relevant) will also be required.

If a general search of an area is required e.g. prior to a development such as a windfarm, the minimum size of objects that are of interest will be needed. This will govern how the search is conducted and with what.

If a disproving search is required, the nature of the object needs to be specified. It is standard practice when conducting nautical charting surveys to UKHO standards that a full search is undertaken within a two nautical mile radius of the object. This takes a long time. Thus, it is worth determining if variations can be accepted from this standard to reduce the time taken and costs.

3 METHOD

<u>Specific Object Location</u>

The assumption is that the object is lying on the seabed not under it. That is why knowledge of the morphology of the seabed is rather useful (see also below about rocky areas). The usual method used is side scan sonar (SSS). This sonar looks sideways in both directions from the transducer. The transducer (known as a fish) is towed astern of the vessel at a height ideally about 10% of the total depth of water off the seabed. The great advantage of this approach is that with the fish close to the seabed, the sonar beams are relatively close to horizontal. This results in a large shadow effect behind any object sticking up from the seabed. The closer the fish is to the seabed, the larger the shadow and the more likely that the object will be detected.
With experience, it is also possible to determine differences in the morphology of the seabed. However, looking for a smallish object on a rocky seabed with side scan is usually not possible as the object will be masked by the returns from the rocks unless it is well proud of the seabed.

If the object is lying under the seabed, it really will not be easy to find. SSS will be of no use at all – it cannot penetrate below the seabed.

The two other options are the use of a magnetometer – if the object has ferrous metal content – or a sub-bottom profiler. This latter system involves the use of very low frequency acoustics to penetrate the seabed; it is a particular aspect of shallow seismic reflection surveys. In either case, the area of seabed covered by each system will be measured in a few metres. This means that it will be extremely time consuming and costly to locate any object that is buried beneath the seabed.

<u>General Search</u>

The same principles apply as above but for cost effective searches, it helps if our clients are clear exactly what they are wishing to find – or not as the case may be! Size is crucial. If the object that could be of interest is

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small, it will require a more detailed search pattern using a higher frequency in order to prove or disprove the existence of any object than would be the case for a larger object.

If there is a requirement to obtain bathymetric data at the same time, it may be possible to use a Phase Differencing Bathymetric Sonar (PDBS) – sometimes known as interferometric systems – to achieve both objects with one system. The PDBS systems operate on the same principle as SSS. This only works, though, where the depth of water is sufficiently shallow (probably <15m) so that the beams are at a relatively acute angle to the seabed – at least when away from the transducer's position - to gain from the benefit of shadow generation of an object.

Disproving Search
The method used will almost certainly be similar to that required for specific object location.

4 SPECIFICS

There are differing frequencies used in modern SSS's. These range from typically a low frequency of 100kHz to high frequency of 325/500kHz to extra high frequency of 750-850kHz. The ranges obtained vary according to the frequency. One can expect ranges of 500m each side i.e. a total swath width of 1000m, from LF, 150m from HF and 50m with EHF. However, these expectations have to be married to the depth of water. For instance, if the depth of water is 15m, it is unreasonable to expect a SSS to survey an area that is 150m away.

There are also more recent developments with CHIRP technology, focussed beams and Synthetic Aperture Sonar systems. They all seek to extend the range without detracting from the resolution achieved as well as increase the survey speed (which is normally around 4 knots for conventional systems).

Best practice also requires there to be a 200% overlap between adjacent SSS lines. The reason for this is to ensure that no gaps are left. The weakest area in any SSS search is right under the towfish where the minimum number of 'pings' will hit any object. The further away from the towfish an object is, the larger the number of pings it will receive due to the fanning out of the signal away from the transducer. Thus a good search has to ensure that the area immediately under the towfish is covered by the extremity of the next line's sweep. Thus if one is using a range setting of 150m, line spacing should also be 150m or even 140m to allow for slight deviations from the planned lines.

5 QUALITY

One of the key issues for quality assurance is the confidence that the whole area has been ensonified properly. As previously described, it is important that the whole seabed is ensonified at least twice to ensure that a reliable search has been completed. A combination of the plot showing the vessel's track and knowledge of the range scale of the SSS used would provide this.