

SURVEY TASKS ARISING FROM THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

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1. INTRODUCTION

1.1. The South Pacific region is unique in consisting of a very large ocean dotted with many small, relatively under-developed nations which are, in most cases, made up of small islands spread over large areas of open sea.

1.2. In the nineteenth and the first half of the twentieth centuries the surveying and charting of the South Pacific was undertaken, with little co-ordination, by the European nations with territorial interests in the region, and charts based on these surveys are available in the principal world chart series. However, they are, for the most part, based on extremely sparse data and are rarely adequate for modern deep-draught vessels.

1.3. In the last 15 years, despite (or perhaps because of) the withdrawal of the last Royal Navy surveying ship from the Pacific, there has been an increasing awareness of the need for reliable charting in the waters of the newly-independent nations in the region. With assistance from the United Nations Development Programme, and with personnel and material aid from the United Kingdom, Australia and New Zealand, Fiji has established its own hydrographic service. With Australian assistance, under the Defence Co-operation Programme, a hydrographic unit has been set up in the Solomon Islands. The nucleus of a unit exists in Papua New Guinea and both New Zealand and Australia are occasionally able to send

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surveying ships on deployment into the South Pacific to carry out particular projects.

1.4. All these efforts are, however, only scratching at the surface. The development of the UN Convention on the Law of the Sea has focused attention on the marine environment and has highlighted the paucity of information which many nations have about the waters around their shores. In this paper it is intended to examine the need for the fundamental planning documentation upon which will depend the majority of development activity off-shore.

2. REQUIREMENTS OF THE CONVENTION

2.1. In the not-so-distant past each nation could generally only claim sovereignty over a ribbon of sea, usually three miles wide, around its shores; beyond that were the high seas, and jurisdiction by the coastal State was limited to certain things only — for instance, fishing. During the last 30 years or so, a number of international conventions on maritime jurisdiction have been developed, which have significantly changed the old, time-honoured rules and have culminated in the 1982 Convention on the Law of the Sea. Its effect has been to give jurisdiction for various purposes to coastal States over vastly greater tracts of sea and ocean than has ever been the case before. It not only gives to coastal States certain rights, particularly in relation to resource exploitation, which are clearly beneficial to them, but also lays certain responsibilities upon them. Whilst the former may be particularly attractive to governments as they may lead to income, the latter cannot be ignored, even though significant expenditure may be necessary to fulfil them.

2.2. When a nation accepts the provisions of the Convention, it becomes party to a large number of activities based on these provisions which, if appropriate to its own circumstances, should be put into effect. These are conveniently listed in a document tabled at the Third Conference on the Law of the Sea at Geneva in August 1981 (A/CONF 62/6.76) and are grouped under seven main headings :

- (i) legislation and regulation;
- (ii) regulation by activity;
- * (iii) publication or notification;
- (iv) surveillance and enforcement;
- * (v) administrative and organizational requirements;
- * (vi) co-operation with other States or international organizations;
- *(vii) scientific and technical aspects.

2.3. Amongst these groupings, the hydrographic surveyor will be directly or indirectly concerned with certain aspects of those which have been asterisked; and it may be said that no government wishing to implement the Convention can do

so without the assistance of the hydrographic profession. In particular, the surveyor will be closely involved with :

- (i) the preparation and publication of charts or lists showing the baselines from which maritime boundaries are measured and the limits derived therefrom (these have to be supplied to the Secretary-General of the United Nations);
- (ii) discussion with neighbouring countries on the technical aspects of delimitation between them;
- (iii) determination of features at the continental margin for the purposes of establishing the limits of the continental shelf;
- (iv) the preparation and publication of charts for safety of navigation and to reduce the risk of pollution;
- (v) the establishment and servicing of an organization for promulgating navigational warnings to mariners;
- (vi) the collection and dissemination of bathymetric and other data relating to the potential for off-shore resource exploration and exploitation.

3. THE PROBLEM

3.1. For a country with no, or very limited, hydrographic resources there is, therefore, a major problem. The fundamental need is for the basic documentation upon which all future planning and maritime activity will rely. The charts prepared in the nineteenth century were all very well in their way, but are largely irrelevant (and certainly unsafe) in the modern context. To the land administrator the basic document is the map. No organized planning of land usage can take place without one. No civil engineer would plan the line of a road or the layout of a new town without a reliable map. Similarly, no mariner can safely plan his ship's track and no engineer can plan the line of an off-shore pipeline or jetty without a chart showing the shape of the seabed. The principal difference is that for land mapping the surveyor can actually see the shape of the terrain and aerial photographs can pick up almost every detail; whereas the hydrographic surveyor cannot see — in anything like the same detail — the terrain that he is trying to depict and, with some exceptions, aerial photography and other remote sensing have only limited applications.

4. ESTABLISHMENT OF MARITIME BOUNDARIES

4.1. Clearly no limits at sea can be defined without reference to precisely surveyed points ashore. Equally clearly, because it is wholly impractical to set up boundary pegs off-shore for all to see and respect, it is necessary that the off-shore limits should be defined in terms which are readily accepted and understood by all nations. As much navigation at sea is likely to be done in future using satellite control, which is itself based on the world geodetic system (WGS), it is suggested

that maritime limits should henceforth always be expressed in the same terms and that nautical charts should also in future be based on this system — although it will take many years to convert all those currently published on other geodetic datums (not least those of Australia)

4.2. From the above it follows that, before the sea limits can be defined in terms of WGS, the points ashore which form the baselines for this definition must be precisely fixed; and it is at this point that the land surveyor, as well as the sea surveyor, has a very important role to play.

4.3. Without going deeply into the regulations contained in the Convention which state how the limits of a country's territory are defined, it can be said that maritime limits are generally measured from the low-water lines of the mainland and islands, or from certain drying rocks, reefs or banks, except in particular areas where the regulations allow the use of straight baselines. For a country with a large land mass it is a relatively simple process to decide where the low-water line is important and where the straight baseline rules apply. However, for countries which consist of a large number of widely-spaced islands (as so many in the Pacific), the problem is compounded due to the need to take account of their archipelagic status, if this is appropriate.

4.4. Whatever rules apply, however, there is the need to survey, to as precise a degree as possible, a network of stations all along the relevant coastlines. The 'base points' are not, in themselves, the points from which the maritime limits are defined; but it is from them that the appropriate points on the low-water line can be co-ordinated, and it is using the latter that the actual limits are measured. A 'base point' may be placed conveniently near the coast on a headland; but it is the low-water line at the tip of the headland that is the legal limit for that stretch of coastline. It must not be forgotten that nature has a habit of altering the shape of the coastline: she may submerge sandbanks which were previously critical to the delineation of maritime limits, or she may cause reefs or banks to rise substantially above the level of low water, which can also create the need for adjustments in the limits. A country's surveying community must be alert to the potential for such changes.

4.5. Once the base points have been co-ordinated (preferably on WGS, but obviously tied to the country's geodetic system if this differs from WGS); once the low-water line has been accurately defined, where this is relevant; and once the rules applying to the use of straight baselines and archipelagic limits have been agreed by lawyers and experts in this field (which, for a small country, may involve the need for overseas consultancy) it is then necessary for the baselines to be depicted. Article 5 of the Convention requires that "... the normal baseline ... is the low-water line along the coast marked on the large-scale charts officially recognized by the coastal State".

4.6. Article 16 goes on to say that the baselines (including the various styles of straight baselines) are to be shown on charts of adequate scale or in lists of geographical co-ordinates specifying the geodetic datum. Most countries are depicting their baselines on nautical charts issued by their national hydrographic authorities (where these exist); but some are issuing a special series of maps to show their national baselines which are not suitable for use as charts by mariners. These are primarily for use as reference documents and can, of course, be used as the maps which must be lodged with the Secretary-General of the United Nations.

4.7. In the event that a nation's intended maritime limits are likely to conflict with those of a neighbour, it is clearly important that such differences should be resolved in an amicable fashion. Four things will assist in this. The first is the general acceptance by nations of a common WGS; the second is reliable geodetic control along all coastlines, but especially along those from which potentially conflicting limits may be measured; the third is the existence of reliable hydrographic surveys of areas where these will have significance in the discussions (for instance, during delimitation of continental shelves); and the fourth is the spirit of friendship and professional confidence between surveyors of neighbouring countries that should be developed both bilaterally and at meetings of such organizations as CASLE. If one has personal friendship with, and confidence in the professional competence of, one's colleagues in neighbouring countries, the likelihood of a balanced judgement is increased when briefing those responsible in government on the professional aspects of delimitation issues.

4.8. It is not intended to discuss the definitions of the different maritime limits, most of which depend primarily on distance from accepted baselines. The definition of the edge of the continental shelf does depend, however, on other parameters such as depth, slope angle and, in certain cases, on the proportionate thicknesses of different seabed sediment layers. In an area such as the South Pacific, where islands and the shallows around them rise very steeply from oceanic depths, this may not be too crucial but, for the delineation of the continental shelf of many nations, the hydrographic surveyor has a leading part to play, and in some cases the expertise of the geophysicist may also be necessary.

5. MARITIME SAFETY AND OFF-SHORE EXPLOITATION

5.1. Having defined the sea areas which will come within the jurisdiction of a nation, there then comes the natural question of how this area should be gainfully exploited and, just as important, how to protect the environment within this area from being despoiled, during exploitation or by pollution resulting from damage to ships passing through it. For both exploitation and the prevention of pollution the basic planning document — the chart — is absolutely essential.

5.2. In a region such as the South Pacific, individual islands generally have very small shelves of shallow water around them before the seabed drops steeply to oceanic depths. The wide and more easily exploitable continental shelves adjacent to larger land masses do not exist; and whilst the mineral exploitation of the deep oceans may become practical in years to come, with improved (and hopefully less expensive) technology, it is in the shallower water around the region's island nations that the first off-shore exploitation is more likely to occur. It is also in these shallower waters that the likelihood of a maritime accident is highest.

5.3. In addition to the shelves around the existing islands, there are also off-lying detached banks which are not high enough from the ocean bed to have reached the surface to form islands. They may, however, be areas which have mineral resources on or below the seabed and they may also support fish stocks. Because they do not break the sea surface there is every possibility that many have still to be located, and the search for them in what may, at first, appear to be deep water is essential both for resource exploration and to identify possible dangers to shipping.

5.4. It follows, therefore, that these coastal shelves and off-lying banks should be accurately surveyed without delay to provide the basic document for future off-shore exploration and exploitation and to reduce the risks to shipping. Deeper waters need to be searched for undiscovered shallows. The South Pacific is one of the few remaining areas (Antarctica is another) where the operators of cruise liners can offer the tourist an experience which is wholly unlike any other; however, if the charts of an island or a country are not considered safe (and very many in the South Pacific are not), then the operator will send his ships elsewhere. It is not so very long ago (1971) that the French liner *Antilles* struck a rock and burnt out when cruising close inshore in the West Indies. Reliable charts will encourage such ships to come to countries in the South Pacific; and, although a number of liners do cruise through the region, they follow well-known tracks and rarely divert from them to islands and countries where they cannot be sure it is safe — although the attractions may be just as great and potentially greater.

6. HYDROGRAPHIC SURVEYING

6.1. A small island nation with limited resources is, then, faced with a considerable problem once its maritime limits have been established. If it is to consider exploitation of seabed resources or is to ensure that its seas are safe for navigation, there is a massive surveying task to be undertaken. Ignoring, for a moment, the question of how or by whom this task will be carried out, it is perhaps possible to suggest an order of priority in which to proceed. In the first instance, it is likely that one or more principal ports or harbours exist and are in regular use by overseas shipping. The charts of these may be based on elderly surveys; and it would clearly be prudent to ensure that modern surveys are carried out and also

that the approaches from deep water are fully examined to ensure that no dangers exist which could be hazardous to the largest vessels which can use each harbour.

6.2. The next task, it is suggested, should be the careful delineation of the edge of the continental shelf around each island and, just as important, the location of all detached banks or shoals which rise from oceanic depths. This task can be accomplished by relatively small-scale surveys with widely-spaced lines of soundings. If off-lying banks are located, these can either be examined in more detail at the time, to determine whether there is the likelihood of shoal depths on them which may prove dangerous to surface shipping; or they can be noted for detailed examination later on. At least the positions and extent of such banks will be known and can be charted; mariners will then be able to avoid them; whilst resource investigators will be able to consider their potential.

6.3. Thirdly, the country's marine authorities should attempt to define the main traffic patterns and determine which areas of coastal waters are regularly used by shipping, both local and international, and which passages between islands carry the majority of visiting or passing ships. Account should be taken also of the routes which cruising ships prefer to take within island groups for their particular requirements. All these should be surveyed, in a priority order established by the appropriate authorities and modified as time and changing shipping requirements go by.

6.4. Fourthly, those concerned with off-shore resource exploration will need to investigate areas which appear promising. Often, the techniques used for resource surveys are different from those required by the chart makers and parameters such as gravity, magnetic and seismic observations may be measured. Depth is not always measured, for such purposes, to the precision required by the chart maker and it is perhaps worth making a plea to all those doing research at sea: when obtaining depths for your own purposes, please save the hydrographer some time and effort by recording and reducing your bathymetry in a form and to a precision which will make it possible for it to be used on navigational charts. Hydrographers will always be happy to discuss how this may be done simply; but too often they hear of depths obtained during geophysical cruises, for instance, which cannot be sufficiently refined for charting due to lack of some important but simply-recorded facts.

6.5. Having, therefore, surveyed within and in the approaches to the major ports; having delineated the edge of the continental shelf and off-lying banks (and thereby surveyed the oceanic depths between them); having examined the main shipping routes and surveyed possible off-shore resource areas; there will remain numerous bays, minor harbours, passages and coastal waters which are generally used only by local shipping and craft. These areas too should, in due course, be surveyed; although it is probably true to say that many of those navigating in or through such waters are so familiar with them that no chart is necessary. There will

be many areas, however, that are visited by small vessels or ocean-going yachts which will require reliable navigational charts and have a lively interest in not suffering damage.

7. MEANS TO THE END

7.1. The programme suggested above will naturally appear daunting to countries with large sea areas and few, if any, available resources. How on earth, they may ask, can they possibly be expected to undertake all or any of this work when there are so many other projects ashore which are arguably just as important? How a country allocates its resources is clearly not within the scope of this paper to answer. Nevertheless, it is suggested that, if a nation is to attempt to exploit its off-shore resources and to prevent the pollution and notoriety that may result from a substantial marine disaster, some effort must be made towards achieving a measure of self-sufficiency in hydrographic surveying, whilst at the same time taking advantage of various aid programmes which are available in the region.

7.2. In the first instance, any experienced master mariner or port engineer can carry out simple harbour surveys with the minimum of extra training and a very modest outlay on equipment. A very useful volume entitled "Guidance Notes on Hydrographic Surveying in Small Ports" was published by the British Ports Association in March 1981 and provides sufficient information for an interested person to do perfectly satisfactory and unsophisticated surveys within a port area and its immediate approaches.

7.3. From such small beginnings, it may be practical to establish a slightly more professional organization dedicated to harbour and coastal surveys. This may be based on the existing Marine Department, but does require the co-operation and support of its senior management, as some resources will be necessary, such as the full-time use of a suitable vessel and its crew. Whether the professional surveyors and surveying technicians will be drawn from the Marine Department or from the Land Survey Department is immaterial — some cross-training will be necessary in either direction to convert the mariner to surveying or the surveyor to the sea. It is also likely that some of this specialist training will take place in a neighbouring country where a hydrographic organization already exists. Furthermore, it is also possible that such training may be financed under a regional aid programme such as Australia's Defence Co-operative Programme (this is, incidentally, something of a misnomer in this context, as the word 'Defence' refers only to the fact that training is done using Royal Australian Naval facilities and personnel; there are no other military connotations). New Zealand also assists with such training within the South Pacific region; whilst the Honiara Technical Institute runs both surveying technician courses and courses in several maritime subjects leading to certain marine certificates. In the future, it is possible that the Institute will also be able to establish hydrographic technician training courses which could be very

useful to countries in the region, with on-job training perhaps based on the Solomon Islands' hydrographic unit.

7.4. By whatever means such staff for a hydrographic unit are recruited and trained, there will be a need for a certain basic minimum of specialist equipment so that they can carry out their tasks to a sufficiently high standard that the charts derived from them are readily accepted as reliable. It is no good training a man to use an echo-sounder if he is then given only a leadline. Some initial expenditure will, therefore, be necessary and some funds must be allocated annually for maintenance, calibration and the running expenses of the unit, including salaries and fuel. Experience has shown that the various agencies concerned with UN and regional aid programmes are reasonably amenable to defraying capital costs for such equipment within overall aid budgets, but that they do expect each nation to fund the recurring operational expenses — which is a not unreasonable concept.

7.5. Similarly, assistance has been given, and is still being given, by hydrographic authorities both within and outside the region in providing trained surveyors to act as advisors until a local unit becomes fully established. Clearly, such personnel resources are not unlimited; and it is important that countries setting up their own hydrographic units should attach sufficient priority and resources to the project to permit the unit to become self-sufficient in as short a time as possible, thereby allowing the advisors to transfer their attentions to another country with similar aspirations.

8. SURVEYS OF OCEANIC WATERS

8.1. For most small countries, the establishment of a small hydrographic unit to survey ports and coastal waters is probably all that can realistically be expected. If a country also has a coast guard, naval forces or a marine research institute, however, the means may exist to carry out hydrographic surveys farther off-shore or in oceanic depths on a part-time basis; either by using personnel from the hydrographic unit or by training the ship's staff concerned in the fairly basic techniques necessary to obtain useful bathymetry and other data. It is similarly perfectly feasible to encourage the owners and masters of ships that visit a country regularly to follow slightly different tracks on each occasion (which can be planned by the hydrographic unit), thereby building up a body of data along the main trade routes. To carry out a full survey of off-shore waters and in the oceans around most countries in the South Pacific will, however, be a massive task which will be well beyond the capabilities of most individual nations in the region using their own resources. Two possibilities exist for overcoming this difficulty.

8.2. The first is to enlist the assistance of other countries in the region which have established hydrographic facilities and which are prepared to employ their own

ships, or ships chartered especially for the purpose, on surveys in the waters around their neighbours. This is not a cheap exercise and is probably best funded as part of a more general aid programme. This approach has been successfully applied in the Solomon Islands, and more recently in Vanuatu, using Australian assets; and New Zealand has done similar work elsewhere in the South Pacific. It is expected that Australia will continue to offer aid in this form; but she cannot, of course, do such work without an invitation from interested countries.

8.3. An alternative approach which may be worth consideration is to explore the possibility of establishing a jointly-funded off-shore surveying unit for use in the waters of participating nations on a shared basis. For this to succeed, several countries would need to agree to contribute to the capital cost of a suitable vessel — perhaps an existing ship with necessary modifications. Manning of this vessel, both with crew and surveyors, would need to be carefully considered; and it might prove sensible for only one or two nations in the region to contribute to this, although their pay and allowances, together with the operating costs of the ship, would naturally also be shared by participating countries. Once the ship was operational and the level of contribution agreed between participants, it is suggested that she would then operate in each country's waters roughly in proportion to those contributions. Thus, if three countries participate and one contributes half the cost whilst the others contribute a quarter each, it is not unreasonable to suggest that the surveying activity should be similarly allocated. Such a concept would require some organization to run it, and it is suggested that this might be a very practical function of the projected South West Pacific Regional Hydrographic Commission of the International Hydrographic Organization (IHO). However, this really falls outside the scope of this paper.

9. NAUTICAL CHARTING

9.1. So far, this paper has concentrated mainly on hydrographic surveying; but data resulting from this work must clearly be published in one form or another if it is to be of use to those who need it. There are a number of authorities which publish charts on a world-wide basis, whether on their own account or in collaboration with other hydrographic offices. Probably the most familiar chart series in the South Pacific is the British Admiralty (BA) series, which is complemented on the western edge of the ocean by the New Zealand (NZ) and Australian (AUS) series. Other major charting authorities (for example, France, Japan, the USA and USSR) also publish charts of the countries of the region; but they tend to be derived from the BA series, which itself depends in many areas on outdated surveys or on little data at all.

9.2. Countries such as Fiji and the Solomon Islands, which have set up hydrographic units, have also begun to publish charts of their waters. For countries with indigenous land mapping organizations the step to nautical charting is not a

very large one, but it is suggested that, in the first instance, this should not be thought of as a priority issue. Whilst the need to translate hydrographic surveys into large-scale working graphics for immediate use in harbour engineering, such as dredging or wharf construction, is clearly one which should be satisfied locally and without delay, it may be simpler initially to pass surveys carried out for navigation and ship-safety reasons to an established hydrographic authority for incorporation in the existing charts and for dissemination to world-wide shipping through established distribution networks. For countries, especially the smaller ones with no significant map publishing capability, it is believed that this will be the only practical course for the foreseeable future. It may, however, also be worth considering asking countries within the region, which have established their own charting organizations, whether they would have the capacity to assist in preparing the working graphics, referred to earlier, which may be needed in a short time-scale for national development purposes.

9.3. In the longer term there is a proposal being developed under the auspices of the IHO for a truly international chart scheme at medium and large scales to complement the small-scale international scheme which already exists. In the South West Pacific there has already been some discussion amongst regional members of the IHO on this concept and it is hoped that in 1985 it will be further developed — with Australia probably taking the initial consultative steps with the hydrographic and marine authorities of nations within the region.

10. NAVIGATIONAL WARNINGS

10.1 There is one other subject which requires emphasis, now that the Convention has increased the area over which each maritime nation has jurisdiction. This concerns the publication of navigational warnings. Irrespective of whether a country has a hydrographic capability, it is absolutely essential that it has a formal and well-recognized organization for recording and disseminating information concerning navigational aids, newly-discovered dangers and other information of which the mariner needs to know without delay. This is the first line of defence in ensuring ship safety and preventing marine pollution. In the absence of a hydrographic unit it is likely that the Marine Department will have this role; but it is most important that this is known to everyone in the country who has an interest in maritime safety and that the Marine Department has clear lines of communication not only to local and visiting shipping, perhaps through local notices to mariners and coast radio stations, but also to the overseas authorities most closely concerned with charting in the region. For most of those countries represented at the CASLE seminar this will be the United Kingdom Hydrographer.

11. CONCLUSIONS

11.1. No nation can develop unless it has certain fundamental planning tools. On land, one of these is the map. At sea, one of them is the chart, and every maritime nation needs reliable nautical charting of all its claimed waters if the full potential of its off-shore national assets is to be realised. The UN Convention on the Law of the Sea also requires maritime nations to ensure the safety of shipping in their waters and, for this, reliable charting is an absolute necessity.

11.2. With the acquisition of vastly increased areas of territory needing to be 'mapped' as a result of the 1982 Convention has also come the need markedly to change the thinking of governments and those who have customarily been charged with responsibility for mapping a country's territory; they must be led to realise that the sea also has to be charted. It has to be surveyed by very different techniques from those used ashore; the techniques use platforms and equipment which are not cheap; the persons who will do the charting require specialist training; and, finally, in a region such as the South Pacific, the sea areas requiring to be charted are vastly greater than the land areas.

11.3. For nations with small land areas the potential for development is finite. With the recognition that they also possess much greater areas of sea and seabed, the potential for development is significantly increased. The surveyor's role in this development is fundamental, and the service that he can render needs to be recognized and supported by governments.