BRIDGE TEAM MANAGEMENT

Second Edition

A practical guide

by

Captain A J Swift FNI

Including a new section on electronic navigation by

Captain T J Bailey FNI

THE NAUTICAL INSTITUTE

BRIDGE TEAM MANAGEMENT

A Practical Guide
Second Edition
by Captain A.J. Swift FNJ

including a new section on Electronic Navigation
by Captain T.J. Bailey FNI

Cover: LNG Carrier TV MUBARAZ passing through Singapore Strait eastbound
photo: Jalens

Foreword by
Mr. C.J. Parker OBE FNI
Secretary, The Nautical Institute 1973—2003

BRIDGE TEAM MANAGEMENT
A Practical Guide
by Captain A.J. Swift FNI

including a new section on Electronic Navigation
by Captain T. J. Bailey FNI

First published in 1993 by The Nautical Institute
2(12 Lambeth Road, London, 5E1 7LQ England
Telephone: +44 (0)207 928 1351
Fax: +44 (0)207 401 2817
Publications e-mail: pubs@nautinst.org
Worldwide web site: http://www.nautinst.org
Second Edition 2004

This book has been prepared to address the subject of bridge team management. This should not, however, be taken to mean that this document deals comprehensively with all of the concerns which will need to be addressed or even, where a particular matter is addressed, that this document sets out the only definitive view for all situations.

The opinions expressed are those of the authors only and are not necessarily to be taken as the policies or views of any organisation with which they have any connection.

Readers should make themselves aware of any local, national or international changes to bylaws, Legislation, statutory and administrative requirements that have been introduced which might affect any conclusions.

Typesetting and layout by J A Hepwoith

1 Ropers Court, Lavenham, Suffolk, Col0 9PU, England

Printed by O'Sullivan Printing

Trident Way, Brent Road, Southall, Middlesex, UB2 SLF

ISBN 1 870077 66 0

FOREWORD
By Mr. C.J. Parker OBE ENI Secretary, The Nautical Institute 1973-2003

I was p]eased to be asked by the author to write the foreword to the second edition of Bridge Train Management because the book exemplifies the professional approach to navigation. In this book the task conies first and that task is to ensure the safe and timely arrival of ships. To achieve this, all members of the bridge team including the pilot, when carried, need to share the same sense of purpose.

The practice of navigating safely in coastal waters and port approaches has a number of components which include competence, planning, teamwork, control and flexibility. The task is to ensure that the ship, when navigating close to land, will be kept in safe water allowing for currents, tidal influences, under keel clearance, wind and changes in visibility. Additionally provision needs to be made for contingences.

The realisation that people can make mistakes is an essential part of developing good procedures. This point is however difficult to articulate in legislation because the regulator provides instruments which specify requirements to be followed, but which cannot in themselves prevent people making mistakes.

In the IMO, the STCW95 Convention lays down well-considered standards for safe navigation. Similarly IMO has produced useful guidelines in Part B chapter VIII that are quoted and discussed in this book. These two major instruments provide a framework for developing international training standards and good operational procedures.

Similarly, merchant-shipping legislation makes the master responsible for the safety of the ship but pilotage legislation in compulsory areas specifies that (he pilot takes charge. These two requirements are incompatible at face value. Certainly such pilotage law serves to make it an offence not to carry a pilot in a compulsory area, but this does not provide a meaningful solution to this age-old problem.

The answer of course is to share a common sense of purpose based upon professional values, which are described so well in this book. That is why I also urge pilots to adopt these standards and training methods so that good practices are reinforced and communication improved.

Bridge Team Management provides that extra professional dimension which puts the guidance and regulations into context. For example the subject of error chains informs the reader that there are many activities, which can lead to mistakes. These can include equipment which was not set up correctly, mistaken identity, misread information, errors in calculations and misunderstandings.

The essence of Captain Swift's book is that navigational safety has to be managed and the techniques of organization. leadership and teamvork need to be applied if the ship is at all times to demonstrate reliable performance. Good management ensures that the potential activities, which might lead to error chains, are crosschecked before they can adversely affect the ship's progress. This crosschecking can only be done, however, against a pre considered plan.

These management principles need to be applied equally to modern technology. The new section in this updated second edition by Captain Bailey explains how electronic charts can provide enhanced navigational performance and he demonstrates how to set up and operate electronic navigational systems safely..

He also points out that electronic charts are held on very large databases and that the modern navigator requires proficient computer skills to ensure that at all times the most appropriate information is displayed. Captain Bailey makes an overwhelming case that navigators using these systems should be fully trained in their use.

Irrespective of the navigational methods used, Captain Swift states categorically that it is necessary to prepare a passage plan. for if there is no plan there can be no bridge organisation and individuals will he left isolated as there is no basis for communication and consequently little awareness when something might go wrong.

Good planning leads to good teamwork, which enhances meaningful communication and ultimately provides a sense of achievement. The greatest risk that a ship can be exposed to is a navigational accident. Bridge Team Management demonstrates how to ensure that ships make their safe and timely arrivals to the satisfaction of all. This book is an excellent example of professional practice.

PREFACE

The author, Captain A.J. Swift FNI first went to sea in 1952, as an apprentice, now termed cadet, with the Bank Line Ltd., of London. He then served 18 years at sea, including five years in command of general cargo ships, before joining the Navigation Department of Brunel Technical College, Bristol, teaching masters and mates for certificates of competency.

He then transferred to the Simulator Section at Warsash Maritime Centre in 1980, and specialised in the use of simulation to reinforce bridge team management. In common with the other members of the section, he kept his practical experience updated by regularly returning to sea in an observing role on vessels of all types and by riding with pilots in major British ports.

Since retiring in 1999 he has continued to conduct seminars in bridge team management, in conjunction with the West of England P&I Club and others and has given lectures in many European ports, particularly Greece, a series in Korea and Turkey and recently in Japan.

Despite the improvements in all technical aspects of the industry, the proliferation of serious marine disasters in recent years indicates that bridge team management is a subject that still needs to be improved at sea. There are many publications showing what needs to be done but almost none showing how it should be done.

The first edition of *Bridge Team Management* was produced in 1993, by The Nautical Institute and has become established as the definitive guide to the subject. However, the introduction of electronic navigation systems and recent publications by IMO have shown that it is necessary to update it. So a second edition has been written.

ACKNOWLEDGEMENTS

This book has been developed to give meaning to the convention, standards and resolutions prepared by the International Maritime Organization and I wish to acknowledge the valuable work undertaken at the intergovernmental level to provide the essential international framework for bridge operational standards.

The principles of the International Chamber of Shipping *Bridge Procedures Guide* have been used as a basis for shipping company practice, whilst the texts and notices issued by the UK Department of Transport have provided essential guidance in the compilation of this volume.

Over the years, fleet managers and superintendents from companies all over the world have discussed their requirements and been instrumental in measuring performance from which it has been possible to assess the effectiveness of the methods chosen.

A book like this cannot be conceived without the accumulated experience of over 3,000 officers attending training courses who have, in their own wax, either directly or indirectly. contributed to my understanding of bridge management. Io all these people and organisations I owe particular thanks, for without their professional commitment this hook is unlikely to have been written.

When preparing the text for the second edition I would like to thank ML Clive BurnellJ ones, Marine Manager Northrop Grumann Sperry Marine Systems and Captain Christopher Thompson, Simulator Manager at South Shields Marine and Technical College, who allowed me to participate in their training programmes to gain a wider appreciation ol technological developments and the potential of new bridge equipment.

I am very grateful to Captain Trevor Bailey for his practical and informative section on navigating with electronic charts. He has first hand experience with these systems and is also a training instructor.

I also wish to thank my former colleagues at the Simulation Section of the Maritime Operations Centre, Southampton Institute of Higher Education, Warsash, where I was a member of the team from 1980 1999, for their support in the production of this book, with special thanks to Roy Stanbrook MNI.

Background to the Maritime Operations Centre

Since 1985 the College of Maritime Studies, which had its origins as far back as 1850, initially as a University College School of Navigation in the early 20th century, is now part of the Southampton Institute of Higher Education. Established in Warsash just outside Southampton in 19Th, the School of Navigation has changed through the decades to meet the changing needs of a national and international industry without losing sight of its mission: ‘to provide the maritime and shipping industries with high quality training, consultancy and research services.’

Today, the Maritime Operations Centre continues to provide those services with highly experienced staff, most of whom have held command and with state of the art technology in the form of sophisticated ship’s bridge, radar, VTS, machinery space and cargo handling simulators. Bridge Team Training, using ship’s bridge simulators, has been conducted at Warsash since 1977. In addition to bridge team management training, ship handling courses for pilots, masters and senior officers are conducted with the use of accurately scaled models operating on a 13 hectare lake with appropriate canal, channels, SBM and jetty facilities.

In addition to training and assessment courses, the ship’s bridge simulators are also used for port design and accident investigation studies as well as government funded research projects, thereby making a significant contribution to the enhancement of safety of life at sea and effective ship operations.

THE BRIDGE OPERATIONS PROGRAMME

This message appeared in the first edition of Bridge Team Management,

and is reproduced here as it is still applicable.

Whenever a ship puts to sea, the master and navigating officers have a duty both in public and commercial law to navigate competently at all times. Upon their actions depend the successful outcome of the voyage, safety at sea and protection of the marine environment.

The International Maritime Organization recognises the essential requirement that all watchkeeping officers must be properly trained. This training needs to be initiated ashore and before watchkeeping officers are qualified to take a navigational watch, they need to be proficient in such disciplines as navigation, the application of the rules to avoid collisions and seamanship. IMO has resolved to revise the STCW Convention through an accelerated process and together with the on board training proposed in this programme will represent a major contribution to the improvement of standards that is so important.

It is, however, at sea on the bridge of ships that watchkeepers have to work together and make decisions. Once they have been trained, good practices need to be continually refreshed and that is why I am strongly supporting these measures by The Nautical Institute and Videotel Marine International to provide leadership, encouragement and positive advice through the Bridge Operations Programme (see page 110).

Each part of the programme has been designed to reinforce the application of practices and principles developed in IMO, industry codes and shipboard routines. The programme starts with the trainee, ends with the master whilst involving the pilot. In so doing, owners and managers are also reminded that they have obligations too. They have to provide the means of keeping charts op to date, equipment functional and the standards of training appropriate to the responsibilities that watchkeeping entails.

Above all, this imaginative programme demonstrates the level of knowledge and skills applied in pursuit of safe ship operation. We come to appreciate that watchkeeping is very responsible work and that supporting the human element demands long term commitment, which is likely to be most effective if it provides a common sense of purpose amongst the bridge team.

Watchkeeping officers, through their diligence and professionalism, provide a highly valued service to society. This contribution is recognised by IMO and, in launching this project, I wish to pay tribute to the world’s seafarers and those organisations which are working with us to enhance safe ship operations.

W. A. O’Neil

immediate past Secretary-General of the IMO

CONTENTS

Chapter		Page

Chapter	**Page**

Annex	**Page**

List of Figures

Note: Figures 1 to 6i and 8 to 9 are Crown copyright.

Reproduced from Admiralty Chart 3274 with the permission of the Hydrographer of the Navy

Note: Figures 11, 15, 19 and 20 are reproduced with the permission of Northrop Grumann Sperry Marine

Note: Figures 13,14, and 16 to 18 are reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy

Chapter 1

BRIDGE TEAM MANAGEMENT

Introduction

In times gone past a commercial voyage was considered to be an adventure. Today, fortunately, most commercial voyages are not adventures, merely the routine of safely and successfully completing the voyage and delivering the cargo.

Sometimes though, this is not the case. Voyages are not always completed, cargoes not always delivered. Non completion of the voyage and non delivery of the cargo always comes as a shock to the mariners concerned, the shipowners, the charterers, the shipper and the public in general. We expect cargoes to be delivered on time and ships to go safely about their business. We forget that, even in this thy and age1 although ships have reliable powerful engines and the latest technology helping the mariner, the voyage is still a risk and the ship and its crew still subject to the vagaries of nature.

Non completion of voyages though may not just be the result of a hostile environment. The majority of incidents at sea are the result of human error. In many of these cases information which could hate prevented the incident occurring was available but was either unappreciated or not used.

Most accidents occur because there is no system in operation to detect and consequently prevent one person making a mistake, a mistake of the type all human beings are liable to commit.

This book is designed to make the voyage safer by explaining how to carry out the different aspects of bridge team management

It is now some ten years since The Nautical Institute published the original edition of *Bridge Team Management*. The ideas in that edition had been largely developed through the author working at the Simulator Section of the Maritime Operations Centre of the Southampton Institute of Higher Education.

Although the first edition has been accepted throughout the world, as the definitive book on the subject, the world's shipping still does not necessarily follow team management and passage planning. But the world authorities are now catching up with the industry in realising that both management and planning are absolutely necessary in promoting safer shipping practice, indeed IMO has now come out with recommendations on both subjects.

This edition sets out in chapters 9 and 10 to put the IMO recommendations into plain seafaring English, following the format used in the rust edition. The IMO recommendation is on the left-hand side of each page and its meaning alongside it.

> 5.14 Members of the navigational watch should at all times be prepared to respond efficiently and effectively to changes in circumstances. IMO STCW B-VIII Part 3.1 (Guidance on keeping a safe navigational watch)

IMO STCW 95 B-VIII Part 3.1 concludes with the above statement, making it quite dear that no matter how well a voyage may have been planned and conducted and no matter how well the team may have worked together, everything can change.

This is the lime when team work and planning really come into their own, as any officer, including the most junior one in the team, may have to make decisions that he knows are really beyond his capability.

However if the ship is operating under a good system of bridge team management and the passage plan has been carefully drawn up, even the most junior and inexperienced officer will have a substantial fund of knowledge lo back up his actions. He will know that the decisions he has to make will be safe and will apply the knowledge he already has to the system he has been working.

The original book Bridge Team Management was written before the 1MO decided that it too had to produce a resolution on the subject. Bridge Ram Management has been well received throughout the world and is proving to be the basis for most ship's passage planning and bridge resource management.

This, the second edition, seeks to explain the IMO's statements, confirming what so mans of us already know and work to. It also brings the subject up to date with a new section on electronic navigation.

Team Management

One of the requirements for manning and running a ship is to have the highest calibre personnel and the latest equipment. This must still be the wish of every shipmaster and officer but, faced with today's harsh economic realities, is often not possible. Frequently, bridge teams will consist of groups of mixed ability personnel working with outdated equipment. Nevertheless to achieve the successful completion of the voyage it is the concern of alt ships' officers to make the best possible use of available resources, both human and material. Each member of the team has a part to play in this.

The title "Team Management" is the interaction required within the team for such a system to work. It does not refer to an act of management by one person but to a continuous acceptance and understanding by each of the team members that they all have to fulfill the roles to which they have been assigned.

To consistently achieve good results there are a number of factors that need to be addressed. Firstly those concerning technical knowledge and skills and then the requirements of the more traditional man management or "people" skills involved in the development of human resources. In looking at the technical skills, consideration must be given to the techniques involved in preparing for and conducting the proposed voyage (passage planning).

The skills concerning the development of human resources are covered in depth in other publications. The smooth and efficient running of any bridge team depends upon the basic principles of good communication and man management. With current ship manning policies these skills must be developed on board to overcome cultural boundaries as well as those of a more traditional hierarchical rank structure.

Training and Coaching

The ability to do a job well depends, to some extent, on the quality of the training a person has received. A poorly motivated trainer will often produce a poorly motivated trainee. We all spend a great part of our lives either imparting knowledge to others or learning such knowledge. This starts when we are cry young and continues, no matter what our chosen vocation, throughout our lives. Proportionally, very little of this is conducted in the formal atmosphere of a learning establishment, most learning taking place at mother's knee or in the workplace. As such we are all teachers and we should not be reluctant to pass on knowledge when required.

The methods of passing on knowledge are many and various. They may be split into two main groups — training and coaching. These differ slightly in concept. Training a person involves instructing them in the execution of various tasks or procedures to a required standard. Coaching, however, involves the development of existing abilities through delegation and monitoring. It is a fine line between delegation for coaching purposes and abrogation of one's own responsibilities! Care should be taken to avoid delegating at too early a stage of development. If the trainee is unprepared for the task, the effects can be devastating. They can become demoralised and confidence will be undermined.

Training requirements for bridge tasks do not always lend themselves to direct training methods except perhaps in the case of very- inexperienced personnel or for new concepts. The method of “Sit next to Nelly and she will show you” is not always appropriate because it is a drain on already stretched human resources. This is where the concept of coaching is appropriate. As with any coaching situation it is essential to maintain the supervision of the trainee and supply sufficient feedback on the progress being made. Lack of feedback prevents the trainee from understanding how to improve.

The development of a team from a selection of individuals may take a great deal of effort. Not all members will start with the same baseline of knowledge. Once the team is functioning, the flow of information will increase as a direct result of the newly found confidence of its members. All team members should be kept fully aware of what is expected of them and their performance of their job frequently monitored and feedback given. One of the primary functions of the team is the provision of a system of checking and cross checking decisions that will directly or indirectly affect the passage of the ship.

Well Being

The efficient team member will be both mentally and physically fit. Watchkeeping is often seen as being a passive role and in certain low-key situations this may be the case. The watchkeeper can then be considered to be in a situation requiring only the maintenance of the present unstressed situation. This role can change dramatically when risk develops, requiring more forceful action to prevent a situation arising, not merely responding to factors that may be getting out of control. This type of reaction requires both physical and mental well being of a high standard.

Morale

A demoralised team, or even demoralised members of a team, is not going to produce the high standards required ensuring the continuous safety of the ship. Morale depends upon a large number of factors. But good teamwork and effective operation will be achieved if the team members are clear as to their role in the team, can see the results of their own efforts, have their own deficiencies carefully corrected and are given credit when it is due.

Error chains

Maritime incidents or disasters are seldom the result of a single event, they are almost invariably’ the result of a series of non-serious incidents: the culmination of an error chain.

Situational awareness, i.e. knowing what is happening in and around the ship, helps the OOW or other watchkeeper to recognise that an error chain is developing and to take action, based upon this recognition, to break the error chain.

Indications of error chain development

Certain signs, apparent to members of a bridge team will indicate that an error chain is developing. This does not necessarily mean that an incident is about to happen, but that the passage is not being conducted as planned and that certain elements of situational awareness may be lacking. The ship is being put at unnecessary risk and action must be taken to break the error chain.

Ambiguity

Ambiguity may be easily definable or may be a subtle indication that things are not going as expected. In the event that two independent and separate position fixing systems do not agree,

Ambiguity (cont.)

e.g. Radar fix and GPS positions may not he the same; something is obviously wrong with one of the fixes and an ambiguity exists. Immediate action is required to correct this ambiguity and determine which one of the fixes is correct.

A more subtle ambiguity may occur if the echo sounder reading does not agree with the charted depth shown. The less conscientious 00W may just accept this fact) another may not be satisfied and will try to determine why there is a difference between the anticipated and actual sounding.

Ambiguity may exist in that two team members do not agree on a point of action. Ambiguity exists; of itself it may not be dangerous, but it does mean that there is a difference and the cause of this difference needs to be understood. One of the team members may be losing, or has lost his situational awareness and an error chain may be developing.

The OOW may be aware that certain pre-agreed decisions, e.g. night orders, company procedures etc. are not being followed. Again ambiguity exists, he must ask himself why has there been deviation from the accepted procedures?

Ambiguity may be a result of inexperience or lack of training. The junior officer may feel that he is not in a position to voice his doubts. This should not he the case Every member of a well constructed and well briefed team will feel confident (hat his doubts or fears can be expressed without his being reprimanded for what may turn out to be, in one instance an unwarranted worry, in another a very pertinent and relevant remark identifying a real hazard.

Distraction

Distraction, the full attention of a person upon one event to the exclusion of others or concentration upon what is often an irrelevancy can be an indication that situational awareness is beginning to break down, even if only for a restricted period. Distraction can be caused by an excessive workload, stress or fatigue, emergency conditions or, all too often, inattention to detail. It can also be caused by an unexpected, though not threatening event, such as a VHF call, which can take the full attention of a person to the exclusion of other more urgent needs. In such an event, a senior officer, e.g. a pilot having the con, may have to be made aware of the distraction.

Inadequacy and confusion

Inadequacy and confusion must not be mistaken for the confusion of a junior officer who just does not have the experience or knowledge to cope with a complex situation .Such a situation arises with even senior officers in disaster circumstances and needs to be noted and corrected before it can become dangerous.

Communication breakdown

Breakdown in communications can occur in several ways. It may be that members of a team simply do not understand one another due to being from different backgrounds or even different parts of the same country. Merely practising communications in their everyday life can easily rectify such differences.

Further difficulties may occur in trying to understand a pilot of a different cultural background. Rectification in this case will not lend itself to practice, but can only develop with experience. However such a situation should have been allowed for at the planning stage of the passage.

Other difficulties may occur in trying to understand a person using the radio in a shore station, or on another ship. Patience and perseverance are the only methods to rectify this situation.

Improper con or lookout

It is not always clear who actually has the control of the ship. This can occur in several ways. The arrival of the master, on the bridge, does not necessarily transfer the con to him. In fact until he states otherwise the con remains with the OOW. The easiest way to clarify this situation is for the OOW to make a log book entry to the effect that the master has taken the con, otherwise it may be assumed that it remains with the OOW .This procedure is recommended in the ICS Bridge Procedures Guide.

A similar situation can arise when it is not clear who has the con when there is a pilot on board. Normally the master will have the con when making the pilot station and should quite clearly state when the pilot takes the con, thus clarifying the situation to all concerned. This too can be clarified by the OOW making a log entry to this effect.

A lookout who is unclear about his duties is usually a result of poor team management.

Non-compliance with the passage plan

Non-compliance with the passage plan may result from the improper con noted above, and is another indication that situational awareness is breaking down. Unjustified departure from a clearly defined and understood passage plan must be recognised as a breakdown of situational awareness. As an example, the OOW of a ship that is proceeding in the wrong lane of a Traffic Separation Scheme must ask himself, why am I doing this? The ship will be off the planned track and it is in direct violation of the International Rules. If the OOW is both deviating from track and ignoring the Rules then it is likely that he is not fully aware of the position of the ship.

Any indication of any of the above requires action on the part of the person becoming aware of it. He must either correct the fault, particularly if it is his own responsibility or draw the attention of other individuals, or even the whole team, to the error.

Procedural violation

Procedural violations will occur similarly to that of not complying with the passage plan. Again the question has to be asked, are we doing it this way?” If the question cannot he easily answered then the OOW or watchstander must be doubly careful.

Casualties and their causes

At the International Safety Conference (INTASAFCON III) held in Norway in 1975 it was agreed that two principal factors seemed to be the main causes of collisions and groundings namely:

1 **Weaknesses in bridge organisation** and the result of such weaknesses.

2 **Failure to keep a good lookout**.

Such casualties may have been avoided by:

Setting double watches in appropriate circumstances

Too often it is considered adequate to proceed in a more complex situation with the same bridge manning levels as if the ship were deep sea with less immediate potential hazards.

Ensuring sufficient personnel are available in special circumstances

Additional personnel are often required to prepare equipment or to be available under certain circumstances. However if calling them is left too late they may not become available until the ship is in the situation that they could have helped prevent.

Precise instructions for calling the master

Too often the master is called after a situation has irredeemably deteriorated. If the OOW is unclear as to when he should call the master then his indecision may lead to his not calling the master. If the OOW is any doubt whatsoever then he should call him.

Posting look-outs

The OOW may consider that he alone can keep the look out in addition to his own duties. However not posting a lookout may cause him to neglect other important duties.

Manning the wheel

An unmanned wheel requires the OOW to monitor and correct the steering. This too may cause him to overlook other duties.

An established drill for changing over from automatic to manual steering

Modern steering gear can usually be changed easily from one system to another. However major incidents are on record where lack of awareness of the precise steering system currently in operation, or a lack of knowledge of how to change from one system to the other, has led to disaster.

Precise instructions regarding reducing speed in the event of reduced visibility

A busy OOW may not realise that the visibility has deteriorated, particularly at night. Even when he has realised that the situation has deteriorated he may not appreciate the increase in workload and may consider that he can still cope. Precise instructions in night or standing orders will prevent this situation arising.

Groundings and their causes

The following features have been noticeable as causes of grounding:

Failure to pre-plan a track

Frequently it is not considered necessary to plan a track and show it on the chart. This may be because the mariners concerned feel that they know the area sufficiently well or because there is a pilot on the bridge. There is however little point in planning and then not showing the track on the chart.

Failure to adequately monitor the vessel's progress along the planned track

Although a planned track is shown on the chart OOWs may not always constant and regularly fix the ship. This may lead to the OOW not being aware that the ship is deviating from track, perhaps towards danger.

Failure to take immediate action to regain track having deviated from it

Even when aware that deviation from track is occurring, the attitude may be that it doesn't really matter because there is enough safe water, when this is not actually the case. Ships are never planned to go aground, so compliance with the planned track will ensure safety.

Failure to cross check fixes by comparing one means with another

If only one method of fixing is used when the ship is in constrained waters, mis-identification of a navigation mark or faulty electronic information, left unchecked and unobserved, can leave the OOW with a false sense of security.

Failure to use visual faxing when available

Electronic position fixing may sometimes lie more accurate or convenient but electronic fixes do not necessarily relate the ship's position to navigational hazards. Ignoring visual fixing may lead to the OOW becoming unaware of his situation.

Failure to use the echo sounder when making a landfall or navigating in constrained waters

Except when alongside or threatened by another ship, the nearest danger is inevitably vertically below. Although it cannot be considered to be a position fix, observation and appreciation of the under keel clearance will often warn the observer of approaching danger or that the ship is not in the position that ii should be.

Failure to correctly identify navigational lights

An observer may convince himself that he sees the light he is looking for, not the light he is actually looking at. This misidentification can lead to subsequent error or confusion.

Failure to ensure that important navigational decisions are independently checked by another officer

By their very' nature human beings are liable to make errors. It is essential that such human errors cannot occur without being noticed and corrected. An integral part of the navigational plan and bridge organisation must be to constantly double check and minimise the risk of such errors going unnoticed.

Many of the instances cited above occur because the OOW does not appreciate the complexity of his role in a deteriorating situation. This may be because such responsibilities have not been made clear to him.

SAFE NAVIGATION - THE OVERVIEW

Bridge organisation

An efficient bridge organisation will include procedures that: -

1 Eliminate the risk that an error on the part of one person may result in a disastrous situation.

2 Emphasise the necessity to maintain a good visual lookout and to carry out collision avoidance routines.

3 Encourage the use of all means of establishing the ship's position so that in the case of one method becoming unreliable others are immediately available.

4 Make use of passage planning and navigational systems which allow continuous monitoring and detection of deviation from track when in coastal waters.

5 Ensure that all instrument errors are known and correctly applied.

6 Accept a pilot as a valuable addition to a bridge team.

Individual role

These procedures can only be achieved by each member of the bridge team appreciating that he has a vital part to play in the safe navigation of the ship. Each member will also realise that safety depends upon all personnel playing their part to the utmost of their ability.

Each team member must appreciate that the safety of the ship should never depend upon the decision of one person only. All decisions and orders must be carefully checked and their execution monitored. Junior team members and watchstanders must never hesitate to question a decision if the consider that such decision is not in the best interests of the ship. Careful briefing and explanation of the responsibilities required of each member will help to accomplish this.

THE PLAN

Voyages of whatever length can be broken down into two major stages.

1 PREPARATION

2 EXECUTION

Included in **PREPARATION** are:

a APPRAISAL

b PLANNING

EXECUTION of the voyage includes:

c ORGANISATION

d MONITORING

Chapter 2

PASSAGE APPRAISAL

Introduction

Before any voyage can be embarked upon or, indeed, any project undertaken, those controlling the venture need to have an understanding of the risks involved. The appraisal stage of passage planning examines these risks. If alternatives are available, the risks are evaluated and a compromise solution is reached whereby the level of risk is balanced against commercial expediency. The appraisal could he considered to be the most important part of passage planning as it is• at this stage that all pertinent information is gathered and the firm foundation for the plan is built. The urge to commence planning as soon as possible should be resisted. Time allocated to appraisal will pay dividends later.

Sources of information

The master's decision on the overall conduct of the passage will be based upon an appraisal of the available information. Such appraisal will be made by considering the information from sources including but not limited to:

1 Chart Catalogue.

2 Navigational Charts.

3 Ocean Passages for the World.

4 Routeing Charts or Pilot Charts.

5 Sailing Directions and Pilot Books.

6 Light Lists.

7 Tide Tables.

8 Tidal Stream Atlases.

9 Notices to Mariners.

10 Routeing Information.

11 Radio Signal Information (inc. VTS and Pilot service).

12 Climatic Information.

13 Load Line Chart.

14 Distance Tables.

15 Electronic Navigational Systems Information.

16 Radio and Local Navigational Warnings.

17 Draught of Vessel.

18 Navigational Terms.

19 Owner's and other unpublished sources.

20 Personal Experience.

21 Mariner's Handbook.

22 Guide to Port Entry.

23 Nautical Almanac.

Not all such sources will be necessary for all passages and voyages, but the list gives a quick check on what information is necessary for most. Experience will show the planner just what is required for the passage he is planning.

These items are discussed in detail below. Only British and American catalogue numbers are quoted. Other, similar, publications may be available from other national sources.

1 Chart Catalogue

Published annually by the Hydrographer of the Navy (British) as NP 131 and by the Defence Mapping Agency (U.S.) as CATP2V0IU. *

2 Charts

Many merchant ships carry British charts published by the Hydrographer of the Navy. However there are areas of the world where the mariner may well be advised to consider using locally published or other charts as well. British Admiralty policy is to chart all British home and most Commonwealth and some Middle Eastern waters on a scale sufficient for safe navigation. Elsewhere the policy is to publish such charts as will enable the mariner to cross the oceans and proceed along the coasts to reach the approaches to ports. Along many coasts not covered in detail by British charts the mariner may find it better to use the charts of the Hydrographic Office of the relevant country.

Both U.S. and Canadian regulations require that vessels in their waters must carry and use the appropriate national charts. This means that the vessel's chart outfit needs to be checked to ensure the charts meet the requirements of the regulations.

Approximately 50 countries are listed as having established hydrographic offices publishing charts of their national waters. Addresses of the agents appointed by such offices may be obtained from "The Catalogue of Agents for the Sale of Charts", published by the:

International Hydrographic Bureau

4 Quay Antoine 1er, BP 443, MC9SOI I, Monaco Cedex

Principality of Monaco

Tel. +377 93 10 81 00

International standard chart symbols and abbreviations allow foreign charts to be used with little difficulty but care must be taken to establish the chart datum used.

3 Ocean Passages of the World

Published by the Hydrographer of the Navy (British) as NP 136. It contains information on planning ocean passages, oceanography and currents.

---

* British and American Hydrographic Office publication numbers are subject to change and need to be confirmed.

4 ***Routeing Charts and Pilot Charts***

Routeing Charts are published by the Hydrographer of the Navy (British) as Charts Nos. 5124-8. Similar charts are published by the Defence Mapping Agency (USA) as Atlases NVPUB105-9, PILOT16 and PILOT55.

Both series give monthly information on ocean routeing, currents, winds and ice limits and various meteorological information.

5 ***Sailing Directions and Pilot Books***

British Pilot Books are published in 74 volumes by the Hydrographer of the Navy and give worldwide coverage. Sailing Directions are published by the Defence Mapping Agency (USA) in the series SDPUB 121-200.

Some of these latter books are referred to as Planning Guides, giving information essentially the same as the British Ocean Passages for the World, others as "Enroute", giving similar information to the British Pilot Books.

6 ***List of Lights and Fog Signals***

Published by the Hydrographer to the Navy (British) in eleven volumes (NP74-84) giving worldwide coverage. The British Navy also publishes Light Lists as CD-ROMs.

The US Coast Guard publishes seven volumes of Light Lists, (COMDTMI65021-7) giving details of all US coastal lights, including the Great Lakes. DMA publications LLPUB 110-6 cover the rest of the world.

7 ***Tide Tables***

Published by the Hydrographer of the Navy (British), annually, in three volumes, covering the world.

Tidal times and heights may be readily obtained by using a computer programme published by the British Admiralty (SHM159A)

The US National Ocean Service (NOSPBTT) also publishes worldwide Tide Tables.

8 ***Tidal Stream Atlases***

Published by the Hydrographer of the Navy (British), these atlases cover certain areas of Northwest Europe and Hong Kong.

Tidal Current Tables covering the Atlantic coast of North America and the Pacific Coast of North America and Asia are published by the US National Ocean Service; Tidal Current Charts are published by the US National Ocean Ser ice for four major US ports.

9 ***Notices to Mariners***

Notices to Mariners are published in Weekly Editions by both the British and US Hydrographic Authorities, enabling ships to keep their charts and other publications up to dale.

Also available as CD ROMs for updating electronic charts.

10 Ship's Routeing

Published by IMO. This publication gives information on all routeing, traffic separation schemes, deep-water routes and areas to he avoided that have been adopted b IMO. Routeing information is also shown on charts and is included in the sailing directions.

11 Radio Signal Information

The (British) Admiralty Lists of Radio Signals consists of twelve volumes of text and diagrams covering the following:

- NP281(1) Vol. 1 Part I Coast Radio Stations, Europe , Africa and Asia (excluding the Far East).
- NP281(2) Vol. 1 Part 2 Coast Radio Stations, Oceania, the Americas and (he Far East.
- NP282 Vol. 2 Radio Aids to Navigation, Satellite Navigation Systems, Legal Time, Radio Time Signals, and Electronic Position Fixing Systems.
- NP283(l) Vol.3 Part 1 Maritime Safety Information Services: Europe, Africa and Asia (excluding the Far East).
- NP283(2) Vol.3 Part 2 Maritime Safety Information Services: Oceania, the Americas and the Far East.
- NP284 Vol.4 Meteorological Observation Stations.
- NP285 Vol.5 Global Maritime Distress and Safety System (GMDSS)

Similar information is available m US DMA publication RAPUB 117.

12 Climatic Information

Climatic information is available from a variety of sources including the Pilot Books, Pilot Charts and Ocean Passages for the World already mentioned. The UK Met. Office hook Meteorology for Mariners gives further general information. Climatic information needs to be always updated by the latest Weather Information.

13 Load Line Chart

Load Line Rules are mandatory and the load line zones are shown in Ocean Passages for the World or BA Chart D6083.

14 Distance Tables

Both Ocean and Coastal Distance Tables are available from a variety of sources including British Admiralty (NP351) and US DMA publications NVPUB151 and NOSSPBPORTSDIST

15 Electronic Navigation Systems Handbooks

Such information most he available and will prove necessary should the prime source of electronic information fail. Information required will depend upon the systems in use on the particular ship and should have beers supplied with the equipment.

16	***Radio and Local Warnings***	The latest information available on changes to navigation aids etc. will be obtained from radio (including NAVTEX) and local warnings and must always be made available to those responsible for appraisal and planning. Local information is often available from the Harbour Authority. For information on the World Wide Navigational Services and the transmitting stations see *Admiralty List of Radio Signals Vol .3.*
17	***Draught of Ship***	The anticipated draught and trim of the ship at different stages of the passage will need to be known in order to calculate the under keel clearance when in shallow water. The extreme height of the ship above the waterline, known as the air draught will also be required if there are low overhead clearances
18	***Navigational Terms***	All watch keepers and others invoked with safe navigation, including shore personnel, need to have a clear understanding of navigational terms. ISO 19018 covers these requirements when this volume was being prepared.
19	***Owner's and other sources***	Supplementary information from the vessel's owners and charterers should be consulted, when available, as should reports from other vessels, information from agents and Port Authority handbooks and regulations.
20	***Personal Experience***	The personal experiences of crew members that have been to the anticipated ports and areas can prove of value.
21	***The Mariner's Handbook***	Published by the Hydrographer to the Navy (British), this book contains information of general interest to the mariner.
22	***Guide to Port Entry***	Published by Lloyd's of London Press and Port Guides, these books often give in Formation not available from other sources.
23	***Nautical Almanac***	Necessary for determining times of sunset and sunrise and assists in position fixing when electronic systems fail.

Having collected together all the relevant information the master, in consultation with his officers, will be able to make an overall appraisal of the passage.

Ocean

The passage may be a transocean route in which case the first consideration will need to be the distance between ports, the availability of bunkers and stores etc.

A great circle is the shortest distance hut other considerations will need to be taken into account.

Meteorological conditions will need to be considered and it may well prove advantageous to use one of the weather routeing services. Although the recommended route may be longer in distance it may well prove shorter in time and the ship suffers less damage. Ocean currents may be used to advantage, favourable ones giving the ship a better overall speed, offsetting the disadvantage of taking a longer route.

Weather systems also need to be considered, e.g. a ship in the Far East in summer needs plenty of sea room if it is liable to be involved in a tropical revolving storm and a passage in high latitudes may require ice conditions to be considered. Irrespective of the advantages of using a preferred track, the Load Line Rules must always be obeyed. In certain circumstances, often political or for safety purposes, a ship may need to keep clear of specified areas.

The ship owner and the charterers may have certain conditions that the planner will have to take into account. Specified under keel clearances may have to be observed as may distances off grounding areas or land and the owners may have areas of the world they prefer not to use, such as certain straits in some of the archipelagos. Some charterers may specify that the ship must remain within certain latitudes or that a given speed needs to be maintained. The master, of course, will have the final authority over such matters and should specify any such conditions before the planning starts.

Coastal

The first consideration at the appraisal stage will be to determine the distance that tracks should be laid off coastlines and dangers. When the ship is passing through areas where IMO traffic separation and routeing schemes are in operation such routeing will have to be followed. In some coastal areas minimum distances off for all, or specified vessels, may be determined by the relevant state. Shipping companies or charterers may also specify minimum distance off dangers or land.

In archipelagos, it will be necessary to determine which straits and passages are to be used and whether or not pilotage is required. Under certain circumstances it may be preferable to divert around an archipelago.

Having made his appraisal of the intended voyage/passage, whether it is a short coastal passage or a major trans-ocean voyage, the master will determine his strategy and delegate one of his officers to plan the voyage. On most ships this will be the second mate, on some a designated navigating officer, whilst on others the master may prefer to do his own planning. Irrespective of who does the actual planning, it has to be to the requirements of the master who carries the final responsibility for the plan.

The plan needs to include all eventualities and contingencies. Passage plans are often made from pilot station to pilot station but IMO Resolution A.285 (VIII), Annex A (v) states:

> "Despite the duties and obligations of a pilot, his presence on board does not relieve the officer in charge of the watch from his duties and obligations for the safety of the ship."

This makes it quite clear that it is necessary to plan from berth to berth even though it is anticipated that there ill be a pilot conducting the vessel at certain stages of the voyage.

Navigational hazard notes

The bridge team needs In be able to verify that corrections are up to date and all relevant navigational warnings have been noted. Charts containing corrections do not necessarily indicate whether they are the most up to date available. A notebook entry enables this detail to be verified (see Annex II).

Chapter 3

PASSAGE PLANNING

Introduction

Planning may be considered in two stages:

1 Ocean and open waters.

2 Coastal and estuarial waters.

Though, at times, these two stages will merge and overlap.

Charts

Collect together all the charts for the intended voyage, putting them into the correct order. Charts not absolutely necessary for the voyage but which are adjacent to the area to be traversed should be included, as should very large scale charts, e.g. port plans on the coastal part of the voyage. Although it may not be necessary to actually use such charts they may include information that will prove of use during the voyage. Ensure that all charts and publications have been corrected to the latest Notice to Mariners available and that any authentic Nav warnings etc. received from any source are also included (see Annex II). Similar corrections may also have to be made during the voyage after the plan has been completed and the plan having to be subsequently modified.

No-Go areas

Coastal and estuarial charts should be examined, and all areas where the ship CANNOT go must be carefully shown by highlighting or cross hatching, care being taken to not obliterate information such as a navigation mark or a conspicuous object. Areas so marked are to be considered as no-go areas. In waters is here the tidal range may not be very large, no-go areas will include all charted depths of less than the ship's draught plus a safety margin. Such areas will vary according to the ship's draught so will riot necessarily be the same for both inward and outward passages. In general the line determining "no-go" will be not less than draught + 10%, though this will need to be modified according to the prevailing circumstances. Draught + 10% may well prove adequate in areas where the sea is smooth but will require a considerably higher figure if the ship is liable to pitch, roll or squat.

In confined waters, where the tidal height may have a large influence, such no-go areas will vary according to the time of passage. Initially all areas and dangers showing charted depths of less than the draught plus the safety margin should be considered no-go, though such no go areas may be subsequently amended when the actual time of passage is known. Such areas will need to be carefully marked showing the times and state of tide at which they me safe.

Figure 1 shows no go areas for a ship on a draught of 9.1 metres, approximating to the 10 metre contour, no allowance being made for tidal height.

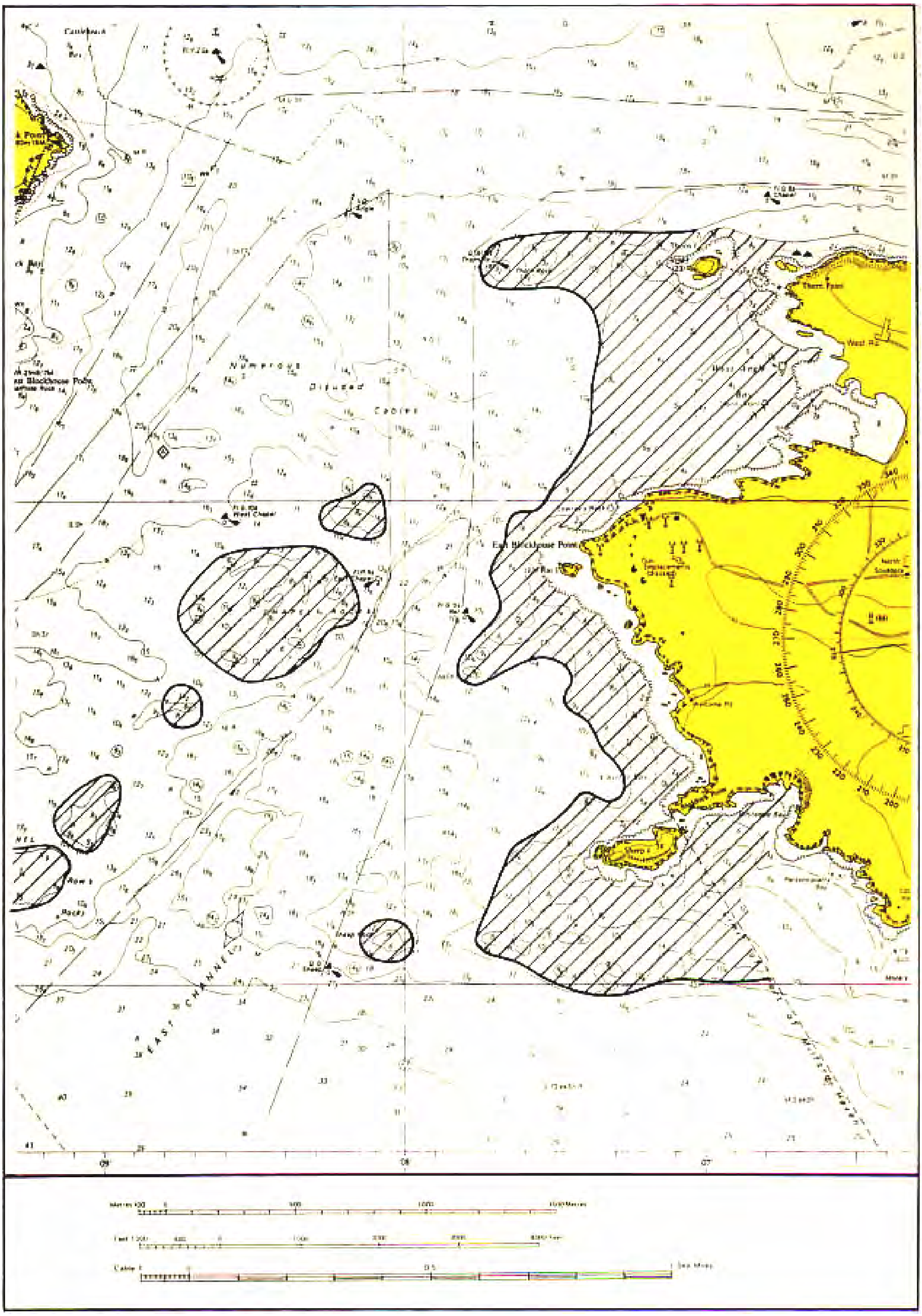


Figure 1 NO-GO AREAS

Assuming ship on maximum draught of 9.1 metres

Margins of Safety

Before tracks are marked on the chart the clearing distance from the no-go areas needs to be considered. When a fix is plotted on a chart it invariably represents the position of a certain part of the ship's bridge at the time of the fix. With large ships, although the plotted fix at a certain time may already be in it – with disastrous results. A safety margin is required around the no-go areas at a distance that, in the worst probable circumstances, the part of the ship being navigated (the bridge) will not pass. On occasion, the margins of safety can be readily monitored by eye, e.g. using buoys marking the safe limits of a channel or easily identified clearing bearings.

Among the factors which need to be taken into account when deciding on the size of this "Margin of Safety" are: -

1 The dimension of the ship.

2 The accuracy of the navigational systems to be used.

3 Tidal streams

4 The manoeuvring characteristics of the ship.

The Margins of Safety should be chosen so that they can be readily monitored. To achieve this they need to be related to one of the navigation systems in use (e.g., clearing bearings related to headmark or Parallel Indexes).

Margins of Safety will show how far the ship can deviate from track, yet still remain in safe water (see below). As a general rule the Margin of Safety will ensure that the ship remains in waters of a depth greater than draught +20%. It is stressed that this is only a general rule. Circumstances may dictate that the 20% clearance will need to be considerably increased, e.g.:

1 When the survey is old or unreliable.

2 In situations where the ship is pitching or rolling.

3 When there is a possibility that the ship may be experiencing squat,

4 When the ship may have increased the draught by passing into fresh water.

Safe Water

Areas where the ship may safely deviate are considered to be Safe Water and the limits of this safe water are bounded by the Margins of Safety.

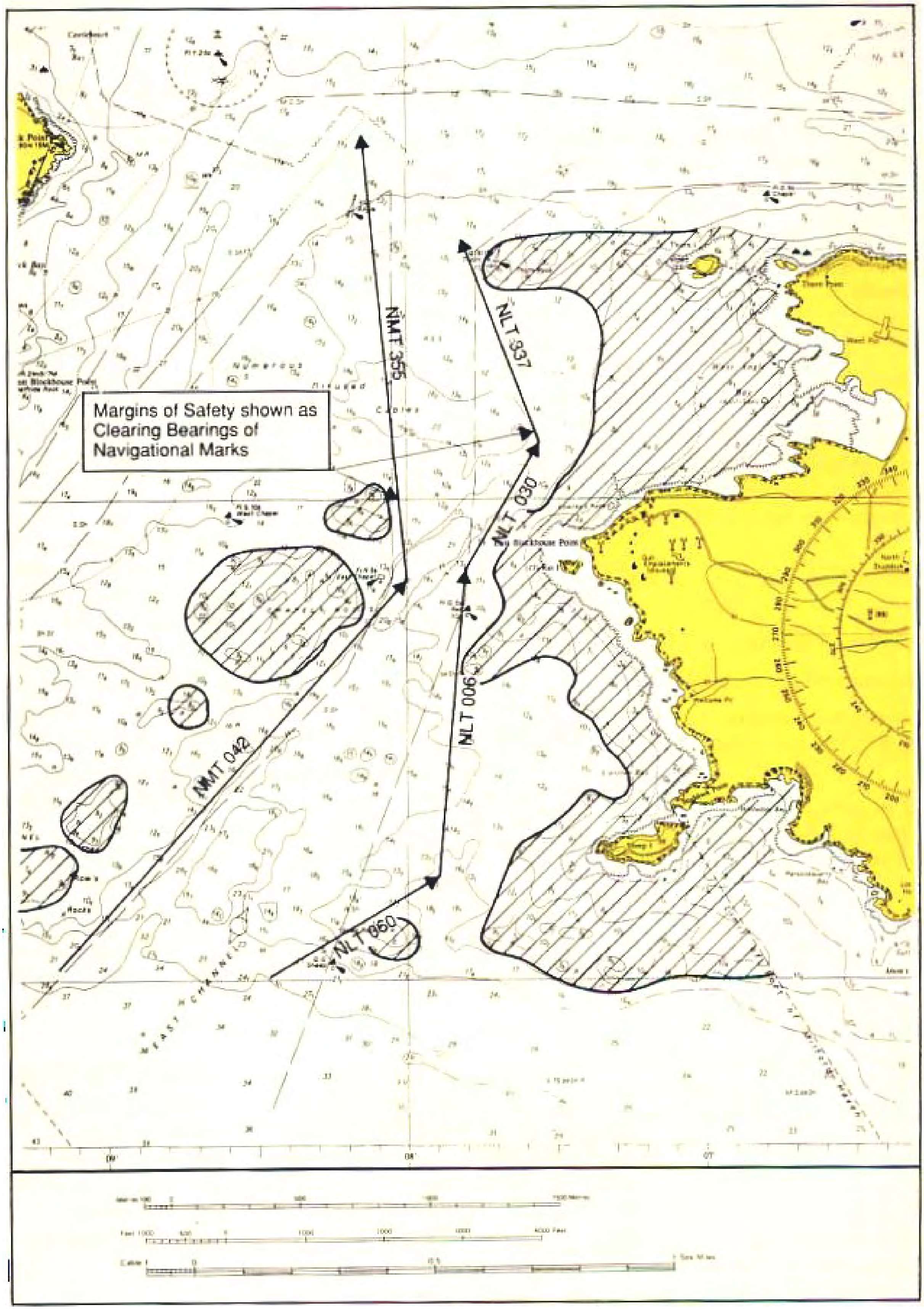


Figure 2 MARGINS OF SAFETY

(for definition of clearing bearings see below)

Ocean and Open Water Tracks

Ocean and Open Water tracks should first be drawn on small-scale charts, according to the decisions made at the appraisal stage regarding the route to be taken. Great circle and composite great circle tracks will have to be calculated or obtained from the GPS or from great circle charts. Rhumb lines may be drawn straight onto the Mercator chart, but all tracks will have to conform to the limits determined at the appraisal stage.

Coastal and Estuarial Tracks

Coastal and Estuarial Tracks will also be constrained by the decisions made at the appraisal stage and should be first drawn on the small scale charts covering large portions of the coastline, preferably from the departure port approaches to the arrival port. This will depend upon proximity of the ports and the charts of the area. In many cases more than one chart will have to be used. These first tracks will form the basis of the plan and from them may be obtained distances and steaming times and when the departure time is known, the ETAs at the various waypoints en route can be established.

The true direction of the track should he shown close to the track on the chart. This will not necessarily be the course steered to make this track; it only indicates the direction to make good. The course to steer will depend upon various factors at the time of making the passage, e.g. tidal set and drift, leeway, etc.

When completed, these tracks should be transferred to and drawn on the large-scale charts of the area to be traversed. Transfer of a track from one chart to another must be done with great care.

To ensure that no mistakes arc made, it is good practice to double check this operation by using a range and bearing of the transfer position from a readily identifiable object e.g. a light common to both charts. This can be further confirmed on both charts by checking the latitude and longitude of the transfer position.

Chart Change

It should be quite clearly shown on a chart the position where it is required to transfer to the next chart, giving the next chart’s number.

Track Consideration

As a general rule there is nothing to be gained by closely approaching a danger other than to reduce passage distance and consequently, steaming time. When it does become necessary to approach a danger there are general minimum rules that need to be followed. The ship has always to remain in safe water (see page 19) and keep sufficiently far off a danger to minimise the possibility of grounding in the event of a machinery breakdown or navigational error.

Distance Off Danger

It is not possible to lay down hard and fast rules regarding the distance off a danger that a ship should maintain. It will depend on:-

1 The draught of the ship relative to the depth of water.

2 The weather conditions prevailing; a strong onshore wind or the likely onset of fog or rain will need an increase in distance off.

3 The direction and rate of the tidal stream or current.

4. The volume of traffic.

5 The age and reliability of the survey from which the information shown on the chart. has been derived.

6 The availability of safe water

The following guidelines will help in determining just how far

to pass off dangers.

Where the coast is steep to and offshore soundings increase quickly the minimum passing distance should he 1 ½ - 2 miles. Where the coast shelves and offshore soundings increase gradually, the track should ensure that adequate under-keel clearances are maintained. As a guideline:

- Vessel's draught less than 3 metres — pass outside 5 metre contour.
- Vessel's draught 3-6 metres pass outside 10 metre contour.
- Vessel's draught 6-10 metres pass outside 20 metre contour.
- Vessels with a draught of more than 10 metres must ensure that there is sufficient under keel clearance, exercising due caution within the 200 metre line.

Irrespective of the safe under keel clearance, a ship in a situation where the nearest navigational danger is to starboard must allow sufficient distance to allow an adequate alteration of course to starboard for traffic avoidance.

Regulations

Owners', charterers' and national regulations regarding offshore distances must also be observed.

Deviation from Track

Ideally the ship will follow the planned track but under certain circumstances it may he necessary to deviate from such track, e.g. having to alter for another ship. Even so, such deviation from track should be limited so that the ship does not enter areas where it may be at risk or closely approaching the margins of safety.

Under-keel clearance

In certain circumstances a ship may be required to navigate in areas with a reduced under-keel clearance (UKC). It is important that the reduced UKC has been planned for and clearly shown. in cases where the UKC is less than 10% of the deepest draught, or other such percentage as was agreed at the appraisal stage, then it is essential that the OOW is aware of such reduced UKC. He also needs to be aware that speed may have to be reduced in order to reduce squat with its

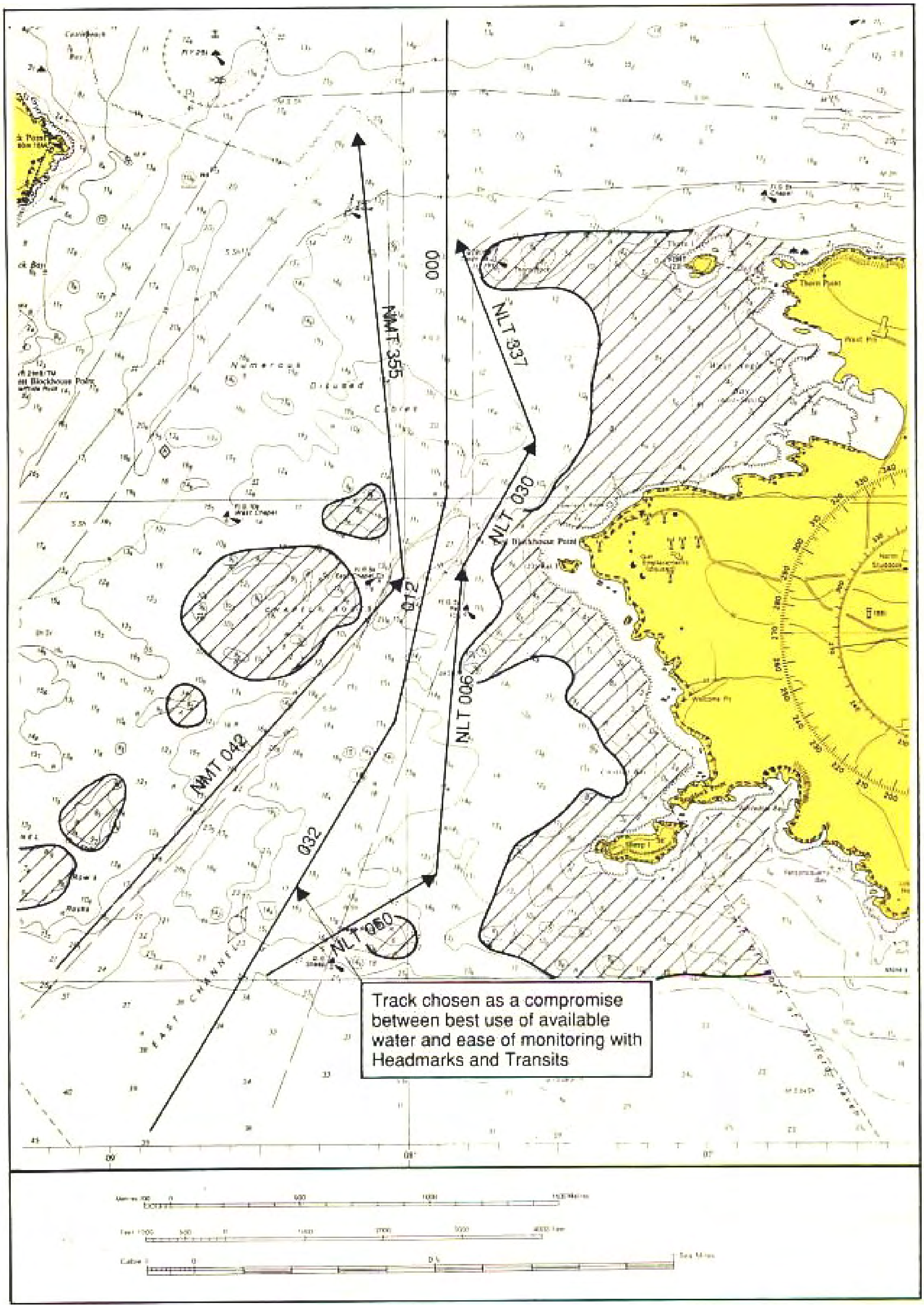


Figure 3 CHARTED TRACKS

consequent reduction in draught. Such information needs to he shown on the chart.

Tidal Window

In tidal areas adequate UKC may only be attainable during the period that the tide has achieved a given height Outside that period the area must be considered no go. Such a safe period, called the Tidal Window, must be clearly shown so that the OOW is in no doubt as to whether or not it is safe for the ship to proceed.

Stream Allowance

In open sea situations track correction is often made after the ship has been set oil track by the tidal stream and/or current. Such correction may he adequate in offshore situations. Where the ship is not close to danger. but as the planned track approaches the coast it is better to make tidal and current correction prior to its taking effect.

Current information, set and rate is often available on the chart though more detailed information is given in *Ocean Passages for the World*, Routeing Charts and Pilot Books (see Appraisal sections 3, 4 & .5). Currents vary according to their location and the season and may be influenced by changes in meteorological conditions.

Tidal information is available from Charts, Tide Tables and Tidal Atlases, further local information being available iii Pilot Books (see Appraisal sections .5, 7 & W) Tidal streams vary according to the time of high water and the phase of the moon (neaps and springs) and can be influenced by local meteorological conditions.

When the actual time of transit of a given area is known the Tidal Heights and Streams can be calculated and due allowance made for these streams in order to calculate the course to steer to achieve a planned track. As well as adjusting these allowances, as the tidal stream varies according to location and time, the 00W must still carefully monitor the ship’s position and adjust the course steered to maintain the planned track.

Course Alterations and Wheel Over

In the open sea and offshore coastal waters when navigating on small scale large area charts, course alterations will usually coincide with the planned track intersections. This will not he the case in confined waters when navigating with large scale charts and where the margins of safety may he so close as to require the ship to commence altering course at the wheel over position, some distance before the track intersection in order to achieve the new planned track.

Usually the pilot using his judgement. based upon his experience, will determine such wheel over. However, ship’s officers, not having such experience should determine such wheel over positions from the ship’s manoeuvring data and mark them on the chart. Suitable visual and radar cues should then be chosen to determine when the ship is at the wheel over position. The best cues for large alterations of course consist of Parallel Indexes or visual bearings parallel hi the new track, whereas for small alterations a near beam bearing is often better.

Even when the pilot has the con the wheel over position should be shown on the chart so that the OOW will be aware of its imminence and importance. It is also part of the ship's officers' monitoring of the pilot.

Figure 4 shows the wheel over position using two separate methods of monitoring. At the course alteration from 032° to 012°, the wheel over position is achieved when Thorn Island is ahead at 1.31 miles (known as the dead range). At the course alteration from 012° to 000° the wheel over position is achieved when the Southern Edge of Rat Island bears 096°.

Parallel Indexing

Parallel Indexing (PI) is a useful method of monitoring cross track tendency in both poor and good visibility. It is good practice to inconspicuously mark the planned PI on the chart at the planning stage. Like any radar technique, it is advisable to practice using PIs extensively in good visibility before placing total reliance on them when thick weather makes visual navigation methods impossible.

This simple and effective method of continuously monitoring the ship's progress is carried out by observing the movement of the echo of a radar conspicuous navigation mark with respect to track lines previously prepared on a reflection plotter or by using ARPA index lines. It is most effective when the radar is in the North up, relative motion mode ship centered.

A fixed radar target, such as a lighthouse or a headland, will apparently track past the own ship, depicted as being at the centre of the screen, on a hue parallel and opposite to the ship's ground track. Any cross track tendency, such as may be caused by a tidal stream, will become apparent by the target moving off the parallel line

The parallel index may also be used to monitor other events, e.g. a wheel over position. In this case the range and hearing of the target at the wheel over point and the new track is mat ked on the P1. 1 his also allows for a distance countdown to be made and the new track can be subsequently monitored

ARPA Mapping

Many modern ARPAs have the facility to generate synthetic maps that can be stored in a retrieval system. In some instances, such maps may be stabilised through an electronic navigational system, but such facilities should be used in addition to and not to the exclusion of other systems.

Waypoints

A waypoint is a position shown on the chart when a planned change of status will occur. It will often he a change of course hut may also be an event such as:

1 End or beginning of sea passage.

2 Change of speed.

3 Pilot embarkation point.

4 Anchor stations, etc.

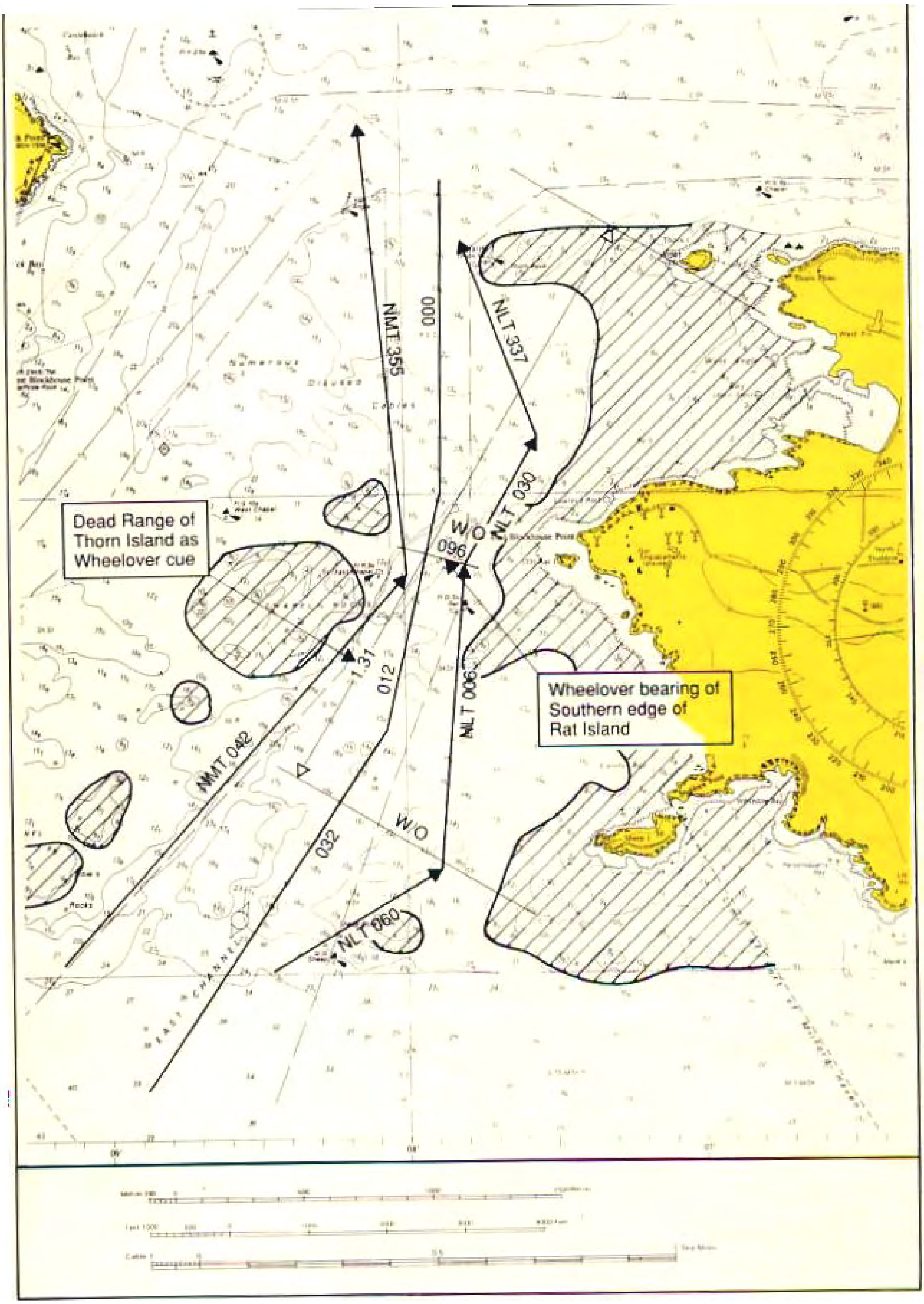


Figure 4 COURSE ALTERATIONS AND WHEEL OVER POSITIONS

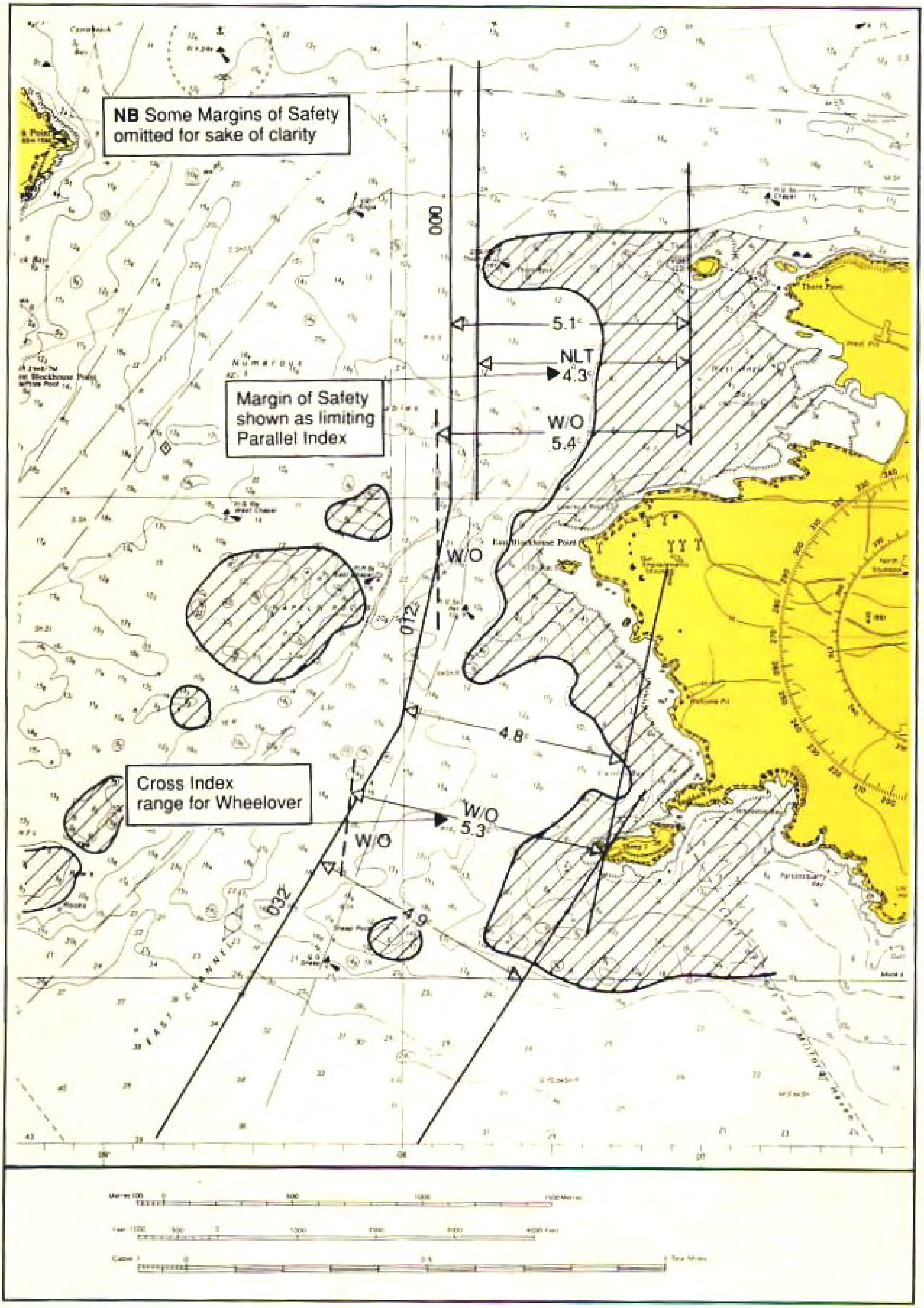


Figure 5 PARALLEL INDEXING

Crown Copyright. Reproduced from Admiralty Chart 3724 with the permission of the Hydrographer of the Navy.

Waypoints may also be used as useful reference points to determine the ship's passage time and whether or not a schedule is being maintained. Such information can be included in the notebook relevant to the plan or checked when it has been included in the appropriate electronic navigational system. Where an electronic navaid which stores waypoint information is in use, care should be taken to ensure that waypoint designators remain uniform throughout the plan.

Aborts and Contingencies

No matter how well planned and conducted a passage may be, there may come the time when, due to a change in circumstances, the planned passage will have to be abandoned.

Aborts

When approaching constrained waters the ship may come to a position beyond which it will not be possible to do other than proceed. Termed the 'point of no return', it will be the position where the ship enters water so narrow that there is no room to turn or where it is not possible to retrace the track due to a falling tide and insufficient UKC.

Whatever the reason, the plan must take into account the point of no return and the fact that thereafter the ship is committed. A position must be drawn on the chart showing the last point at which the passage can be aborted and the ship not be committed to entry. The position of the abort point will vary with the circumstances prevailing, e.g. water availability, speed, turning circle, stream direction etc. but it must be clearly shown as must a subsequent planned track to safe water.

The reasons for not proceeding and deciding to abort will vary according to the circumstances but may include:

1 Deviation from approach line.

2 Machinery failure or malfunction.

3 Instrument failure or malfunction.

4 Non availability of tugs or berth.

5 Dangerous situations ashore or in the harbour.

6 Sudden changes in weather conditions such as onset of poor visibility or dangerous increase in wind speed or direction.

7 Any situation where it is deemed unsafe to proceed.

Contingencies

Having passed the abort position and point of no return the bridge team still needs to be aware that events may not proceed as planned and that the ship may have to take emergency action. Contingency plans need to have been made at the planning stage and clearly shown on the chart so that the (30W does not have to spend time looking for and planning safe action, but has instantly available action to correct the situation.

Contingency planning will include:

1 Alternative routes.

2 Safe anchorages.

3 Waiting areas.

4 Emergency berths.

It will be appreciated that emergency action may take the ship into areas where it is constrained by draught, in which case speed will have to he educed; or tidally constrained areas which can only be entered within the tidal window. Such constraints must be clearly shown.

Having drawn no go areas, the margins of safety and the track to he followed, the planning should now be concentrated on ensuring that the ship follows the planned track and that nothing can occur which is unexpected or cannot he corrected.

Figure 6 shows the abort position for the ship as she approaches the channel between Rat Buoy and East Chapel Buoy. The navigator may call out the distance to this position and the pilot and master determine whether on not the ship is in all respects correctly positioned to make the turn and transit. Should this not be the case then the ship must proceed direct to the Contingency Anchorage shown and determine the situation.

Position Fixing

A variety of position fixing methods is now available but it must not be assumed that any one of these methods will suit all circumstances.

Primary and Secondary Position Fixing

In order that the position fixing process is smooth, uneventful and clearly understood by all concerned, the passage plan will include information as to which fixing methods are to be used: i.e. which one is to be considered the primary method and which ones1 are to be used as backup or secondary.

For example, whilst the ship is out of sight of land it may well be that the GPS is the primary system, with Loran C as the secondary or backup system. As the ship approaches the coast, the GPS will still he providing the primary fixing method, the Loran C becoming less important and the radar fix confirming the GPS fix.

Eventually the Loran C, although still running, will become redundant and more reliance placed on the radar fix, with the UPS taking the secondary role. In enclosed waters the UPS position max become inappropriate and position fixing depends upon radar and visual methods. It is important to be flexible. Reactions will depend upon the equipment available and the circumstances of the individual case. All concerned must be aware that a system is in operation and that it should be follow ed as far as is practicable.

Radar Conspicuous Objects and Visual Navaids

In order to reduce the workload while navigating in coastal waters, the navigator will have determined and planned the primary arid secondary methods of fixing. To further reduce the OOW’s workload the navigator will have studied his chart at the planning

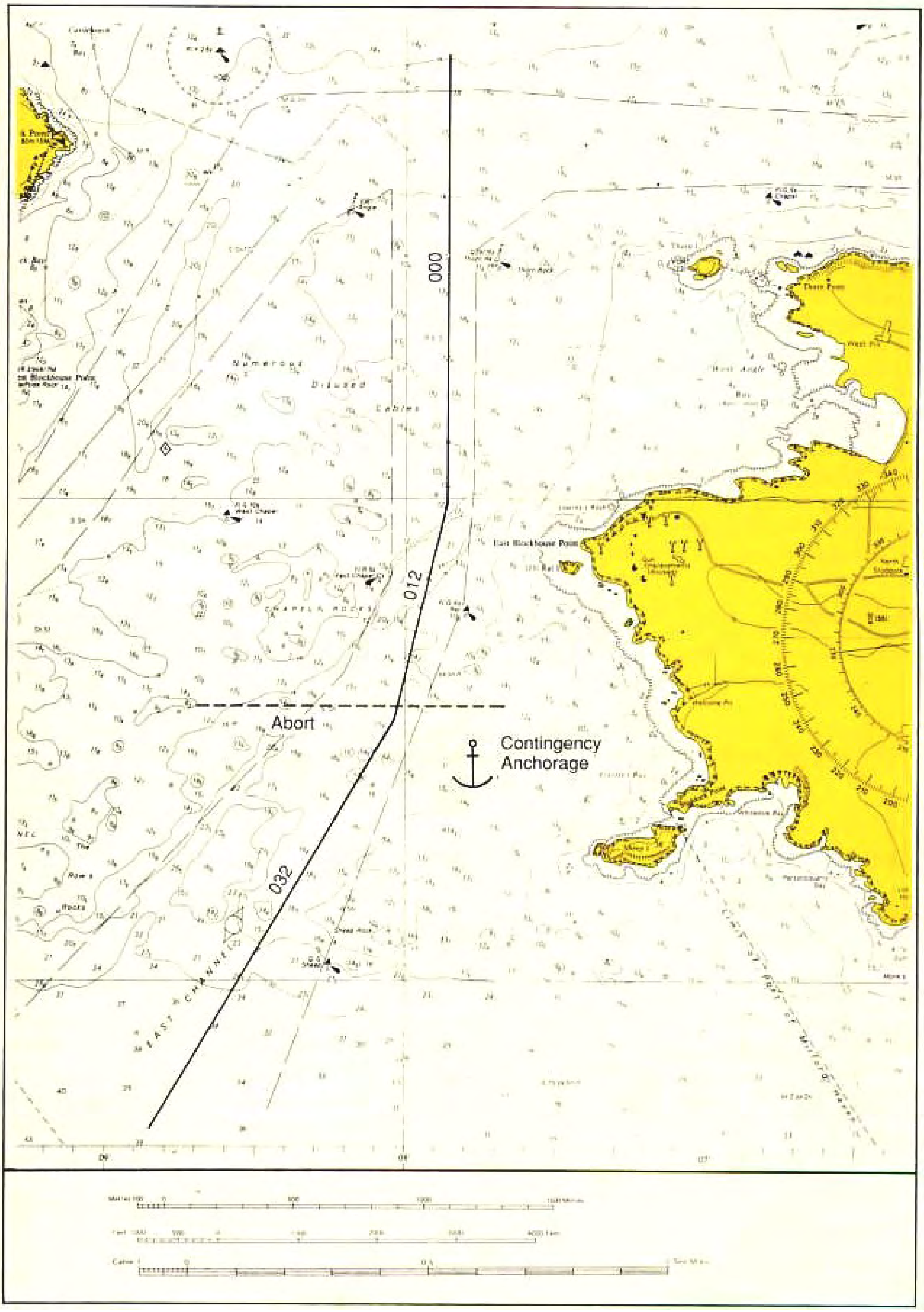


Figure 6 ABORTS AND CONTINGENCIES

Crown Copyright. Reproduced from Admiralty Chart 3724 with the permission of the Hydrographer of the Navy stage and decided which radar conspicuous marks and visual aids are to be used at each stage of the passage. Such uniformity will not be confusing to the watch relief, nor to the master should he have reason to come to the bridge.

Landfall Lights

When making a landfall it should not he necessary for the 00W to have to minutely examine the chart to find which lights will be seen first. These will have been clearly shown on the chart with their maximum visibility range so that the OOW can concentrate on actually looking for the light concerned, not looking on the chart trying to discover which lights should visible. By determining the bearing and range of a “dipping light” the OOW can obtain an approximate position, often long before radar can have detected such light.

The same applies when passing along a coastline or through constrained waters. As lights shown on a chart look similar the need to be studied to determine their individual significance. This needs to be done at the planning stage. not the operational stage when the 00W concerned may be too busy to spend time behind the chart table. See section on range of lights below.

Radar Targets

Similarly with radar targets. A little time spent at the planning stage will soon determine which targets are to be looked for and used; a steep-to islet is going to be more reliable than a rock awash.

Highlight on the chart Racons and other radar conspicuous objects that will be used for position fixing. Highlight visual navaids as appropriate, differentiating between floating and fixed navaids and high powered and low powered lights, bearing in mind that, of choice, floating navaids should not be used as they may not he in their charted position.

Buoyage

Whenever buoys or other floating navmarks are being used as position fixing aids their own position must be first checked and confirmed that they are as shown on the chart. In situations where buoy fixing is critical, such positions can be predetermined at the planning stage by noting their range and bearing from a known fixed object or by confirming from the local VTS that all navigational aids are as charted.

Fix Frequency

Irrespective of the method of fixing to be used, it is necessary to establish the required frequency of the fixing. Quite obviously, this is going to depend on the circumstances prevailing, a ship close to danger will need to he fixed more frequently than one in the open sea. As a guideline, it is suggested that fixing should be at a time period such that it is not possible for a ship to get into danger between fixes. If it is not possible to fix the position on the chart at such frequency (fixes at intervals of less than three minutes can be very demanding) then alternative primary navigation methods. Parallel Indexing, for example, should be considered.

Fix Regularity

Having established the fix frequency it is good practice to ensure that fixes are in fact made at that frequency, not as and when the 0()W thinks fit. The only exception to this will be if the 00W has other priorities to contend with, e.g. course alterations for traffic or approaching a critical heel over position. To this latter case the ship's position should be established immediately before the turn and then again, as soon as possible, on completion.

Additional Information

Although not essential to the safety of the ship, a lot of additional information can be shown on the plan which, by reminding the OOW of his obligations or reminding him to make certain preparations, will make the execution of the voyage simpler. Such information will include the items listed below:

Reporting Points

Reporting to the relevant authority as and where required can only make the vessel's routeing safer and may also be compulsory. When inexperienced officers are making such reports it is advantageous to write down, on the chart at the reporting point or in a separate book, the information the officer will need. This may include the appropriate VHF channel and key data required to be transmitted.

Anchor Clearance

Positions where anchors need in be cleared and anchor stations called should be shown in order not to be overlooked.

Pilot Boarding Area

Timely preparation of the pilot ladder and warning to involved personnel to stand by as required.

Tug Engagement

Reminder to OOW to call the crew necessary to secure tugs.

Traffic Areas

Areas where heavy traffic or where occasionally heavy traffic, e.g. ferries or fishing boats may be met.

Safe navigation of the ship does not only require fixing the position of the ship on the chart at regular intervals. The COW needs to be constantly updating himself regarding the position of the ship relative to the required track and the tendency to increase or decrease deviation from track. Although regular fixing will give this information there are other, less obvious ways of obtaining such information, often requiring little input other than just observing natural features. Many of these can be planned in advance and marked on the chart:

Transit (Ranges)

Transits, (known as Ranges in America) i.e., the line on the chart upon which an observer would see two identifiable objects in line, can be used to give the OOW a quick indication of his position. Although it is only a single position line its advantage is that it requires no use of instruments but can be seen h eve. For extreme accuracy the distance between the observer and the nearer object should be no more than three times the distance between the objects observed, though transits of greater than this distance can be used to advantage.

Transits are sometimes printed on charts of inshore waters but good use can be made of natural and clearly identifiable transits found at the planning stage and drawn on the chart.

Transits can also he used as a cue for a pie-arranged action to be taken, e.g. wheel over, or as a reminder that an event is about to occur. -

Compass Error

Transits may used to determine gyro and magnetic compass errors by comparing charted and observed bearings.

Leading Lines

Leading lines are often shown on charts. In this case the transit printed on the chart is a track little to be followed to ensure that the ship passes clear of danger. By observing that the leads are in line the OOW is assured that his ship is on the planned track.

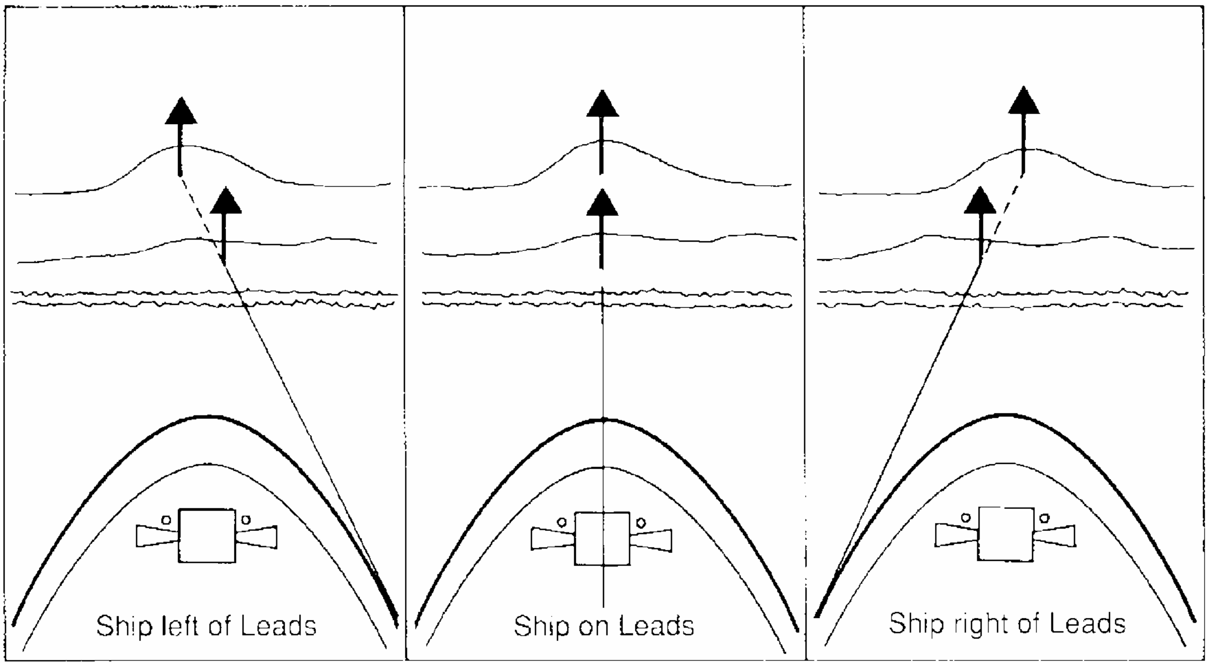


Figure 7 LEADING LINES

Clearing Marks

Clearing marks can be used to ensure that a ship is remaining within a safe area or is not approaching a danger. In Figure H the clearing bearing is shown so that as long as the Western end of Rat Island remains open of and to the left of Sheep Buoy then the ship is making a safe approach with reference to that side of the channel.

Head Mark

Often a ship is required to follow a track in narrow waters without the benefit of a leading line. In this case a suitable head mark should be selected. This should he a readily identifiable conspicuous object shown on the chart, which lies on the projection of the required track at that part of the passage. As long as the compass bearing of the head marker, corrected for errors and preferably taken with a centre line repeater, remains constant, (i.e. the same as the required track) the ship is remaining on track. It should be noted that (he ship need not necessarily be heading directly at the object, only that it is on the line of the required track. In many cases the ship’s head will need to be offset to allow for tide or leeway. Such head mark can only be monitored by a compass bearing; a relative bearing can become completely misleading as a vessel can actually circle a target on the same relative bearing.

Clearing Bearings

In the event that no clearing marks are available a single identifiable charted object may he similarly used. In Figure 9 as long as the bearing of the mark remains within the range 028°T— 042°T then the ship will be in safe water. These clearing bearings should be shown on the chart and may be shown as NLT 028°T and NMT 042°T (not less than/not more than).

Observing clearing bearings and clearing marks cannot he considered to be fixing” the ship but can assist the OOW to ensure that his ship is not standing into danger. Similarly using dipping distances, whilst not being considered to be an accurate fix, can make the OOW aware that he is approaching danger.

Range of Lights

The maximum range at which a navigational light can be seen depends upon three separate factors:

1 The combined height of eye of the observer and the elevation of the light.

2 The intensity of the light.

3 The clarity of the atmosphere.

Geographical Range

The greater the height of the light the greater the distance at which it will be visible; equally the greater the height of eye of the observer, the further he will see the light. These two factors combined will give a maximum range of visibility called the Geographical Range and may be obtained from tables in the List of Lights. in practice, this range will be severely reduced if the light observed is only low powered and therefore not capable of being seen at its Geographical Range.

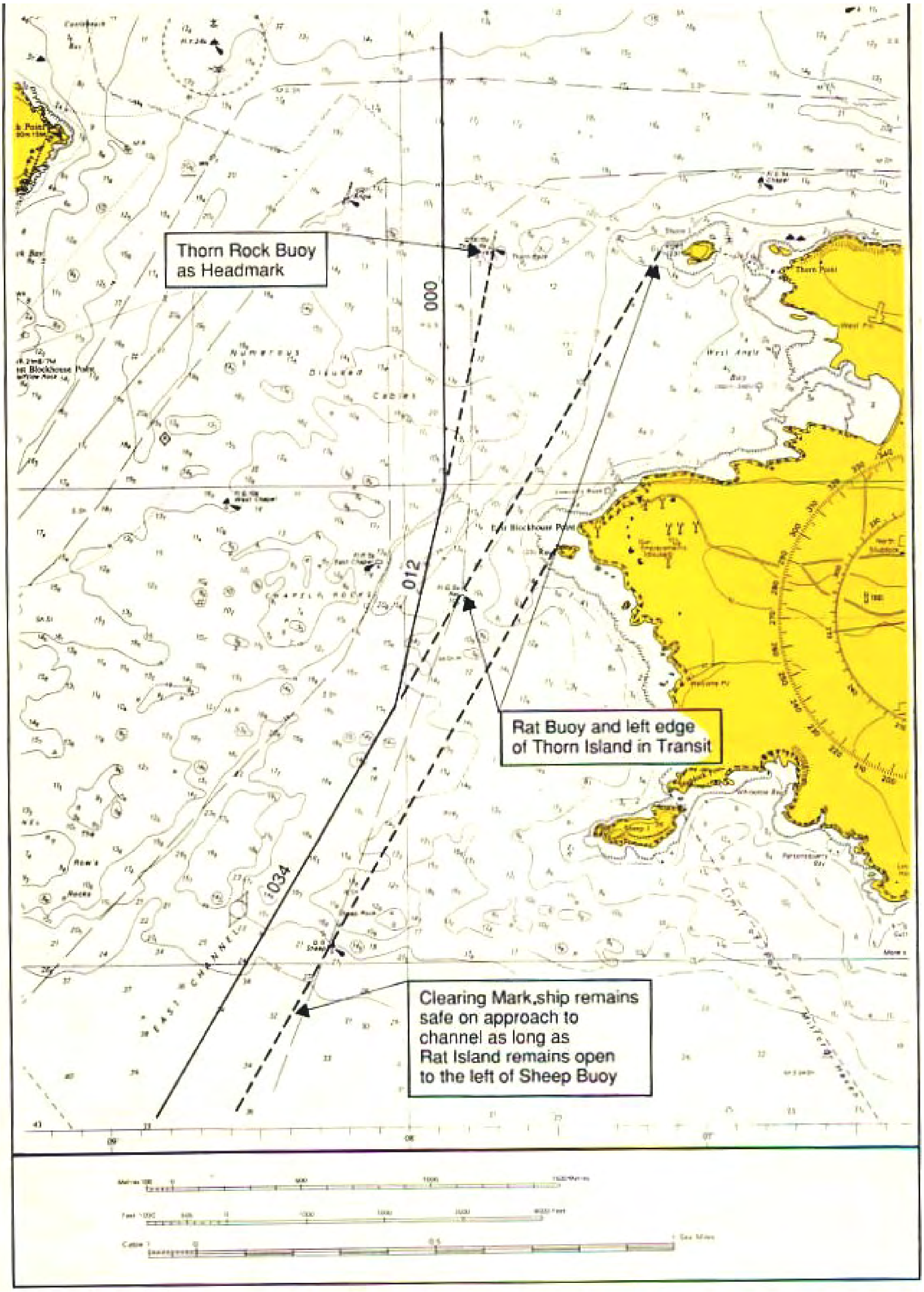


Figure 8 NATURAL TRANSIT, CLEARING MARKS AND HEAD MARKS

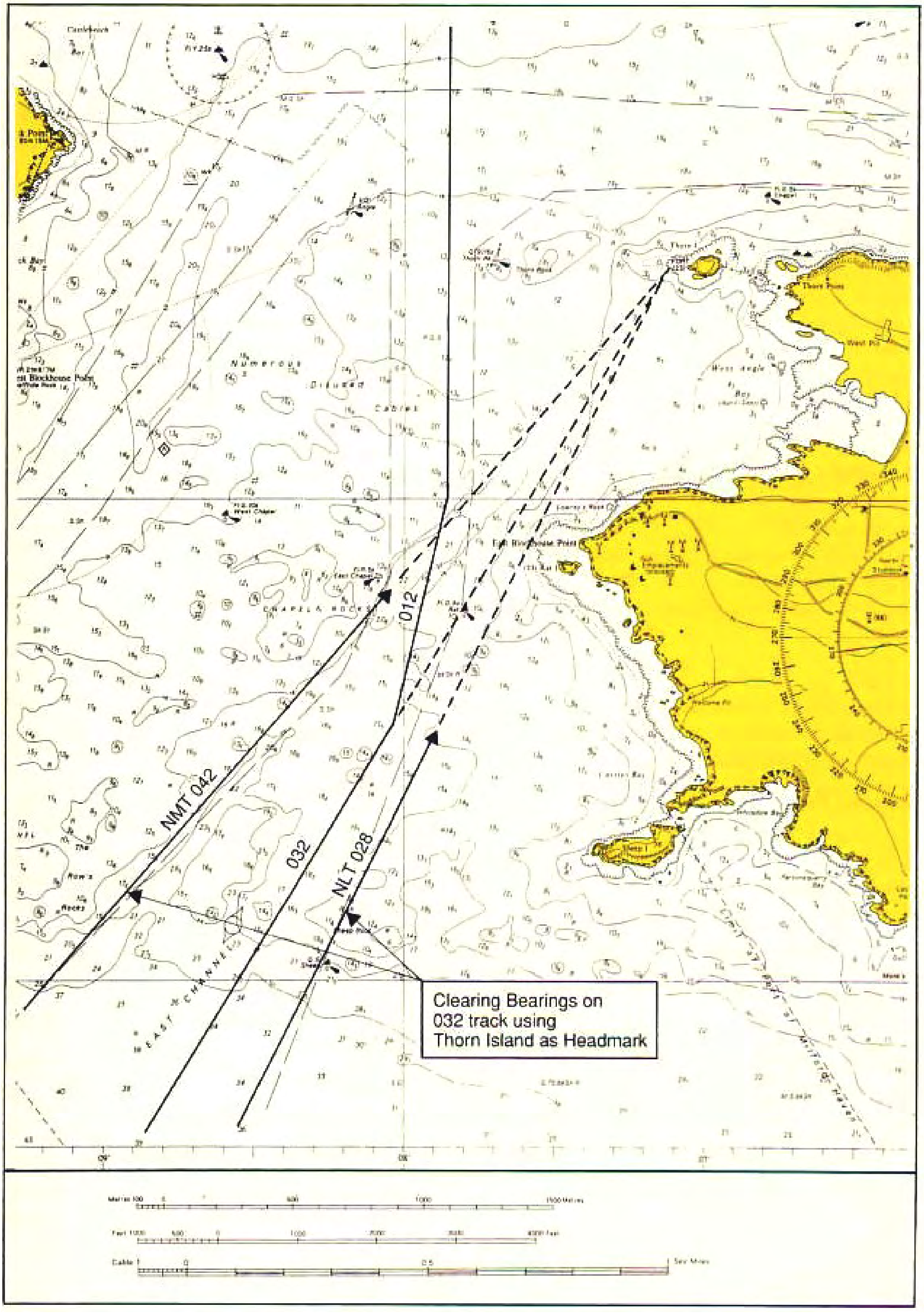


Figure 9 CLEARING BEARINGS

Crown Copyright. Reproduced from Admiralty Chart 3724 with the permission of the Hydrographer of the Navy

Luminous Range

This is the maximum distance at which the light can be seen and is dependent upon the intensity of the light and tile atmospheric visibility prevailing. It takes no account of the height of the light nor that of the observer's eye. Obviously, the more intense the light, the further it will be seen, whatever the state of the atmosphere, and the appropriate table will give a good indication of how ha the light can be expected to be seen.

Nominal Range

The range shown on the chart, beside the light star, is usually the Nominal Range, i.e. the luminous range when neteoro1ogical visibility is 10 miles. This is not invariable though. Some countries, such as Japan, chart the Geographical Range: some such as Brazil, the Geographical or Nominal according to whichever is the greater. It is the navigator's responsibility to make himself aware of which range is shown and to ensure that the OOWs are also aware of this fact.

Landfall Lights

At the planning stage of the voyage, the navigator will have the opportunity to determine the maximum distance at which a landfall light should become visible. A comparison of the nominal and geographic ranges can be made and the lesser of the two selected as being the range at which the light should be seen, assuming meteorological visibility of at least 10 miles. It should be noted that only lights whose luminous range exceeds their geographical range could be considered as giving an approximate fix. In any case the arcs of maximum visibility should he drawn on the landfall chart so that the OOW is aware of the likelihood of seeing lights and which ones he should see first.

Extreme Range

When approaching the coast lights will come into view according to their height, their intensity and the ambient visibility. Sometimes the first indications of the proximity of the coast will be powerful navigation lights that may be seen before the radar can detect them as targets. Whilst not pretending that sighting the lights can he an accurate fix, an observation of the compass bearing at the time of sighting and plotting this with the extreme range of the light at this time will give the OOW an awareness of the proximity of danger.

In the event that a light is not sighted as expected then the OOW will be aware that the ship is:

1 Not where he anticipated it to be.

2 The light is unlit or obscured in cloud.

3 There is poor visibility between the ship and the light.

The actual cause must be determined by his own judgement. The fact is that there is something which is not quite as it should he.

Echo Sounder

Some ships leave an echo sounder running at all times. On ships where this is not the case, it is good practice to switch the echo sounder on prior to a landfall being made, As in the case of a light at maximum range, whilst not providing a fix, the actual decrease in soundings will make the OOW more aware that he is approaching danger.

Chart Overcrowding

The information required to monitor the passage will, in many instances, be shown on the working charts. In some situations this may not be possible; there may be too much information needing to be shown, thus overcrowding the working area, or even blotting out certain chart details. In some cases this overcrowding can be reduced by writing the required information well clear of the track, e.g. on the land, and drawing attention to it by either a connecting tine or a reference letter.

Planning Book

In any case, certain information may be better written in a planning book, e.g. times of high and low water, times of sunrise and sunset, VHF working frequencies, etc. Where a ship uses a port regularly the navigator may prefer to put the whole of his plan into a planning book in addition to the chart, so that it can be referred to at a later date. He may choose to hold such information on a computer, where it can be accessed and modified when making a return visit

Conning Notebook

Depending upon the length and complexity of the passage, or certain parts of it, it is good practice for an abbreviated edition of the plan to be made into a notebook. The person having the con can then update himself as and when required without having to leave the conning position to look at the chart.

Master's Approval

On completion the plan must be submitted to the master for his approval. Opportunity must also be taken to make all members of the bridge team aware that the voyage/passage plan is complete and to invite them to both examine it and make such comment as is necessary.

Plan Changes

All members of the bridge team will be aware that even the most thorough plan may be subject to change during the passage. It is the responsibility of the person making such changes to ensure that such changes are made with the agreement of the master and that all other members of the team are so advised.

Automatic Identification System (AIS)

The requirement to carry AIS means that additional information may be available which otherwise could not be obtained. Of particular value is the identification of ships hidden by land or in rain. Also, early detection of target heading changes can be observed. Because of manual inputs into the system. care must be taken when using the information for decisions.

Chapter4

EXECUTING THE PASSAGE/VOYAGE PLAN

Tactics

The plan having been made, discussed and approved, execution of the plan now has to be determined. By this is meant the methods used to carry out the plan, including the best use of available resources. Final details will need to be confirmed when the actual timing of the passage can be established. The tactics to be used to accomplish the plan can then be agreed and should include:

ETAs for Tide — Expected Times of Arrival at critical points to take advantage of favourable tidal streams.

ETA for Daylight — ETAs at critical points where it is preferable to make a daylight passage or with the sun behind the ship.

Traffic conditions — Traffic conditions at focal points.

Destination ETA — ETA at destination particularly where there may be no advantage to be gained by early arrival, or where a pilot boarding time has been confirmed.

Tidal Streams — Tidal Stream information, obtained from the chart or tidal stream atlases, can be included in the planned passage when the time of transit of the relevant area is known. Ideally, courses La steer should be calculated prior to making the transit, though in fact, strict adherence to the planned track will automatically compensate for tidal streams. Current information can also be obtained and shown on the chart.

Plan Modification — It must always be borne in mind that safe execution of the passage may only be achieved by modification of the plan in the case of naiga1ional equipment becoming unreliable or inaccurate or time changes having to be made e.g. delayed departure.

Additional Personnel — To achieve safe execution of the plan it may be necessary to manage the risks by using additional deck or engine personnel. This will include an awareness of positions at which it will be necessary to:

1 Call the master to the bridge for routine situations such as approaching the coast, passing through constrained waters, approaching the pilot station etc.

2 Change from unattended to manned machinery space.

3 Call an extra certificated officer to the bridge.

4 Make personnel, in addition to the watchkeepers, available for bridge duties such as manning the wheel, keeping look out, etc.

5 Make personnel, in addition to the watchkeepers, available for deck duties such as preparing pilot ladders, clearing and standing by anchors, preparing berthing equipment, engaging tugs, etc.

Briefing

Before commencing the voyage/passage it will be necessary to brief all concerned. This ensures that all personnel are aware of their involvement in the proposed planned passage's/voyage and also gives them the opportunity to query or comment on any part of the plan that they do not hilly understand. Briefing may take place over a considerable period of time. As the actual commencement of the voyage approaches, certain specific personnel will have to be briefed so that work schedules and requirements can be planned.

In particular, any variation from the routine running of the ship, e.g. doubling of watches, anchor party requirements etc. must be specifically advised to involved personnel, either by the master or the navigator. Such briefing will require frequent updating and different stages will have to be re-briefed as the voyage progresses. Briefing will make individuals aware of their own part in the overall plan and contributes to their work satisfaction.

Fatigue

Prior to the commencement of the passage. and in certain cases, during the passage. it may be necessary for the master to ensure that rested and unfatigued personnel are available. This could include such times as leaving port, entering very heavy traffic areas, bad weather conditions or high risk situations such as transiting a narrow strait etc. This availability can be achieved, within the limits of the total number of persons available, by ensuring that watchkeepers of all descriptions are relieved of their duties well in advance of being required on watch in order that they may rest.

This could require changes to routine watchkeeping periods, extending certain watches or even curtailing watches but it is at the master's discretion and he should not hesitate to make such changes.

Passage/Voyage Preparation

One of the basic principles of management is ensuring that the workplace is prepared and readied for the ensuing task. This will normally be the task of a junior officer who will prepare the bridge for sea. Such routine tasks are best achieved by the use of a checklist but care has to be taken to ensure that this does not just mean that items on the checklist are ticked without the actual task being done.

Bridge Preparation

At the time designated by the master, the officer responsible should prepare the bridge by:

1 Ensuring that the passage plan and supporting information is available and to hand. It is likely that the navigating officer responsible for preparation of the passage plan will have made these items ready; nevertheless, their readiness should still be confirmed.

Charts should be in order, in the chart drawer and the in use chart be available on the chart table. It is bad practice to have more than one chart on the table at a time, as information read from one and transferred to the other may not be correct.

2 Checking that chat t table equipment is in order and to hand, e.g. pens, pencils, parallel rules, compasses, dividers, note pads, scrap pads, etc.

3 Checking that ancillary watchkeeping equipment is in order and to hand, e.g. binoculars, azimuth rings, Aldis lamp, etc.

4 Confirming that monitoring and recording equipment. e.g. course recorder, engine movement recorder is operational and recording paper replaced if necessary.

5 Confirming that the master gyro is frilly operational and correct and repeaters aligned. The magnetic compass should be checked.

6 Checking that all instrument illumination lamps are operational and their light levels adjusted as required. The availability and whereabouts of spares should be checked.

7 Checking navigation and signal lights.

8 Switching on any electronic navigational equipment that has been shut down and the operating mode and position confirmed.

9 Switching on and confirming the readouts of echo sounders and logs and confirming associated recording equipment.

10 After ensuring that the scanners are clear, switching on and toning radars and setting appropriate ranges and modes.

11 Switching on and testing control equipment i.e. telegraphs, combinators, thrusters and steering gear as appropriate.

12 Switching on and testing communications equipment both internal (telephones and portable radios) and external (VHF and MF radios, NAVTEX, INMARSAT and GMDSS systems as appropriate.)

13 Testing the whistle.

14 Ensuring that clear view screens and wipers are operational and that all windows are clean.

15 Confirming that all clocks and recording equipment are synchronised.

16 Ensuring that the workplace is in correct order, lighting is as it should be, doors and windows open and close easily, temperature controls are set as appropriate and movable objects are in their correct place.

17 Switching on and correctly entering the ship’s data into the AIS.

18 After ensuring that there is no relevant new information on the Telex, Fax or Navtex advising the master that the bridge is ready for sea.

The list above is only a general guide. Each ship will have its own specific checks that have to be included. A modified version of the above should also be carried out when approaching port or any area where other than routine watch keeping may occur.

Chapter 5

MONITORING THE SHIP'S PROGRESS

Introduction

Monitoring is ensuring that the ship is following the pre-determined passage plan and is a primary function of the Officer of the Watch. For this, he may be alone; assisted by other ship's personnel; or acting as back up and information source to another officer having the con.

Monitoring consists of following a series of functions, analysing the results and taking action based upon such analysis.

Fixing Method

The first requirement of monitoring is to establish the position of the ship. This maybe done by a variety of methods, ranging from the very' basic three hearing lines, through a more technically sophisticated use of radar ranges and bearings, to instant readout of one of the electronic position fixing systems, e.g., LORAN or GPS. The result though. is always the same. However the fix has been derived the OOW finishes up with no more than a position. It is how this information is used that is important.

Visual Bearings

As stated above, fixing methods vary. Basic fixing consists of taking more than one position line obtained from bearings using an azimuth ring on a compass. Gyro or magnetic, the bearings are corrected to true, drawn on the chart and the position shown. Three position lines are the minimum required to ensure accuracy.

Poor visibility or lack of definable visual objects may prevent a three bearing fix being made. In this case radar derived ranges (distances) may be included in the fix and under some circumstances make up the whole of the fix. In any case a mixture of visual or radar hearings and radar ranges is acceptable. Other methods may be used, e.g. running fixes (which may be inaccurate as they depend on an element of DR) sextant angles etc, but these are seldom used on modern ships. Any good chartwork textbook will give a wide range of less used fixing methods.

Electronic position fixing may also he used, particularly where there are no shore based objects to he observed and the radar coastline is indistinct. Whilst these systems appear to be infallible the operator needs to have a good understanding of the principles and failings of the electronic system being used, in order to avoid a false sense of security.

Fix frequency will have been determined at the planning stage. Even so. this may' have to be revised, always hearing in mind the minimum frequency required is such that the ship cannot get into danger between fixes.

Regularity

Fixing needs not only to be accurate and sufficiently frequent it also needs to be regular.

Estimated Position

Regular fixing also allows a fix to be additionally checked. Each time a position has been fixed, it is good practice to estimate the position that the ship will have reached at the next fix. Providing fixing is being carried out at regular intervals this can easily be picked off as the distance between the present and the previous fix and checked against the anticipated speed. If the next fix coincides with the Estimated Position (EP) then this acts as an additional check that the ship is maintaining its track and speed. Should the fix not coincide with the EP then the OOW is aware that something is either wrong with the obtained position or some external influence has affected the ship. The first action is to check the EP, then check the fix. If they are both correct then something is influencing the ship; either the course being steered is not the one required or the engine revolutions have changed. If both these features are in order then some external influence is affecting the ship, either the wind has changed direction or strength or the tidal stream has changed. The OOW is immediately aware that something is influencing the ship and can take immediate action to correct it.

Soundings

It is also good practice to observe the echo sounder at the same time as fixing and writing this reading on the chart beside the fix. If the observed reading is not the same as that expected from the chart then the OOW is immediately aware that something is not right. It may be that the chart is wrong; it may be that the ship is standing into danger.

Cross Track Error

Having fixed the position the OOW will he aware of whether or not the ship is following the planned track and whether or not the ship will arrive at the next waypoint at the expected time. If the ship is deviating from the planned track the navigator must determine whether or not such deviation will cause the ship to stand into danger and what action he should take to remedy the situation. Apart from deviating from track to avoid an unplanned hazard such as an approaching ship, there is seldom justification to not correct the deviation and get the ship back onto the planned track. The OOW must use his judgement. as to how much he needs to alter course to return to track. He must also bear in mind that e en when he has returned to the planned track he may need to leave some of the course correction on in order to compensate the cause of the earlier deviation.

International Regulations for the Prevention of Collisions at Sea

Irrespective of the planned passage, no ship can avoid conforming with the requirements of the Rule of the Road. These Rules are quite clear, are internationally accepted and understood by most OOWs.

RULE 16 states “Every vessel which is required to keep out of the way of another shall, so far as possible, take early and substantial action to keep clear”.

Despite the requirement to maintain track, RULES makes it quite clear that the give way ship must keep clear, either by altering course or if this is impossible then by reducing speed, or a combination of both these factors. Proper planning will have ensured that the ship will never be in a situation where such action cannot be taken.

In areas of heavy traffic and proximity of dangers, the person having the con will have to hold a delicate balance between planned track maintenance and other ship avoidance. The priority will be to avoid collision, but not at the expense of grounding.

Non-navigational emergencies

Similarly, the bridge team must never allow the reaction to an emergency situation to so dominate their response that the ship is put into a hazardous situation such as accidentally entering an area of high danger. Again, the planning should have allowed for such contingencies but even the best plan cannot allow for every conceivable situation. Situational awareness and careful assessment of the changing circumstances, coupled with principles of bridge team management will help prevent a bad situation compounding and becoming worse.

Time Management

In the event that the ship is ahead of or behind the planned ETA at the next waypoint, the OOW must use his judgement as to whether he adjusts the speed or not. In some instances, as for example when it is imperative that the ship's ETA is critical to make a tide, then ETAs have to be adhered to.

In either of the instances cited above, it will be the observance of night or standing orders or at the OOW's discretion as to whether he advises the master.

Lookout

The OOW's situational awareness will be improved by both the structured management of the team and his own self-discipline ensuring that he keeps a good professional watch. This will include his confirming that a good lookout is kept. A good lookout clues not just mean that he personally keeps a good visual lookout of the ship's surroundings.

Rule 5 of the International Regulations for the Prevention of Collisions at Sea (1972, ratified 1977) states:

> "Every vessel shall at all times maintain a proper look out by sight and hearing as well as by all available means appropriate in the prevailing conditions so as to make a full appraisal of the situation and of the risk of collision."

Though specifically addressing collision the above quoted rule also applies if the OOW is to maintain his situational awareness. The keeping of an efficient look out needs to be interpreted in its fullest sense and the OOW needs to be aware that look out includes the following items:

1 A constant and continuous all round visual look out enabling a full understanding of the situation and the proximity of dangers, other ships and navigation marks to be maintained. In some instances, particularly in poor visibility, radar will give a better picture of the ship's environment than actual visual observation. However, unless the OOW has considerable experience of comparing the radar picture with the visual scene he cannot automatically interpret his radar picture. in any case, the visual scene is the real scene not an electronic version of reality and the OOW who frequently observes the scene outside the windows will have a better understanding of and feel for the world around him.

2 Visual observation will also give an instant update of environmental changes, particularly visibility and wind.

3 Visual observations of the compass (magnetic or gyro) bearing of an approaching ship will quickly show whether or not its bearing is changing and whether or not it needs to be considered a danger.

4 Visual observation of characteristics of lights and timing of them is the only way of positively identifying them and thus increases the OOW's situational awareness.

5 Lookout will also include the routine monitoring of ship control and alarm systems, e.g. regularly comparing standard and gyrocompasses and that the correct course is being steered.

6 Electronic aids should not be overlooked or ignored under any circumstances, but it should be borne in mind that echo sounders, radars etc. are aids to navigation, not merely single means of navigation.

7 Also included in the concept of lookout should he the advantageous use of VHF. judicious monitoring of the appropriate channels may allow the OOW to be aware of situations arising long before the ship is actually in the affected area.

8 A routine should be established for major course alterations including:

8.1 Checking astern prior to altering.

8.2 Checking, both visually and by radar along the bearing of the new track.

The OOW's situational awareness will also be enhanced by his observation of the environment using all available means, not just limiting himself to the routine of fixing and correcting as described above.

Under-keel Clearance

Routine observation of the echo sounder needs to be one of the procedures of the watch.

Waypoints

Besides being points noted on the chart where a change of status or an event will occur, waypoints are also good indicators of whether the ship is on time or not. If not, then something has occurred or is occurring that has affected the passage and the OOW will lake steps to correct this occurrence.

Transits (Ranges)

Transits are often important navigational features; they can for example be used to cue decisions such as a wheel over, but can also be used in a more passive role. The OOW can use a transit to confirm that the ship is on schedule or that it is remaining on track, particularly when (his occurs after an alteration. Of itself, the confirming transit may be no more than a minor occurrence but it will help the observant OOW confirm in his own mind that all is well and as it should be.

Leading Lines

Leading lines, i.e. the transit of two readily identifiable land based marks on the extension of the required ground track and usually shown on the chart are used to ensure that the ship is safely on the required track.

Natural Leading Lines

In some instances the OOW may be able to pick up informal leading lines, e.g. a navmark in line with an end of land which confirms that the vessel is on track.

Observation of a head mark and a quick mental calculation will give an indication of the distance that the ship has deviated from her track. The distance off track in cables is equal to:

Required brg - observed brg x dist. from object (miles) / 6

Alternatively, the off track distance can readily be evaluated by looking down the required bearing and estimating the distance between the headmark and where the observed bearing meets the land. Man made features such as cars, buses and lamp posts can aid this estimate.

Clearing Marks and Bearings

As described in Planning, clearing marks and clearing bearings, whilst not being considered to be a definitive fix, will indicate to the OOW that his ship is remaining in safe water.

Rising/Dipping Distances

Making a landfall or running along a coastline, observing rising and dipping distances of powerful lights and marking this on the chart with the observed bearing can also help assure the OOW that the ship is in the anticipated position.

Light Sectors

The changing colours of sectored lights can also be used to advantage by the 00W and in certain instances, which he should be very aware of, will indicate that the ship is standing into danger. On occasion the flickering sector change can ‘Virtually be used as a hearing. Care needs to be taken in icy weather, as sectors can become indistinct.

GPS

The provision of navigational satellites, giving ships the opportunity to determine their position at any time, is one of the greatest achievements of modern technology. However, like all navigational systems, incidents have occurred when they were least expected, so it is worth re-stating the principles used in this hook to avoid haphazard risks. Such principles also need to he applied to satellite navigation.

Principle 1 Good planning is essential.

Principle 2 The ship must not be put at risk through a one-man error.

Principle 3 The ship must not be put at risk through equipment failure.

Principle 4 The ship's position must at all times be correctly related to the land.

With satellite navigation there are two key factors which require to be monitored. The first is the possibility of equipment failure in both the satellite and in the on board equipment. The second is the geographical reference of the satellite when compared to the chart. In reality, many charts show the land in the wrong position, which considering that none of the original navigators had such navigational aids as satellite navigation systems is hardly surprising. Consequently, great care must be taken when making a landfall, especially in less busy parts of the world, and when changing from one chart to another.

To avoid a one-man error, as there are many different types of satellite receiver, the prudent mariner must double check readings and chart positions and have them checked again at the handover of the watch.

Concerning equipment errors, even ships with two or more independent satellite receivers can experience source errors from the same satellite and would be similarly affected in the event of satellite failure. Consequently, separate GPS systems cannot be relied on to check one another, so the prudent navigator will be checking satellite readings by another independent means, even though this may be as simple as DR (Dead Reckoning derived simply from the resultant of course and speed through the water). When available, more sophisticated systems such as radar fixing or even visual fixing will be used and even these should be verified by constant updating of the DR or preferably EP. In coastal waters an excellent way of confirming the GPS is to operate a parallel index system c on currently.

All the above rely on the officer of the watch making his input into the system. The precise display of navigational information, especially when operating with an integrated system. can often lead to a situation whereby the navigator may consider the system to be failsafe and not needing constant surveillance. This may well not be the case because failed electronics may not be self connecting, nor give an obvious warning (see *Royal Majesty*, Bermuda to New York). CI'S does not lessen the requirement for careful, diligent navigation and it always needs bearing in mind that the navigator has had no part in the construction of a CPS fix but is merely an observer. A GPS fix is, in fact, no more than an easier method of obtaining a fix. It must be emphasised that it is the way the fix is used which makes it contribute to safe navigation.

Chapter 6

TEAMWORK

Introduction

IMO Resolution 285 requires that the OOW *"ensures that an efficient lookout is maintained"* but concedes that *"There may be circumstances in which the officer of the watch can safely be the sole lookout in daylight."*

However *"When the officer of the watch is acting as the sole lookout he must not hesitate to summon assistance to the bridge, and when/or any reason he is unable to give his undivided attention to the lookout such assistance must be immediately available."*

It is normal practice to have the uncertificated watchstander working in the vicinity of the bridge where he can be called should he be required. At night the lookout is normally on the bridge carrying out his exclusive lookout duties.

Under certain conditions the OOW may be the only person actively engaged in the navigation of the ship. The steering may be in automatic and the lookout engaged in duties around the bridge area. There is no apparent call for teamwork; the OOW will be personally responsible for all aspects of safe navigation. Nevertheless he will be required to work within a framework of standing and specific orders so that the master will be confident that the watch is being kept to his, and the company's, standards.

The single watchkeeper status may change at short notice. If the 00W becomes engaged in duties which require him to forgo his obligations as lookout then he will have to call his uncertificated watchstander to take that role. Here we have the first basics of teamwork.

It is the responsibility of the OOW to ensure that the seaman assigned watchkeeping duties:

1 Has been properly instructed in lookout duties as to what is expected of him.

2 Knows how to report observations.

3 Is adequately clothed and protected from the weather.

4 Is relieved as frequently as necessary.

5 Is positioned where he can best act as lookout.

The watchkeeping officer may require a man on the wheel in addition to the lookout. It is the responsibility of the OOW to see that the vessel is safely and efficiently steered.

We are now in a situation requiring a considerable amount of organisation and cooperation. The watch officer still has the responsibility for the watch but has to use and rely upon the assistance of two other people. It is his responsibility to ensure that they are aware of their duties and carry them out in a manner that will enhance the effectiveness of the watch. Although neither person, in this case, should find the duties particularly onerous nor difficult, the watch officer still needs to ensure that orders are correctly followed, e.g. helm orders are complied with as required, not as the helmsman thinks fit.

Under certain circumstances the 00W may find it is necessary to call the master to the bridge. This may be because the pre-planning requires the presence of the master on the bridge or the masters standing or night orders have required him to be called under the developing circumstances or because the COW has realised that the situation needs the experience and expertise of the master

Calling the master to the bridge will not transfer the con from the watch officer to the master. Until such time as the master actually declares that lie has the con the OOVI4T must still carry out his duties as he was prior to the master's arrival. Once the master has taken the con, and the event has been logged, then the watch officer moves into a supportive role, but is still responsible for the actions of his watch members.

It is now necessary to define the role of the individual team members. Quite obviously this will to a large extent depend upon the individuals involved and the practice of the ship. hut unless each individual’s role is understood by au involved certain functions may be duplicated or ignored. Teamwork will depend upon agreed roles and the following are suggested.

The MASTER controls movement of the vessel in accordance with the Rule of the Road and recommended traffic schemes, regulates the course and speed, supervises the safe navigation of the vessel and coordinates and supervises the overall watch organisation.

The WATCH OFFICER continues to navigate the ship reporting relevant information to the master, ensuring that such information is acknowledged. He fixes the vessel and advises the master of the position and other information. He monitors the execution of helm and engine orders, coordinates all internal and external communications, records all required entries in log books and performs other duties as required by the master.

The lookout and helmsman s ill still be carrying out their duties, as above.

Under certain circumstances, the master may consider it necessary to have the support (if two navigating officers, one as OOW the other as back up. The master’s responsibilities will be as above, but the responsibilities of the two officers will require careful definition. It is obvious that a scenario requiring two watch officers supporting the master will indicate that the ship is in a high risk situation. Probable factors will be:

1 Narrow margins of safety requiring very careful track maintenance.

2 Reduced underkeel clearance.

3 Heavy traffic.

4 Poor visibility or any combination of similar factors.

The OOW will still carry out his duties as defined above and be generally responsible for the normal running of the watch.

An ADDITIONAL OFFICER’s role will be to provide the master with radar based traffic information and to giving general backup to the OOW on the chart. This will include providing the chart with navigational information as required, confirming important navigational decisions and coping with both internal and external communications.

It is difficult to establish exact rules about how the tasks of the bridge team should be distributed. It will depend upon the abilities and characters of the personnel involved, the circumstances requiring the additional personnel involvement and the lay out of the bridge. The important thing to bear in mind is that each member of the team knows the role that he is required to carry out and the roles of other members of the team. As stated above this will preclude unnecessary duplication of tasks and, more importantly, ensure that other tasks are not ignored or overlooked.

Training and Coaching

It cannot be assumed that Bridge Team Management and Passage Planning is a simple natural function that can be practised by anyone. Instruction and training is a necessary factor. Personnel have to be taught in order to achieve their maximum potential. On a well-organised ship, this may be a natural extension of the way in which personnel carry out their functions, introducing a new member of staff to their way of working and ensuring that he becomes a member of an already well organised bridge team.

This, though, may often not be the case. Bridge teamwork and passage planning is often not a part of a person’s training. Many countries do not require such features in their certificate structure; the student thus requires the coaching of senior personnel to correct this. But such coaching may not be available, due to the senior officers having undergone training that (lid not require such functions as passage planning, or from them having inherited a culture that (toes riot require such features.

Simulator training

In many cases the best method of learning such skills is to attend a simulator course with a whole ship's crew, or at least the watchkeeping officers, including the master. Such courses are run at simulation centres in many parts of the world and are regularly available. They are generally organised by the shipowners concerned, as they are rather expensive, but do not have to include personnel from one ship only but can involve personnel from one company or even individuals from various companies.

In general, courses are run on a similar basis but may vary a little between providers. Depending on the shipowners' requirements and the level of students, the simulator can be programmed to make the exercises as difficult, or otherwise, as required. It is normal to use inland or coastal waterways for exercises, as the open sea may not be sufficiently difficult. It just depends on the level of the students. Traffic and weather conditions may be introduced to an appropriate level and pilots too may be involved in order to assess the acceptance of a pilot into a bridge team. In short, the simulator is so versatile as to be able to replicate most circumstances and ship types.

Groups generally consist of four persons, though five may be involved and ideally they will include a master and one each of the navigating officers, but may also include a cadet or other person for each of the roles.

The first session on the first day consists of introducing the students to the staff and explaining the concept of bridge team management and the necessity for passage planning as a function of such management and as a legal requirement. This session concludes by the students entering the simulator and familiarising themselves with the layout and function of all equipment. This may include a simple straightforward passage, with no complications, to provide familiarity.

Thereafter, sessions are conducted so that each student can take a different simulation role in the bridge team, thus giving each one an understanding of other roles. The complexity of the operation can be varied according to the seniority and experience of the individuals in the senior simulated roles. For example, a practising third mate would not be expected to act as master in a situation requiring a genuine command role.

A one week, five working days, course gives each student two opportunities to simulate each of the four roles. Each session consists of one hour thirty minutes planning time, whereby the students plan their passage on charts provided and accessories such as books and computers, two hours in the simulator operating their planned passage and thirty minutes debriefing. The simulator operator or lecturer conducts the whole of each exercise, though the students usually participate in debriefing themselves, because they are well aware of where their planning or conduct may have been at fault. Such debriefing may be enhanced by each student, in turn, taking the role of observer. Whilst being on the simulator bridge, throughout the exercise, the observer takes no part in the running of the operation but makes notes and comments on the actions of the group or individuals, and leads the debriefing. This can prove to be a most cost effective way of operating the simulator, but will depend on the philosophy and culture of the provider.

Whilst not attempting totally to substitute reality, simulated exercises have their own advantages:

1 Simulation need not be restricted to only one group. Depending on the facilities available, timetables can be written to accommodate additional groups.

2 Each group can be operating identical exercises, as simulators are capable of being rescheduled, not only on a daily basis but even to ensure that all groups receive the same course.

3 Problems required for each group can be introduced, either at the layout stage of the exercise, or even during the operation of an exercise.

4 There is no real risk to either personnel or equipment.

5 Each student has the opportunity to engage in all roles, including those senior to his current position.

6 Personnel involved in the exercise feel totally independent in that there is no need for staff to be on the simulated bridge, although interested persons can monitor the bridge from the simulator control room.

7 Failures can be introduced to test contingency plans and teamwork.

8 Communication skills can be enhanced through VHF exercises with VTS pilot stations and ships' agents, as well as discussions within the group.

9 The value of teamwork can be demonstrated.

10 People's knowledge of passage planning and navigational techniques can be improved.

Exercises can be programmed to accommodate the needs of the group concerned. Ships can be varied as required, as can areas and other traffic. Weather can be varied or the whole scenario can be structured to familiarise a group with a certain area or condition. Debriefings can be similarly structured. Obviously, not all simulator courses are the same, but vary with location, simulator type and the culture of the provider and that of the shipowner and staff involved. The final result is similar though. Students will have had the opportunity to plan for, experience and control certain situations, to discuss the results with the lecturer and others in his group and return to sea with a fuller understanding of the required procedures.

The author recommends simulator training as a valid way of managing and reducing navigational risks.

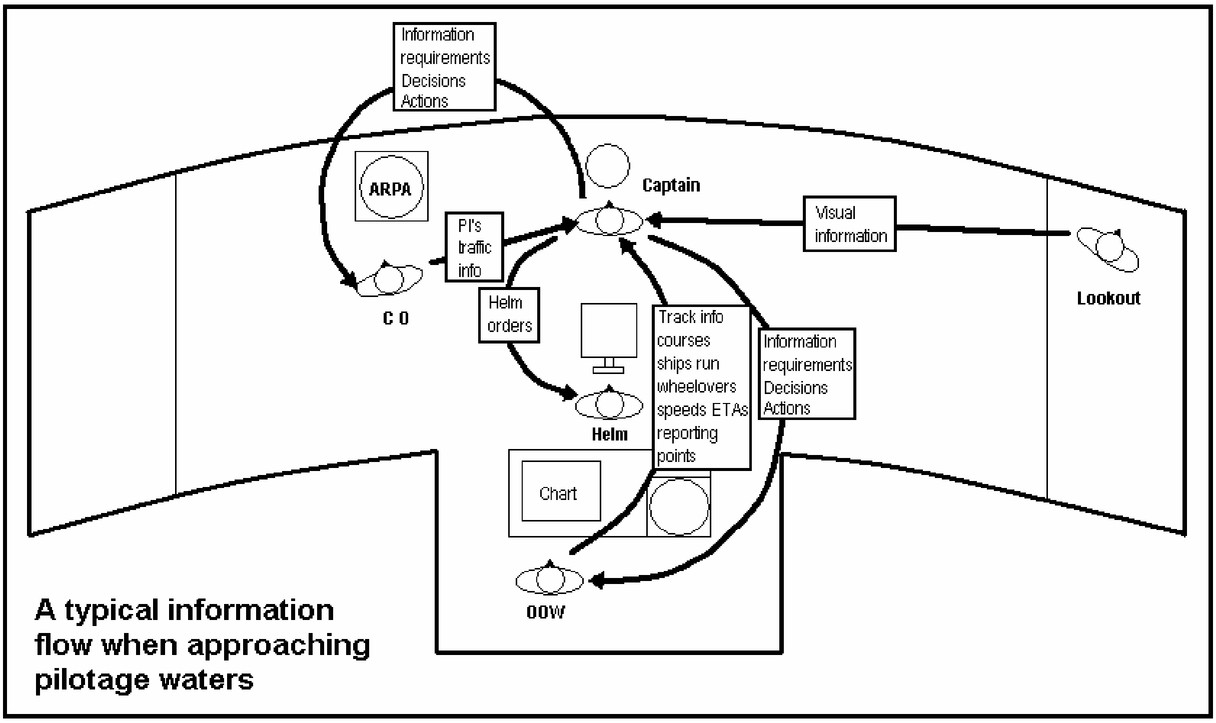


Figure 10

Information flow between the Conning Officer, OOW, Additional Officer, Lookout and Helmsman

This information flow may be modified by bridge design, automation or regrouping of personnel. The information requirements, however, remain the same

SCENARIO

The time is 0100. The ship has made a safe landfall and is approaching the destination port. The ETA at the pilot station was confirmed at 1800 the previous evening and it was agreed that the pilot would board at 0300. The pilotage to the berth is expected to take about one hour. The weather is fine and clear and Nigh Water at the berth is at 0330 thus allowing the ship to berth just after high water on the first of the ebb.

The second mate is on watch with his stand-by rating and end of sea passage is scheduled for 0200. The master left night orders to be called at 0130 and that engines were to be tested at 0100. The anchors were cleared the previous afternoon and the pilot ladder has been put on deck, ready for using on either side. The engine control room has been manned since 2200 and the engineers have been advised that EOP will be at 0200.

The second mate is fixing the ship's position at twenty minute intervals using GPS with visual bearing confirmation and is running a straight line parallel index on the radar for continuous off track monitoring.

0100 Engines tested as per night orders.

0130 The OOW calls the master as per night orders, advising him that the passage is going as scheduled and that there is light traffic in the vicinity.

The OOW confirms with the engine room that the ship is on schedule and that reduction from sea speed will still be at 0200.

The OOW informs his stand-by man, presently acting as lookout, that they are approaching the port and tells him to keep a careful lookout for small inshore craft such as fishing boats and that an additional crew member will be required at 0200 for bridge duties.

0115 The master comes to the bridge arid acquaints himself with the situation on the chart. The OOW, having fixed the position of the ship only five minutes before, the master then takes his customary position at the centre window. The OOW advises the master of the present situation and again confirms that everything is running according to plan. The OOW continues his watch responsibilities as if the master were not in the bridge.

0150 MASTER: "Second Mate, I have the con."

The OOW confirms the course and speed, advises the master of any traffic that is of interest and logs the event.

The master is now in the situation that he will be giving the conning ciders, with the OOW monitoring and confirming those orders and advising the master as appropriate.

0159 The OOW fixes the position of the ship.

OOW: "Captain, last fix shows ship on track. Planned reduction to manoeuvring full ahead at 0200."

0200 MASTER: "Confirmed" and rings the telegraph to reduce Full Sea Speed to Manoeuvring Full Ahead.

Stand-by seaman comes to bridge and steering gear is changed from automatic to manual and the wheel is manned. The helmsman moves the wheel and confirms that the steering is now under manual control.

0215 OOW: “As planned, I have now changed the fix period to 10 minutes and will be fixing using radar and visual.” The master acknowledges.

The OOW will now be spending more time at the chart, fixing more frequently and advising the master of the progress of the ship. both relevant to the planned track and distance to run, speed and ETA at the pilot station. He will also be updating the parallel index on the appropriate radar so that the master can acquaint himself with the situation. Both the OOW and the master will be using the radars to monitor traffic.

0215 The OOW calls additional (previously warned) crew for pilot station and anchor stand-by duties in 30 minutes.

0225 OOW: “Last fix shows vessel drifting slightly right of track. Suggest alter course to 035°T. Distance to run to pilot station five miles, suggest reduce speed to half ahead.”

The master acknowledges. corrects course and brings telegraph to half ahead.

0230 OOW: “Fix confirms ship has regained track, suggest you steer 039°T. The master confirms and adjusts course as relevant.

OOW: “We are on ETA, plan now requires speed of only five knots, suggest you reduce to slow ahead. Do you wish me to confirm pilot boarding.”

Master acknowledges and reduces to slow ahead.

MASTER: “Yes, confirm ETA with the pilot and ask him for his preferred boarding speed and which side he wants to board.”

0235 OOW confirms pilot hoarding by VHF and discusses hoarding speed and pilot approach. He also despatches stand by man/lookout to prepare the pilot ladder as appropriate and to advise relevant crew members to stand by forward.

0245 Due to proximity of margins of safety fix time is now reduced to six minutes, parallel indexing still being used to confirm track maintenance. Speed is reduced to Dead Slow Ahead, using the same procedures as before.

0215 Stand-by man returns and advises that the pilot ladder and ancillary gear is rigged as required. The OOW advises engine room of imminence of pilot boarding.

0250 OOW: “Looks like the pilot vessel approaching. Do you want me to go down to meet the pilot.”

MASTER: “Yes, but take a radio with you and keep me informed and get one of the anchor party to meet you there to haul the ladder back in.”

0252 The OOW fixes the ship’s position and reminds the master that the plan was that the engines would be stopped but speed would be kept at about Four knots. The OOW leaves the bridge to check the pilot boarding arrangements and meet the pilot.

0256 Pilot boat alongside.

0257 Pilot on deck. The OOW advises the master on the bridge via his radio that the pilot is aboard.

0300 Pilot on the bridge. The OOW confirms ship’s position and safety and temporarily resumes the con whilst the master and pilot discuss the ship’s particulars and the pilot’s anticipated plan.

0305 The pilot takes the con and the ship proceeds into the port area. The master still has the responsibility for the safety of the ship and the 00W continues with his monitoring role as before.

The above scenario does not attempt to show how a ship’s bridge will necessarily be organised. It does, however, show the large number of interactive events which may occur when a ship is in, what is to most seafarers, a relatively routine and straightforward situation.

The actual procedures exercised at the pilot boarding may vary considerably from ship to ship. Present requirements are that a responsible officer of the ship should supervise embarkation and disembarkation of a pilot.

In order to comply with this, the personnel involved must to be aware that the master will be alone on the bridge whilst the OOW is meeting the pilot or that another officer needs to be called specifically or this task. In the first instance the master will make such a decision based upon the conditions at the time. It would be unwise to leave the bridge without an OOW in a situation such as heavy traffic, narrow margins of safety, strong tides or any combination of such factors; particularly as under such conditions the actual embarkation of the pilot could be delayed. Calling an additional officer may well be a better alternative; particularly if lie has either just gone off watch or is required shortly. Whilst the final decision is at the discretion of the master, the circumstances should have been allowed for and included at the planning stage.

In any circumstances where the master has the con, it is the duty of the OOW and any other personnel engaged in watchkeeping to provide the master with sufficient information to enable him to make decisions appropriate to the situation. Most of these decisions will be based upon the original plan but it is not solely the master’s duty to see that everything is going according to plan or otherwise. That duty is shared with the master by the OOW who, by regularly fixing the ship’s position, confirms that the original track is being maintained. It is also his duty to confirm that orders given by the master, not just navigational orders, but all aspects of ship control, are carried out as required. Most importantly, it is for the 00’vV to advise the master when lie, the OOW. considers that things are not going according to plan or when a change of circumstances occurs.

Debriefing

Whenever possible after the completion of a passage, the master should take the opportunity to discuss the planning and execution of the passage with his team members. Possible weaknesses should be openly admitted and discussed so that they may be corrected or allowed for in future passages.

Such a debrief need not take long, and can take place during a passage whilst the memory is still fresh in peoples minds. Where corrections are made to a planned passage they can then be saved for future use.

In some instances — for example when a ship regularly visits a certain port or frequently transits an area — it may be found advantageous to keep the charts and notes as they are. Unless major changes are made to the channels or navaids etc. a planned passage will normally be acceptable for future visits, appreciating that meteorological and tidal differences will always have to be taken into account and that inward and outward passages may well be totally different. Parts of the plans may have common features that can be used.

Ships regularly trading to the same ports may well find it an advantage to have two sets of charts, both drawn up, one for the inward passage and one for the outward passage.

Passage plans may easily be held in computer databases that can easily be updated as necessary and readily extracted from the computer as required. Shipowners and managers can use database- held planning information to their advantage in that this system allows for simple standardisation throughout a fleet. If required, plans to the owners/managers' own standards can be made and despatched to all relevant ships, saving duplication of effort and ensuring that correct information and requirements are available. Computer access will also allow plans to be easily modified when prevailing circumstances are changed. (see also Chapter 8).

Chapter 7

NAVIGATING WITH A PILOT ON BOARD

Introduction

The relationship between the ship's team and an employed pilot is primarily professional. The ship's master is charged with the responsibility for the safety of the ship; pilots are engaged to assist with navigation in confined waters and to facilitate port approach, berthing and departure. The master has the ultimate responsibility and has the right and obligation to take over from the pilot in the rare event of the pilot's inexperience or misjudgement. However in compulsory pilotage areas the pilot will expect to be responsible for the navigational conduct of the vessel. In practice, the master may find himself in a situation where he is not satisfied with the way the passage is being conducted by the pilot, yet is in no position to even query the pilot's actions as he, the master, has no idea as to what should be happening.

Ideally, the master and his team should make themselves aware of the pilot's intentions and be in a position to support him and if necessary query his actions at any stage of the passage. This can only be brought about by:

1 The bridge team being aware of the difficulties and constraints of the pilotage area.

2 The pilot being aware of the characteristics and peculiarities of the ship.

3 The pilot being made familiar with the equipment at his disposal and aware of the degree of support he can expect from the ship's personnel.

Unfortunately this is not the way that things always develop. Boarding a strange ship, pilots often feel that they are unsupported. They know that the next part of the passage is going to be entirely up to them and consequently get on with and make the best of a bad job. Equally, the OOW may feel that he is excluded from events. He does not know where the ship is going, how it is to get there, or what is expected of him. Consequently, he is very likely to lose interest. A ship's team operating a consistent system can quite easily overcome such insecurities and doubts.

Planning

A well-planned passage does not stop at the pilot boarding area. The planning will continue from sea to berth, or vice versa, the boarding and monitoring of the pilot's actions being part of the plan. The navigator will have planned the areas where the pilot actually has the con. This enables the master and OOW to compare the progress of the ship with the planned track and also enables them to be aware of the constraints and other details of the passage. Abort and contingency planning will assist should the ship experience navigational or other problems.

Master/Pilot information exchange

As stated above, the master may not be aware of the area, and the pilot may not be aware of the peculiarities of the ship. These problems can he minimised by establishing a routine master/pilot exchange.

When the pilot enters the bridge it is good practice for the master to make time for a brief discussion with the pilot. The master may need to delegate the con to the OOW or other officer, as appropriate, in order to discuss the intended passage with the pilot. Such discussion will include items such as the pilots planned route, his anticipated speeds and ETAs both en route and at the destination, what assistance he expects from the shore, such as tugs and VTS information and what contingencies he may have in mind.

For his part, the master needs to advise the pilot of the handling characteristics of his ship, in particular any unusual features and relevant information such as anchor condition, engine type and control, and personnel availability. Much of this information can be readily available on a MASTER/PILOT EXCHANGE FORM.

When these broad outlines have been established, the pilot will now need to he acquainted with the bridge. Agreement will need to be made on how his instructions are to be executed (does he want to handle the controls or would he rather leave that to one of the ship's staff). Where is the VHF situated and how to does he change channels and which radar is available for his use. In particular he needs to be advised of the present mode of the radar.

The pilot is now better placed to take the con but the above will obviously depend upon many factors.

1 The position of the pilot boarding area. Often this is such that there will be little time between the pilot actually entering the bridge and taking the con.

2 The speed of the ship at the pilot boarding area. This too could limit time availability.

3 Environmental conditions such as poor visibility, strong winds, rough seas, strong tides or heavy traffic may inhibit the exchange.

If the exchange has not been carried out for any reason, even greater care will need to be exercised by the bridge team. This situation should be avoided if at all possible.

Responsibility

Despite the presence of the pilot, the master is still responsible for the safety of the ship. The pilot is the local expert and will obviously conduct the ship to the best of his ability, advising the master as necessary and usually actually conducting the passage. This applies whether the pilotage is voluntary, i.e. the master has requested assistance, or compulsory when the ship is required to take a local pilot within defined areas.

Normally the master will remain on the bridge during the pilotage. This obviously will depend on the circumstances. In the event of a long pilotage it would not be practicable for the master to remain throughout. In this case he must remember to delegate his authority to a responsible officer, probably the OOW, exactly as he would at sea.

Monitoring

In any case the master is in a poor position to question the pilot regarding the progress of the ship or its situation at any moment, unless he, the master, knows what should be happening at that time. The ship's progress needs to be monitored when the pilot has the con exactly as it has to be under any other conditions. Such monitoring needs to be carried out by the OOW and any deviations from the planned track or speed observed and the master made aware exactly as if he had the con. From such information the master will be in a position where he can question pilotage decisions with diplomacy and confidence.

Chapter 8

NAVIGATING WITH INTEGRATED BRIDGE AND ELECTRONIC CHART SYSTEMS

by Captain T. J. Bailey FNI

Introduction

With the continuing development and the increasing acceptance of integrated bridge systems (IBS) and/or electronic chart systems (ECS) – and this term includes Electronic Chart Display and Information Systems (ECDIS) – it is essential to be aware that, on the ships that have this equipment in place, there is a continuing need for the bridge teams, including pilots, to be trained in their use.

The purpose of this section, therefore, is to consider the potential impact on 'traditional navigation methods' of the use of such systems. In doing so, consideration is given to differences between different electronic charts systems. including the advantages and disadvantages of these systems as well as their benefits and their limitations. Some practical advice on the use of these systems is also included.

This section covers the following topics:

- Training requirements and recommendations.
- Carriage requirements.
- Typical IBS configurations
- Electronic charts.
- Accuracy.
- Practical navigation with IBS and ECS.

In developing electronic navigational systems for use on board ship, manufacturers aim to provide the navigator with improved vessel safety by utilising the benefits of continually improving computer processing capabilities with modern electronic aids to navigation. The navigator is presented with a continuous real time display of his ship's position to a greater accuracy than was previously possible and can be assured that this displayed position is derived from a system that continuously checks the integrity of all system inputs. These inputs will provide a degree of redundancy in the event of failure of one system. For example, it will be likely that the system will have at least two GPS receivers and other navigation sensors. When using 'intelligent' data, the systems can provide the navigator with alarms and indicators to warn of approaching dangers and hazards.

Additionally, most systems will allow the navigator greater flexibility in planning, saving and executing routes and passages, as well as saving time and ensuring great accuracy with chart corrections. Although not all ships are currently fitted with IBS / ECS / ECDIS – and it is unlikely that all ships will be fitted with such systems – there is an increasing tendency to see such systems fitted on new buildings as a matter of course. Some ships will have systems retro-fitted at some stage in their life.

However, this section does not provide definitive guidance on the operation of all the systems available. Owners and managers are advised that their electronic navigational systems are likely to contain exceeding large and complex databases with the aim of improving navigation safety. To display the right information quickly and at the right time requires new skills, for which appropriate training is required.

Training requirements and recommendations

At the time of writing, there is no formal requirement in STCW'95 or elsewhere for 'defined' training to be given. The IMO have developed and published a Model Course in the use of Electronic Chart Systems and, in the introduction to the Model Course, it states:

"In the STCW'95 Convention, no particular formal emphasis is placed on ECDIS systems. Instead they are considered to be included under the term "chants" (Table A II/1). Following the functional approach, the officer in charge of a navigational watch must have a "thorough knowledge of and ability to use navigational charts and publications..." Criteria for evaluating competency are stated as "The charts selected are the largest scale suitable for the area of navigation and charts and publications are corrected in accordance with the latest information available'. In Section B II/I (Assessment of abilities and skills in navigation watchkeeping), a candidate for certification must provide evidence of skills and ability to prepare for and conduct a passage "including interpretation and applying information from charts"[1]

The purpose of the IMO Model Course is:

".. to enhance safety of navigation by providing the knowledge and skills necessary to fully utilize the features of ECDIS..."[2]

In the absence of formal requirements, the Model Course contains a recommendation on training:

"Every master, chief mate and officer in charge of a navigational watch on a ship fitted with ECDIS should have completed a course in the use of ECDIS."[3]

The ISM Code and training requirements

Under the ISM Code[4], a shipping company has a responsibility to:

"establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the marine environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given"[5].

Additionally, the company has to:

"ensure that all personnel involved in the Company's Safety Management System (SMS) have an adequate understanding of relevant rules, regulations, codes and guidelines"[6]

"establish procedures for identifying any training which may be required in support of the SMS"[7]

Under the Section dealing with Emergency Preparedness,

"the Safety Management System must provide for measures to ensure that the company's organisation can respond at any time to hazards, accidents and emergency situations (ECDIS failure[8]) involving its ships."[9].

It would appear. therefore, that even in the absence of specific Legislation for ECDIS [or IBS] training, there is a clear obligation on shipowners to ensure that mariners sailing with ECDIS (or IBS) are properly trained to safely use such equipment.

The need for type specific training

In the introduction to the IMO Model Course. it refers to Potential Problems and states that:

> "Due to a lack of standardized ECDIS user interfaces, there is considerable product differentiation."[10].

Officers on board ships at the time of installation of an ECS / ECDIS / IBS generally benefit from close liaison with the in manufacturers' representatives but, in many cases, officers joining later will have to rely on 'cascade training', i.e. passing on knowledge from one officer who has been trained to his relief who has not. This training method is fraught with the potential for serious errors to creep into time use of any systems and, in the case of ECS / ECDIS, may lead to significant errors in navigation.

Common sense and maritime expertise combined with the tenets of the ISM Code clearly indicate that familiarisation training on such vital navigational equipment is a necessity, noting that incompetent operation [of ECS / ECDIS / IBS] could impact adversely on the safety of life and protection of the marine environment.

> "Past experience and problems with the variation in types of radar, ARPA and DGPS/GPS controls and displays suggests that the lack of commonality in ECDIS user interfaces to ECDIS software between the manufacturers will lead to major safety incidents. The operator must he trained to use his particular ECDIS or, as past experience suggests, major accidents will occur. It is therefore a reasonable suggestion that some form of ECDIS "type training" would be a sensible safety requirement."[11].

It is perhaps interesting to note that the Australian Maritime Safety Authority (AMSA) has adopted formal user training requirements which state as follows:

> **User Training Requirements**
> The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 199.5 (STCW'95) and the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) put the onus firmly on the shipowner or operator to ensure that mariners on their ships are competent to carry out the duties they are expected to perform.
>
> If a ship is equipped with ECDIS, the shipowner or operator has a duty to ensure that users of such a system are properly trained in its operation, the use of electronic charts, and are familiar with the shipboard equipment before using ECDIS operationally at sea.
>
> By the STCW'95 implementation date of 1 February 2002 all holders of Australian STCW'9.5 endorsed Certificates of Competency in the deck department will have been required to complete basic ECDIS training.
>
> Before a watchkeeping officer or master intends to use a compliant ECDIS as the primary means of navigation they should complete a generic ECDIS Operators Course complying with IMO Model Course 1.27 – The Operational Use of Electronic Chart Display and Information Systems (ECDIS).

ECDIS type training is to he provided by the shipowner or operator under the terms of the ISM Code. Under the Code, the shipping company has a responsibility to 'establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the marine environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should he identified, documented and given (Section 6.3 of the ISM Code). [12]

Additionally, type specific training satisfies the requirement for effective risk assessment and contingency planning in the use of these systems. By their very nature, IBS / ECDIS / ECS demand new levels of greater user awareness. In particular, all personnel involved with their use must be familiar with the following aspects of their operation:

- Practical operation of the systems.
- How to revert to manual/automatic functions: for example, how to change from autopilot control (*see below*) to manual steering and back again in the event of the need to alter course for other shipping traffic.
- Handling and monitoring alarms.
- Monitoring and verification of the accuracy of the system.
- Knowledge f the benefits and limitations of the system.
- Maintaining safe navigation in the event of failure of the system.

It is recommended that system checks are carried out at the beginning of each watch and at regular intervals during the watch to ensure that the OOW is satisfied that the system in use is functioning correctly and that all connected sensors are providing valid data. The OOW should also 'cross check' the displayed position by 'traditional' methods.

Requirements of electronic chart display and information systems

Chart carriage requirements

Under Regulation 19_2.1.4 of Chapter V of Safety of Life at Sea (SOLAS), all ships are required to carry adequate and up-to-date marine charts (and other nautical publications). The charts are used for planning and displaying the route for the intended voyage and monitoring the ship's position throughout the voyage.

The IMO Performance Standards permit National Maritime Safety Administrations to consider ECDIS as the legal equivalent to the charts required by regulation V/19_2.1.4 of the 1974 SOLAS Convention.

Performance Standards for ECDIS were formally adopted b' IMO On 23 November 1995 and issued as IMO Resolution A.817 (19).

Regulation 19.2, which lays down the carriage requirements for shipborne navigational systems and equipment, requires (at subparagraphs 2.1.4 and 2.1.5) that:

"2.1 All ships irrespective of size shall have: …

.4 Nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage; an electronic chart display and information system (ECDIS) may be accepted as meeting the chart carriage requirements of this subparagraph;

.5 Back up arrangements to meet the functional requirements of paragraph .4, if this function is partly or fully fulfilled by electronic means."[13]

It must also be remembered that, even with a fully type approved ECDIS, the approval is only valid in the sea areas for which the official S-57 chart data (ENC) has been installed in the system and corrected to include the latest updates. In all other situations, updated paper charts must he carried on board to comply with SOLAS Regulation V/19_2.l.4.

(At the time of writing. S-57 charts are becoming increasingly available but they do not cover large amounts of the seas in which we trade.)

In December 1998 the IMO adopted amendments to the Performance Standards for ECDIS to include the use of Raster Chart Display Systems (RCDS).

2. These amendments permit ECDIS equipment to operate in two modes:

.1 The ECDIS mode when ENC data is used: and

.2 The RCDS mode when ENC data is not available.

However, the RCDS mode does not have the full functionality of ECDIS and can only be used together with an appropriate portfolio of up to date paper charts.[14]

IMO does not provide any guidance on what may constitute an "appropriate folio"; this is left to the national administration. As an example, AMSA has defined the term "appropriate folio" as follows:

This folio should contain up to date charts to cover those sections of the intended voyage where ECDIS will he operated in the RCDS mode. These charts are to be of a scale that will show sufficient detail of topography, depths, navigational hazards, navaids, charted routes, and traffic schemes to provide the mariner with ample knowledge of impending navigational complexities and an overall picture of the ship's general operating environment.

As a broad guideline the scale of the charts in this folio should suit the navigational complexity … [of the intended voyage]

Flag State Administrations may allow a relaxation of the requirements to carry paper charts but this does not. necessarily become a blanket acceptance of electronic systems and a complete absence of paper charts.[15]

For many navigators on ships fitted with electronic navigation and chart systems, they are operating with an Electronic Chart System (ECS) and not an Electronic Chart Display and Information System (ECDIS).

It is essential that the user is aware (if the legal status of the equipment at his disposal. The paper chart has the legal authority of the government authorised hydrographic office that issued the chart, provided that it has been corrected up to date.

The revised SOLAS Chapter V Regulation 2.2 also defines the definition of a "nautical chart" to more clearly reflect the electronic charting aspects and the "official" responsibility for their production, quote:

“2 Nautical chart or nautical publication is a special-purpose map or book, or a specially compiled database from which such a map or book is derived, that is issued officially by or on the authority of a Government authorized Hydrographic Office or other relevant government institution and is designed to meet the requirements of marine navigation.” [16]

The electronic chart, on the other hand, does not necessarily have such status – it will depend on where the data used to construct the chart came from. Currently, electronic charts are available from a number of sources. including government authorised hydrographic offices and commercial suppliers, and they are available in two formats ~ raster and vector.

Voyage recording

In its own way, ECDIS is a mini voyage data recorder. It must be able to record and reconstruct the vessel’s navigation history, along with verifying the official database used. for a minimum of 12 hours. In all probability, this period will be considerably longer and there will be a playback function to allow review of the vessel’s track. In some systems, radar overlay may he recorded and this feature provides additional data for review in the unlikely event of a collision or other accident. Recorded at one minute intervals, the information must show own ship’s past track including time, position, heading, and speed, as well as a record of official ENC used including source, edition, date, cell and update history. It must not he possible to manipulate or change the recorded information.

System backup

Adequate backup arrangements must be provided to ensure safe navigation in case of ECDIS failure. Backings up arrangements for ECDIS were adopted by IMO in November 1996 and became Appendix 6 to the Performance Standards. The principal requirements are to:

- Enable a timely transfer to the backup system during critical navigation situations.
- Allow the vessel to be navigated safely until the termination of the intended voyage.

The Appendix lists the functional requirements of the backup system but not the specific arrangements that may meet these requirements, the onus being on national authorities to produce appropriate guidance. There are a number of possible options that could meet these requirements and they include:

- A second, fully independent. type approved ECDIS.
- An ECDIS operating in the RCDS mode.
- A full folio of paper charts corrected to the latest Notice to Mariners covering and showing the intended voyage plan.

Precautions for IBS operators

An IBS, with a properly trained operator, can greatly increase both the safety and efficiency of a ship at sea. However, the wise and experienced mariner knows that it is potentially dangerous to place absolute reliance on any one navigational tool. Remember that the accuracy of an IBS system is dependent upon the quality of sensor data coming in and the quality of the electronic chart on which that sensor data is displayed. That is why it is essential that the Bridge Team become very familiar with the type and characteristics of all sensors and electronic charts which are available on the ship through the IBS.

Typical IBS configuration with ECDIS

An IBS (Integrated Bridge System) is a combination of systems which are interconnected to allow centralised access to sensor information or command/control from workstations.[17]

The objective of an IBS is to improve safety, enhance navigational and conning efficiency, and to provide for more effective management of a ship's bridge operations.

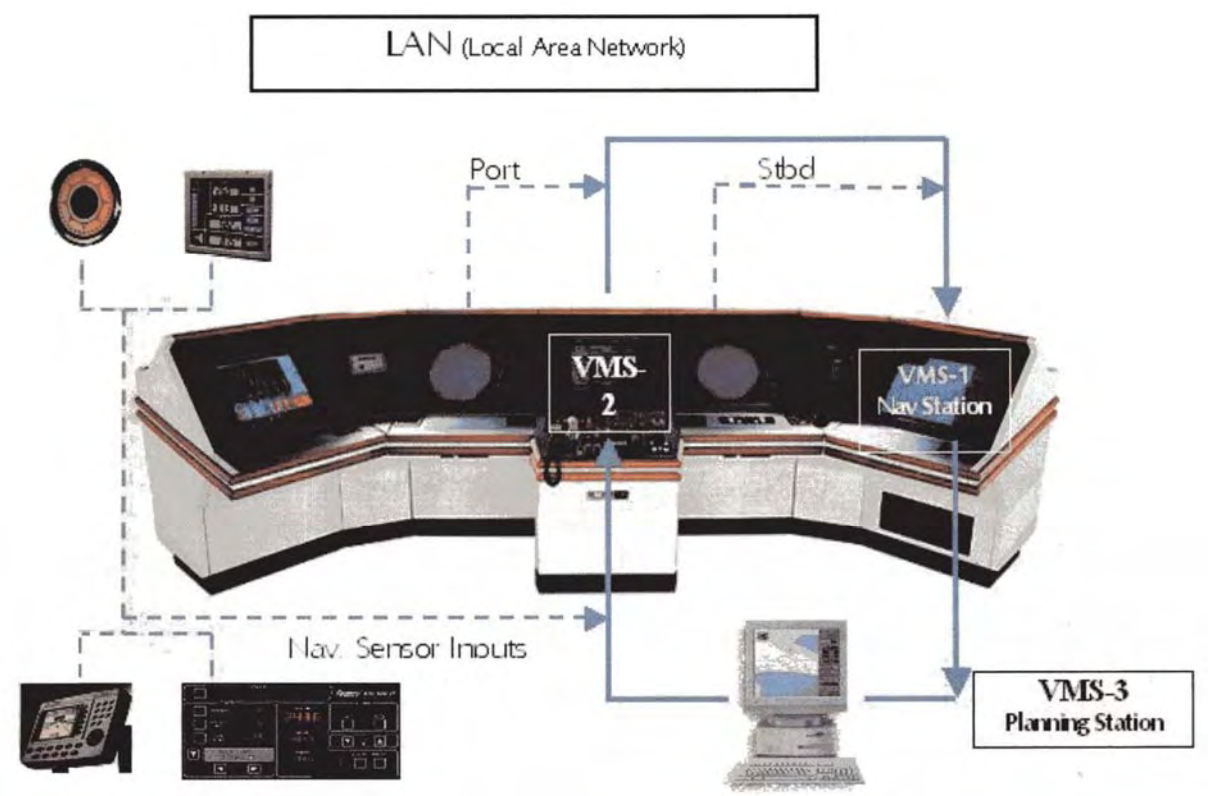


Figure 11 – a typical integrated bridge system

(courtesy of Northrop Grumann Sperry Marine)

The basic network

The LAN (Local Area Network is an "intranet" which connects the ships IBS computers together and allows them to share all data instantaneously.

The critical role of navigational sensors in the lBS

Simply put, the IBS is only as good as the sensors which feed it navigational information. It is extremely important, therefore, that the best available sensors are always chosen to provide data! The ship's officers must know what sensors are available, and the advantages and disadvantages of each. The table at Figure 12 shows a typical list of sensors and the data which they provide.

These sensors are then grouped together so that each group contains one of each main sensor. Each group of sensors are then input into a separate IBS computer which shares that data over the LAN. This type of sensor grouping is what provides the IBS with its sensor redundancy.

GPS	Latitude/longitude, speed over the ground, course over the ground, GMT time and date
OMEGA	Latitude/longitude, speed over the ground, course over the ground, GMT time and date
GYROCOMPASS	True heading
SINGLE-AXIS SPEED LOG	Speed through the water
DUAL-AXIS SPEED LOG	Speed over the ground, speed through the water
ARPA RADAR	Acquired target information, navlines, radar overlay
ECHO SOUNDER	Depth beneath the keel
ANEMOMETER	Relative wind speed and direction
AUTOPILOT	Ordered heading and rate of turn

Figure 12 – Navigational sensors in an IBS

The IBS system can accept information from both serial and analog devices. Serial data is any navigational sensor which transfers information in the standard NMEA format (GPS), while analog data provides information like rudder angle and engine RPM.

Serial data sensor input

Most navigation sensors output data in the standard NMEA format which provides a serial message in the RS-232 or RS-422 electrical protocol. One or more computers in the IBS may have a 16-line serial data interface module ('Rocket Port' for short) connected to it. This interface module can accept up to 16 sensor inputs which are then fed into an IBS computer.

Analog data input

Equipment which outputs 'non-NMEA' information, such as synchro or step data, is interfaced to the IBS by using special analog-to-digital boards.

System integrity

Given that the operation of the system relies on data input from a number of independent sensors, it is essential that these sensors are checked on a regular basis to ensure that the data remains valid. In general terms, an ECDIS will automatically monitor all data input sensors and will make a comparison between the live' data and the calculated or expected data. In other words, the system will carry out an automatic calculation of DR / EP and, where there is a significant discrepancy, it will revert to DR mode, with an appropriate alarm or warning.

Electronic charts

Whether the ship has an Electronic Chart System (ECS) or an Electronic Chart Display' and Information System (ECDIS), you will need Electronic Charts (ECS). It is crucial that the operator is fully aware of the capabilities and limitations of the electronic chart in use,

As we have already seen, there are two formats raster and vector. Electronic charts are available from a number of suppliers but it must be remembered that some charts are produced by commercial organisations other than a government authorised hydrographic office. In the case of these charts, the user must maintain an appropriate backup portfolio of paper charts.

Raster charts

A raster chart is a facsimile image of an existing paper chart. All the information and symbology on the paper chart is reproduced identically on the electronic chart. However, since this type of chart has no "layering" of information, thee user has no control over the look and contents of the displayed chart image, other than to change from daylight to night palettes. Typically, raster charts may be in the following formats:

- BA-ARCS – produced using data from the U.K. Hydrographic Office.
- NOAA – produced for US waters by NOAA in the BSB chart format.
- NDI – produced for Canadian waters by CHS in the BSB format.

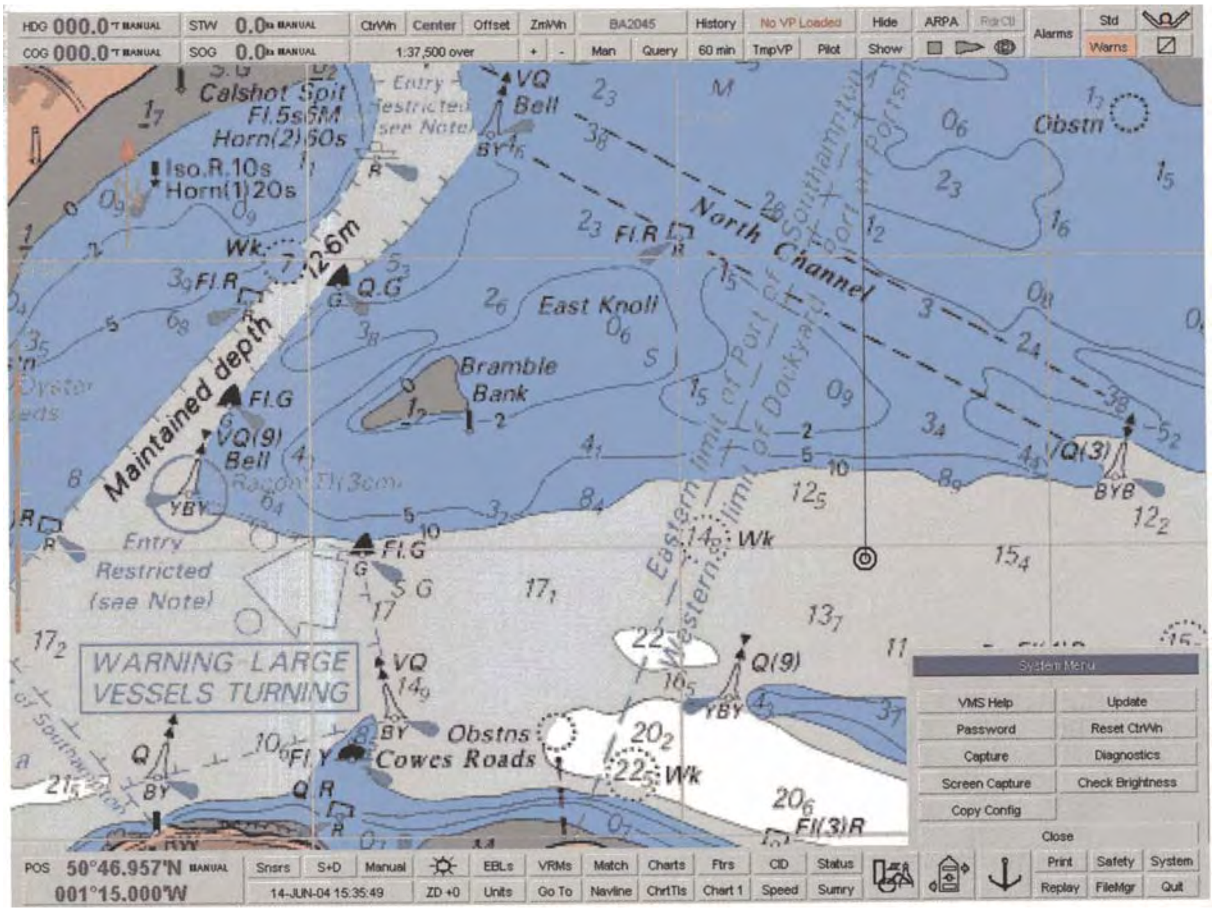


Figure 13 – Extract from BA2045 in RCDS format

(reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Characteristics of raster charts:

- Exact duplicate of corresponding paper chart. The display is therefore, familiar to the navigator.
- Guaranteed to the same legal standard as a paper chart (depending on the supplier and frequency of updates applied)
- Allows for automatic updating of chart content.
- Does not support features (layering), query or safety checking.
- Raster charts are not ECDIS compliant.

Vector charts

A vector chart is a large database of geographical information. ECDIS accesses this database to create a custom electronic chart based on operator selected parameters As with raster charts, vector charts may be produced in a number of formats, including:

- ENC – This is an IMO approved vector chart, produced in the S-57 format, that is approved for use with ECDIS (*see definition at the end of this chapter*).
- DNC – These charts are produced by the US government, in VPF format, for official U.S. military and government use only.
- C-Map (*and others*) – These are commercially produced vector charts with all the standard capabilities associated with a vector product.
- DC – These charts are digitised on board the vessel by the crew using the VMS. They are the simplest form of vector chart with no underlying database and therefore do not support standard vector chart capabilities.

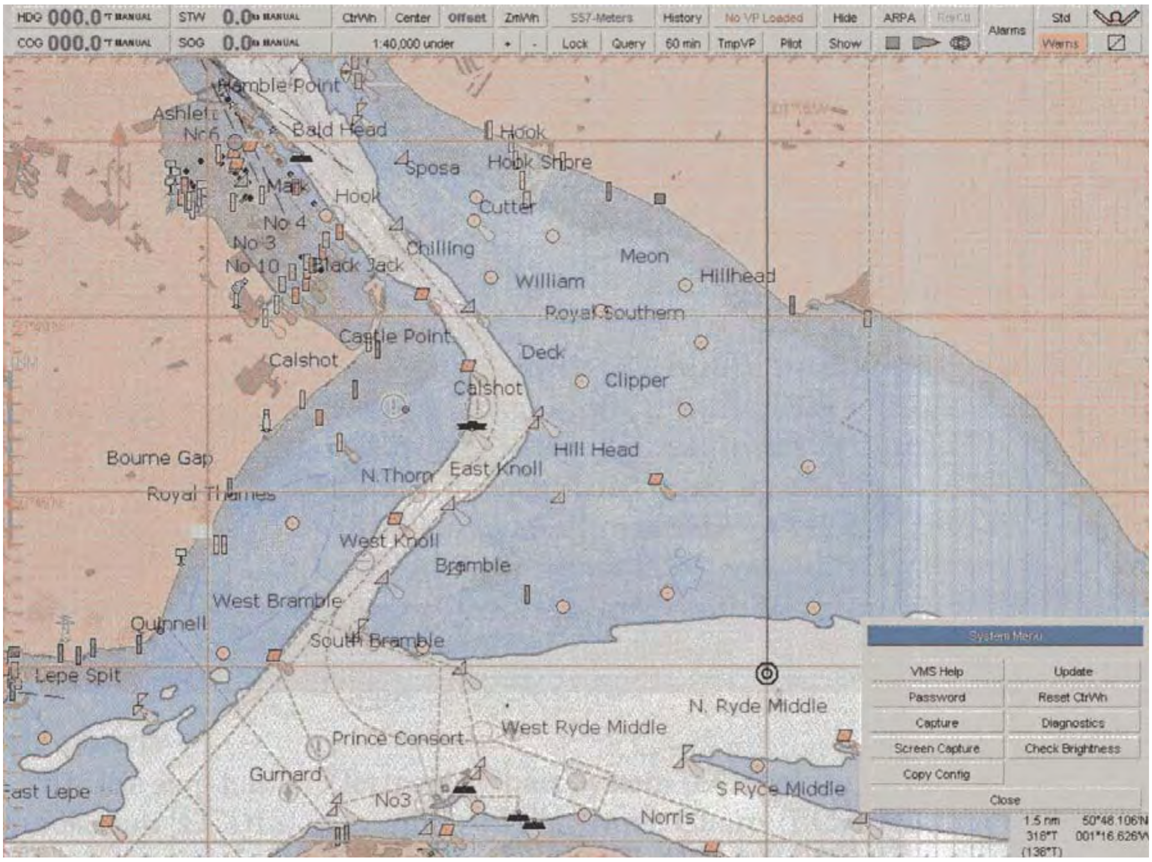


Figure 14 – Extract from s-57 chart (Vector format) of the same area
(reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Characteristics of vector charts:

- Vector charts support a ‘layering’ of information which allows the user to display only the chart information that is desired for the current operating environment. Display features that are not desired may be turned off.
- Vector charts will allow ECDIS to safety check the ship’s route to warn the operator about certain hazards that exist along the ship’s cow-se and planned track.
- When the vessel’s safety configuration is correctly set in the system, ‘safe water’ will be clearly indicated, as depths shallower than the safety depth will be in indicated in a contrasting colour. (In the figure above, the blue shading represents the areas where water depths ate shallower than the safety depth.) If the vessel is approaching this shallow water, an appropriate alarm will be given.
- The user may ‘query’ any feature on the chart and the system displays the characteristics and navigational aid information associated with that feature.
- Vector charts max he displayed with ‘simplified’ or ‘traditional’ symbology. At first experience, the display will be unfamiliar to the navigator and he will need time (and training) to become familiar with this different display.

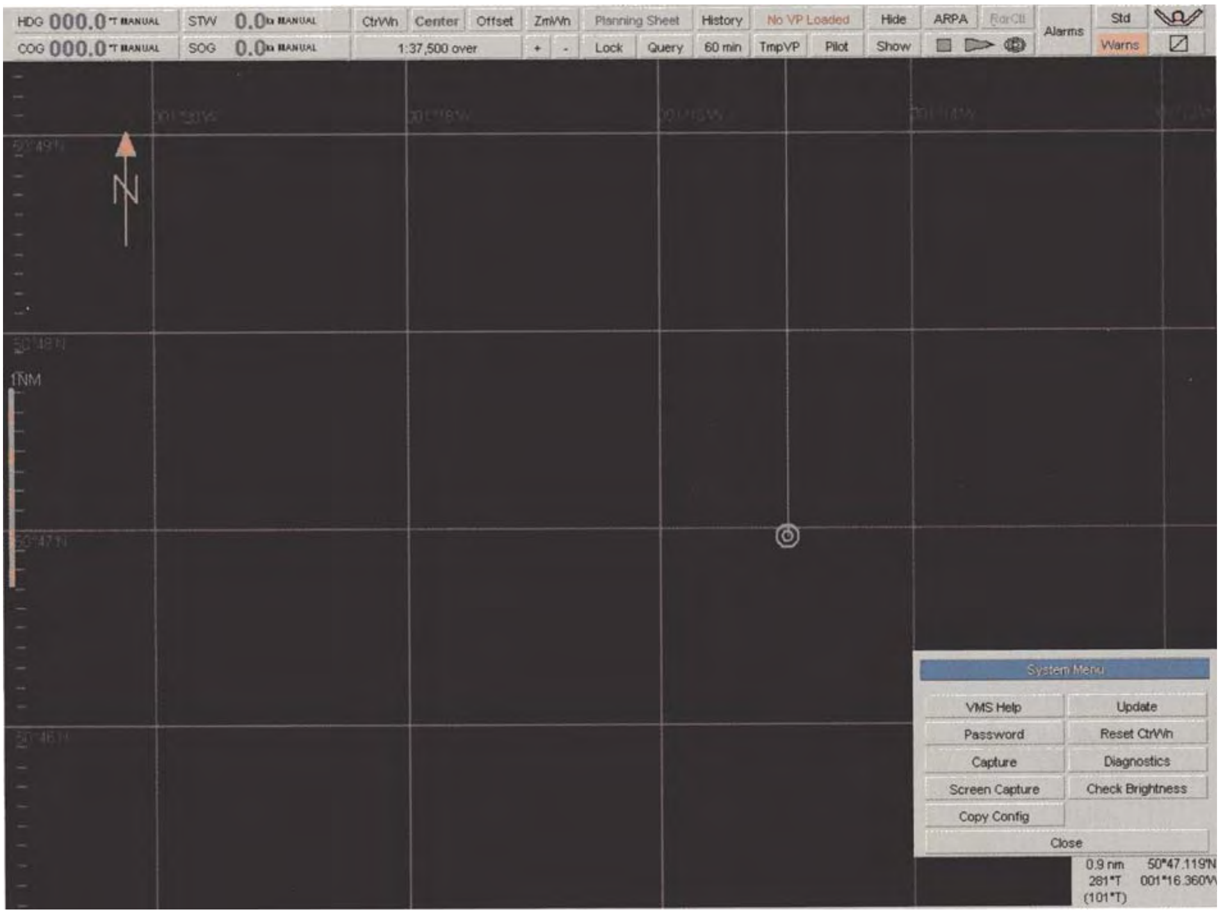


Figure 15 – Planning sheet display

(reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Planning sheet

A planning sheet is a Mercator grid over a black background. The planning sheet is the default display when no chart is loaded or available for the area of operations/interest.

Planning sheets can be used to zoom in to a greater resolution than the chart allows. This is useful for anchoring, tuning the autopilot or at other times that an extremely large chart scale is desirable.

ECDIS Accuracy

This section focuses on the safe and prudent use of ECDIS. The most common causes of degraded system accuracy are described and explained in some detail. When system degradation occurs, the user must turn to additional sources of navigation information, independent of ECDIS when practical, and be prepared to use whatever backup system is available on the vessel.

Risk of over-reliance on ECDIS

ECDIS systems offer numerous benefits compared to conventional navigational methods and are considered to be a significant step towards safer navigation. The goal is eventually to replace paper charts with ECDIS on many ships. However, there is a potential danger that comes along with using computerised systems that can receive highly accurate sensor data and present that real time navigation picture on a chart.

The danger lies in the fact that the system's real time sensor data, high-resolution chart graphics, drawn to scale ship outline, motion vectors, etc. make it very tempting to rely almost exclusively on the system, without understanding the limitations and potential errors. It is extremely important, therefore, that the user understands and acknowledges the potential for system errors and malfunctions. including errors in displayed data, errors of interpretation, incorrect user set-up, or improper configuration or calibration of system parameters.

The mariner must realise that the accuracy of any ECDIS system will vary with sensor accuracy, chart accuracy, user settings and other system variables. The accuracy of an ECDIS is likely to vary from vessel to vessel even if the manufacturer and model are the same. The prudent mariner will frequently use other available methods, independent of ECDIS, to determine the vessel's position, course and speed (*see the earlier sections of/his book*). In doing so the accuracy of ECDIS is monitored more closely and the user will be more prepared in case of an ECDIS failure. Mariners must also determine what is the backup system on hoard their particular vessel, be prepared to use that backup system in case of ECDIS failure, and understand that there might he different levels of backup depending on system configuration and severity of the failure.

Errors in displayed data

Degraded system accuracy is most often associated with one or more of the following:

1 Chart datum.

2 Shifting of buoys.

3 Inaccurate hydrographic data.

4 Sensor limitations.

5 Poor resolution.

6 User set-up errors.
7 Incorrect system configuration or calibration.
8 System or sensor malfunctions.

Errors of interpretation

Errors of interpretation are not the same as degraded system accuracy, but can have a similar undesirable impact on safe navigation. The ECDIS operator makes an error of interpretation any time that he misinterprets an information on the ECDIS display. One example is if the operator thought that radar targets displayed on the ECDIS had relative vectors instead of true vectors. These types of errors can be eliminated by providing the ECDIS operators with quality training.

ECDIS backup arrangements

Each particular ship will have its own ECDIS backup arrangements. These backup systems could range from a completely independent ECDIS system to good old fashioned paper charts. The mariner will need to discover exactly what are the backup arrangements of the particular ship in which they are sailing.

Practical navigation with electronic chart and integrated systems

Note: It must be emphasised that every manufacturer has determined their own way of interpreting the performance standards for all IMO approved navigation equipment, including ECDIS. It must be realised that almost every different system will have a different functionality to achieve the same objective. This will not only be the case with the ‘knobology’ required hut also the format and layout of the display. In pilotage waters, in particular, the use of ECS / ECDIS / lBS takes on an additional significance. Pilots cannot be expected to be fully familiar and proficient in the use of all systems currently available.

All of these systems are necessarily complex and complicated. Some sill do more than others and the notes below can only give a very general insight into sonic of the electronic tools available to the navigator and the bridge team. The comments that follow refer to the general functionality of any system but the pictures are reproduced, with permission, from the Northrop Grumann Sperry Marine Voyage Management System (‘NGSM VMS’ or ‘VMS’).

It must also be emphasised that the provision of sophisticated electronic navigation systems remains an aid to navigation – perhaps the Performance Standards should contain a clause that states

> “Nothing in the provision of this equipment exonerates the Officer of the Watch from the need to maintain an effective all round lookout at all times by all available means – LOOK OUT OF THE WINDOW !!!“

Passage planning

On a vessel that does not have sophisticated electronic navigation systems, the navigator will rely on basic principles and paper charts to plan, verify and monitor his route for the intended voyage. So it will be on the vessel that does have sophisticated electronic navigation systems. The methods used to achieve the task may he different but similar and the end result should be the same.

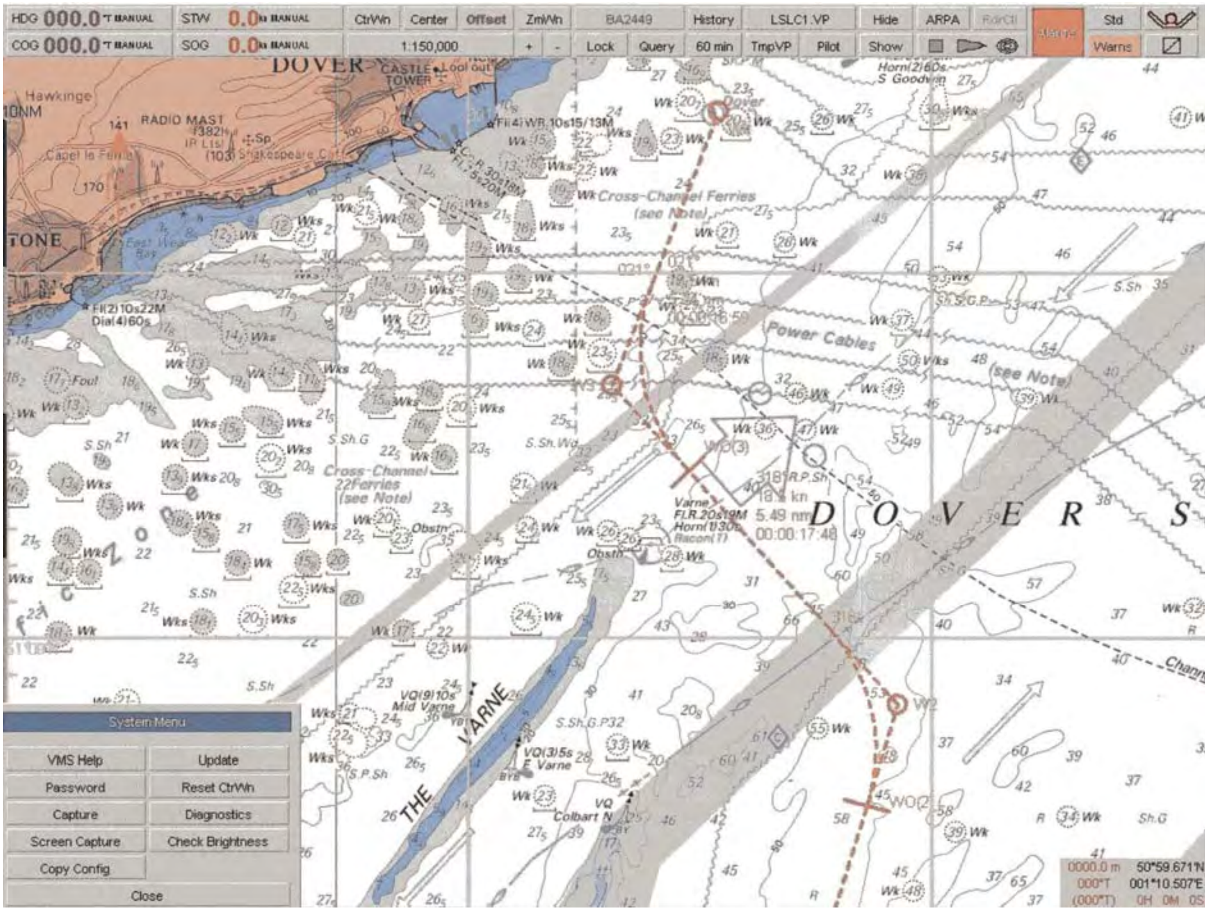


Figure 16 – Extract from BA2045 in RCDS format – showing an extract from a voyage plan

(reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Depending upon the level of sophistication provided, the navigator may be able to allow the electronic system to tell him where there is safe water on his intended passage and to warn him if that is not the case. Some systems will not allow an ‘unsafe’ passage plan to he saved the navigator must correct this first.

Similarly, provided that the manoeuvring or handling parameters of the vessel are correctly entered, the system will draw the voyage plan through the waypoints but will mark on the chart the wheel over positions and will show the expected radius of turn (see figure 16).

In this instance, a raster chart has been used. The dashed red Line shows the intended voyage plan for a passenger vessel approaching Dover from the south east, with the waypoints indicated by a red circle, the wheel over points by a line across the route and the radius of turn as a curved line inside the intersection of the two legs at the waypoint. In this case, if the chart system is linked to the autopilot to maintain track keeping, the navigator must remember that the vessel will follow the radius of turn and will not necessarily go through the geographical waypoint.

It was decided to cross the south west bound traffic lane at an appropriate point but the navigator had to determine that point and he had to ensure that his intended course was in line with the requirements of the collision regulations. This should have been the case whether a vector or a raster chart had been used – automation will only go so far!

Pilotage waters

Given that electronic systems provide the bridge team with a real time display of the ship's position on a chart display, it is advantageous to utilise the system further to provide a display of the intended route. This will be the case not only for coastal and ocean passages but also for pilotage waters. Berth to berth passage plans are recommended but it may be appropriate to make a number of separate plans for the pilotage elements, taking into account alternative routes through a pilotage district, for example.

In discussions during the master/pilot exchange when he boards, it may be possible to display the pilot's intended route and to allow all members of the bridge team effectively to monitor the ship's safe navigation through this phase of the voyage. With no indication of the intended route, a real time display of the ships position has limited benefit to anyone other than the pilot.

As noted above, pilots will have experience of a wide variety of ECS but may not be familiar with their operation. Good liaison between the pilot and the rest of the bridge team becomes essential to ensure that the ECS is used to best advantage.

Charts and chart selection

As the power of onboard computers steadily improves, in particular with respect to hard disk capabilities, electronic charts ma well now be loaded on to the hard disk, as opposed to an 'Area CD-ROM', as was the case with the early versions of the Admiral Raster Chart System (ARCS) and similar systems. In general terms, however, it is prudent to ensure that an appropriate portfolio of electronic charts is selected and that that portfolio is associated with a voyage plan.

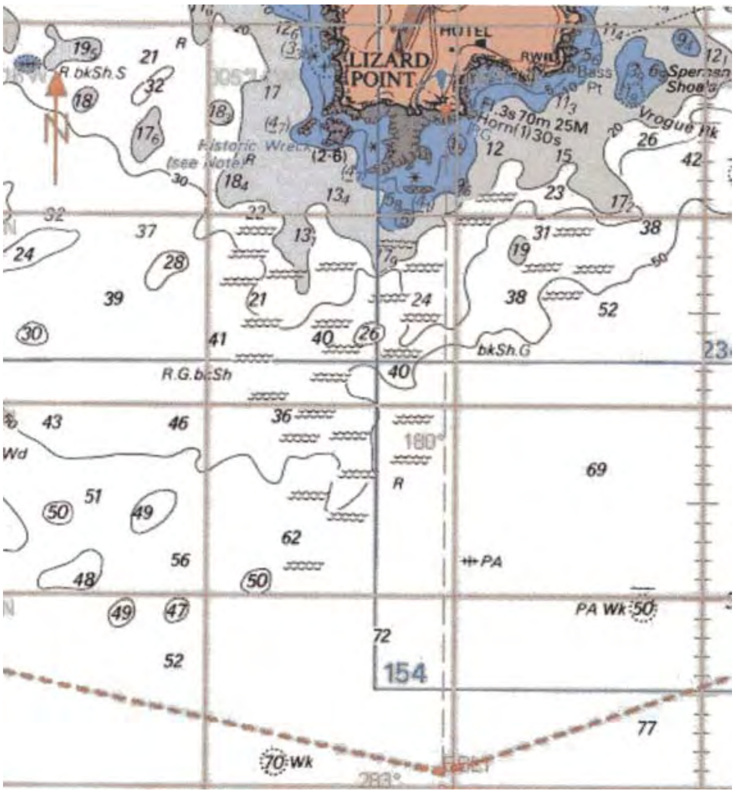


Figure 17 – Extract from BA777 in RCDS format

(reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Way points

Traditionally, the navigator has selected a ‘passage portfolio’ of paper charts by studying the chart catalogue. In most electronic systems he can do the same, using either his knowledge from the paper system or by using an electronic catalogue embedded in the system. Creating a portfolio of electronic charts is an important function for two main reasons.

1 The system may require the selection of an appropriate chart portfolio to automatically display the best chart for the selected view area, and to automatically scroll charts as ownship sails from one area to the next.

2 The system may only use charts in the selected (active) portfolio for safety checking.

We now all use GPS to a greater or lesser extent and there is an increasing likelihood that several vessels will use the same waypoint. This will be particularly so in traffic separation schemes and areas of high density traffic. The prudent mariner will be aware of this and will need to maintain special vigilance in these areas.

Traditionally, waypoints have been established in the vicinity of navigational aids or prominent landmarks and the waypoint’s precise location has been determined by a range and bearing from the navaid or landmark. ECS allow the user to utilise a number of ‘traditional’ tools in establishing a waypoint, including the use of EBL / ERBL and / or VRM, as shown in figure 17. In this case Waypoint 2 is in a position 180° x 5.5 nautical miles from Lizard Point lighthouse.

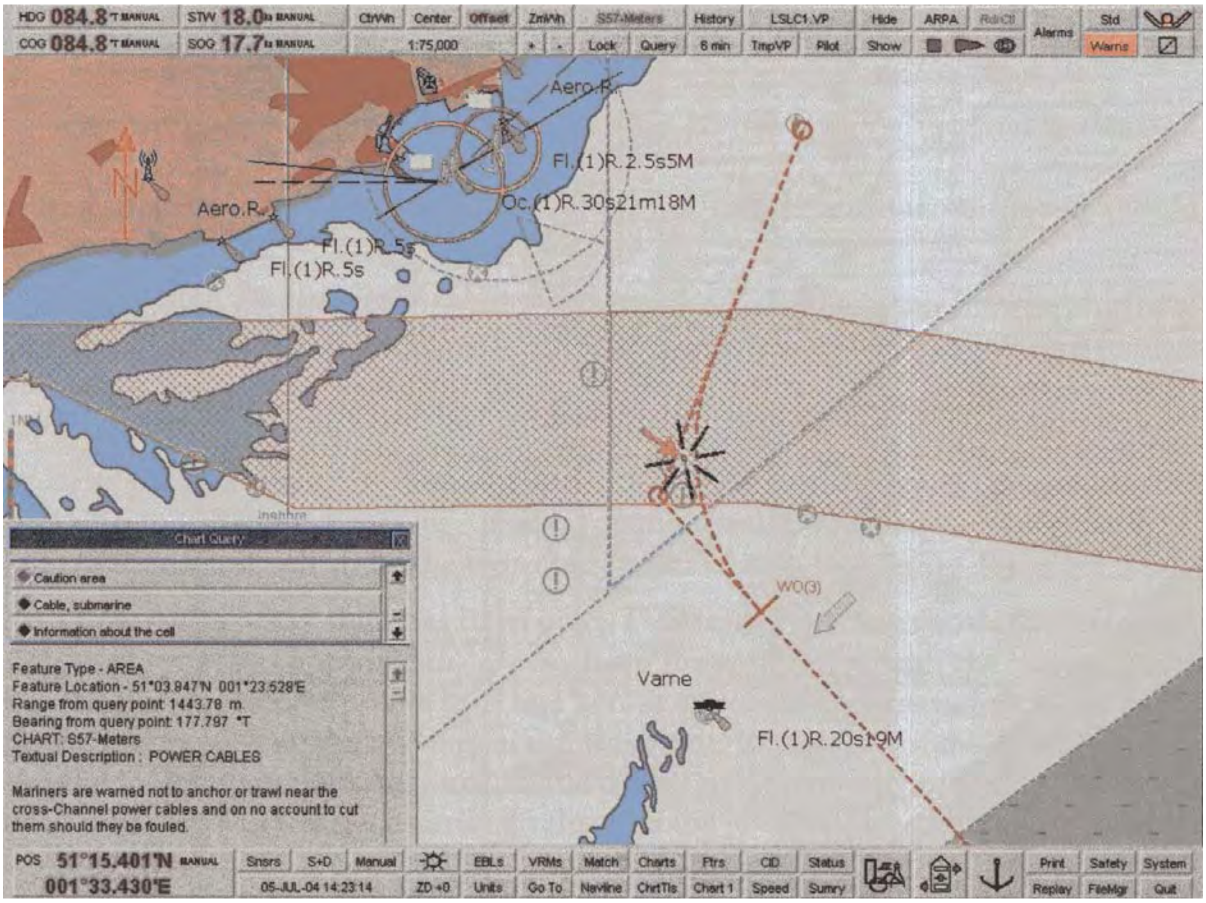


Figure 18 – Extract from S-57 chart (vector chart) – showing a ‘Caution Area’ for power cables hatched in red (reproduced with the permission of Northrop Grumann Sperry Marine and the Hydrographer of the Navy)

Rhumb line or great circle?

No problem! The traditional method of determining appropriate waypoints along the great circle (GC) at which to alter course is now not necessary. Most ECS / ECDIS will calculate the GC route and will provide accurate course to steer information throughout the voyage. The navigator will only have to adjust the autopilot from time to time unless, as we see below, it is connected to the ECS / ECDIS, in which case it will maintain the GC throughout. Similarly, compound routes with limiting latitudes can he planned and executed.

Safety checking

One of the benefits of ECS is that the system will automatically check for dangers along a ship's current course or voyage plan, provided that the appropriate parameters have been set in the first place. These include safe depth and safe height. Where a danger is detected, the system will highlight the danger area in some way – for example. the shallow water may he shaded by cross hatching of a distinctive colour – and the navigator will be given an audible warning.

It must be remembered, of course, that this will only occur if the system is working with vector charts – charts with so called 'intelligent spatial data' whereby the chart is, in effect, a database of spatially related objects that can be interrogated by the software.

A danger alarm is also triggered for a variety of specific object types listed in the international standard for ECDIS, regardless of the safety depth and safety height; for example, Military Practice Areas, Anchorage Prohibited Areas, and Specially Protected Areas. These types of objects always trigger a danger alarm when a safety zone violation is detected.

Most ECS will provide the option for (he navigator to check his intended route during the planning stage. As already noted above, some systems will not allow an 'unsafe' passage plan to be saved the navigator must correct this first. This validation process of the intended route relies on the safety configuration for the vessel.

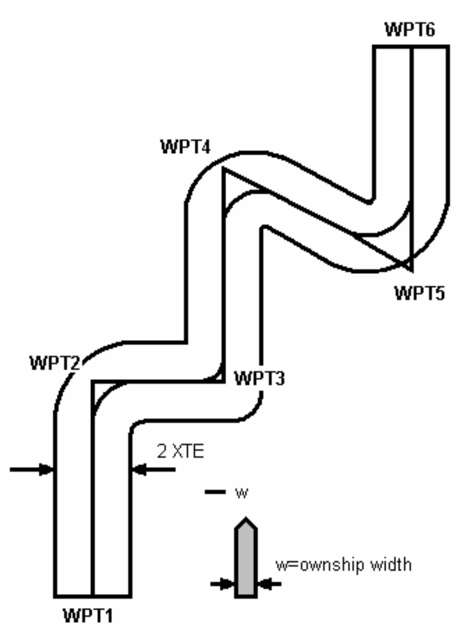


Figure 19 – Voyage plan safety zone

(reproduced with the permission of Northrop Grumann Sperry Marine)

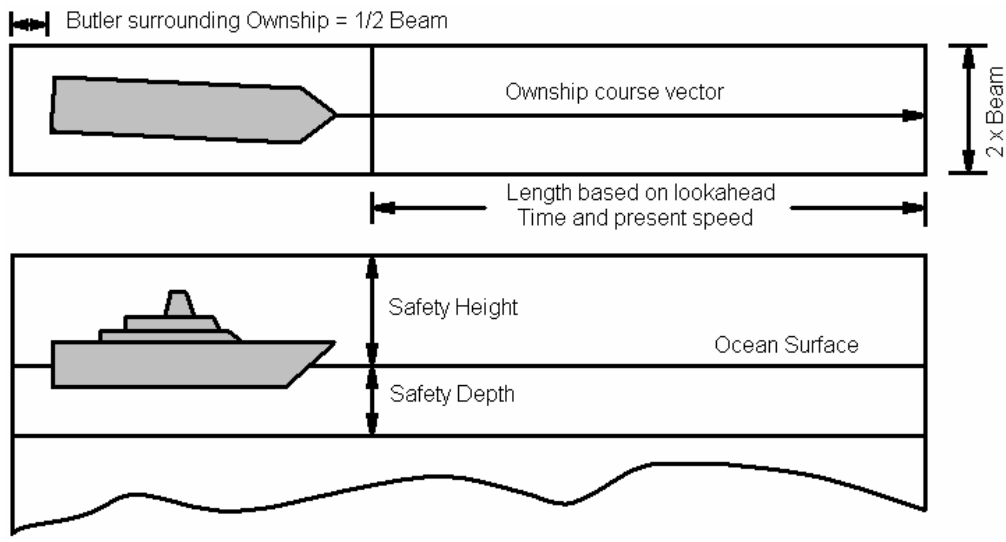


Figure 20 – Voyage plan safety zone

(reproduced with the permission of Northrop Grumann Sperry Marine

Chart additions

Another 'traditional tool' that has been used by the prudent navigator is annotation of the charts to indicate, for example, Temporary or Preliminary Notices, messages or advice when to call the pilot or the master, when to change chart and so on. For the latter, this will not be necessary as the system will automatically scroll from one chart to the next, provided that the next chart has been included within the selected portfolio.

For the other remarks, most systems will allow the user to add his own information to a chart, in both raster and sector formats. The number of options available is vast and this is not an appropriate paper in which to try to list them all. However, when Danger Areas and some other features are added to a raster chart by the navigator, the system will provide a Danger Warning.

('Mariner Objects')

Route monitoring

Once the navigator is satisfied with his planning process, the ECS / ECDIS will allow him to monitor his progress along his intended route with greater accuracy than without such a system. The continuous input of GPS position for example, will provide a continuous real-time display of his ship's position on the most appropriate chart.

He will have the opportunity to 'look ahead' by scrolling through the charts to acquaint himself with potential danger areas, alterations of course, crossing traffic and so on. Although he may choose to do this, a single click of the mouse or roller ball will bring him hack to his own ship's position.

Some systems will be linked to the autopilot such that the vessel will maintain its track within parameters set by the navigator. He may choose, for example, that in coastal waters, he will wish to restrict his cross track error (XTE) to 185 metres (1 cable/0.1 nautical mile but, in open waters, a one mile XTE will be acceptable. This will he done at the planning stage and the autopilot will oblige!

In the NGSM VMS system, for example, safety checking is achieved in one of two ways. ‘When the voyage plan is controlling the autopilot sometimes referred to as track keeping’ mode — the system will look at the intended route and search for dangers along the whole of the route, based on the XTE set in the voyage plan. In this case, the width of the safety zone’ is twice the XTE plus own ship’s beam. If a danger is detected along the route, a warning will be given.

On the other hand, where the voyage plan is not in control, the safety checking is based upon the safety configuration of the vessel and on the actual speed of advance.

The prudent navigator will not rely solely on the ECS / ECDIS / IBS for an indication of his position and progress along his intended route. The traditional tools of his trade are available to him and he must make use of them at all times. As already suggested, many of these tools are available to him in an electronic form and he can use them on screen to check the accuracy of the information presented to him.

He may also see radar overlay, ARPA and AIS information on the same screen. ‘Information overload’ is of significant concern to users and regulators but, with appropriate and effective training, knowledge and understanding of the benefits and limitations of the equipment at his disposal, ECS / ECDIS / lBS can and will contribute to continuing safe navigation.

Conclusion

The navigational technology available on today’s vessels is rapidly increasing. With the widespread use of GPS for both survey and shipboard use, a very accurate ship’s position is instantly available. However, the modern mariner must always be aware of the man)’ factors that can influence the accuracy of plotted positions. Chart datum, surveys and compilation can all have an effect on plotted positions when using both paper and electronic charts.

Similarly, it cannot be emphasised too much that good training and familiarisation with the equipment fitted on board the ship is essential if the bridge team, including pilots when embarked, are to perform effectively and to ensure that the vessel is navigated safely and efficiently from one port to the next. Electronic systems are only as good as the people who use them. If the user does not know what he or she is doing, the machine is of no benefit whatsoever.

ECDIS references and publications

IHO publication S-57 chart data transfer and updating

- IHO S 57 provides the transfer standard for hydrographic data to be used with ECDIS.
- It describes the data structure and format to be used for the exchange of ENC (Electronic Navigational Chart) data between hydrographic offices, ECDIS manufacturers, mariners and other users.

IHO special publication S52

- Specifications for chart content along with display aspects of ECDIS.
- It provides specifications and guidance regarding the issuing, updating and display of ENC when used with ECDIS.

International Electrotechnical Commission (IEC) standard 61174

- Governs maritime navigation and radio-communication equipment systems.
- Describes the Electronic Chart Display and Information System (ECDIS), operational and performance requirements, and provides methods for the required results.

IMO Resolution A.817 (19)

- IMO Performance Standards for ECDIS.
- Describes the minimum performance standards for ECDIS systems, references to both hardware and software, ENC updates, user interface and the integration of external devices.
- INC and the IEC based the development of their publications (IHO S-57, 52 and IEC 61174) on IMO resolution A.817 (19).

Definitions

Integrated Bridge System (IBS)

An Integrated Bridge System (IBS) is a combination of systems, which are interfaced to allow centralised access to sensor information or command/control from individual workstations.

Electronic Chart Display and Information System (ECDIS)

A navigation information system which, with adequate backup arrangements, can be accepted as complying with the up-to-date chart, required by regulation V/19_2.l.4 of the 1974 SOLAS Convention, by displaying selected information from a System Electronic Navigational Chart (SENC) with positional information (referenced to WGS 84) from navigation sensors to assist the mariner in route planning and route monitoring, and by display additional navigation-related information.

ECDIS certified systems

To qualify as an ECDIS system the hardware and software must be simultaneously tested by an authorised Classification Society in accordance with the IEC 61174 requirements, and be granted an approval certificate

The approval is only valid in the sea areas for which the official S57 chart data (ENC) has been installed in the system, and corrected to include the latest updates. In all other situations, updated paper charts must be carried on board to comply with SOLAS Regulation V/19_2.1.4.

Electronic Navigational Chart (ENC) – S-57 vector chart

The database, standardised as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation. Hydrographic offices can directly produce this data or they may commission private companies to produce the data and then verify and certify the results.

System Electronic Navigational Chart (SENC)

A database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means, and other data added by the mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions, and is the equivalent of an up-to-date paper chart. The SENC may also contain information from other sources.

Standard display

The level of SENC information that shall be shown when a chart is first displayed on ECDIS.

Base display

The level of SENC information which cannot be removed from the ECDIS display, consisting of information that is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation.

Electronic Chart Systems (ECS) – not ECDIS

An Electronic Chart System (ECS) can be considered any other type of electronic charts that does not comply with the IMO Performance Standard for ECDIS. Electronic Charting Systems do not necessarily comply with the up-to-date chart requirement of V/ 19_2.1.4 of SOLAS 1974. As such, an ECS is an aid to navigation that should always be used with an up-to-date paper chart from a government-authorised hydrographic office.

Vector type charts

In a vector based system, electronic chart data is comprised of a series of lines (vectors) in which different layers of information may be stored or displayed.

This form of so called intelligent spatial data is obtained by digitising information from existing paper charts or by storing a list of instructions that define various position referenced features or objects (e.g. floating buoys).

With a vector ECS, the user has considerable flexibility and discretion regarding the amount of information that is displayed fin the task at hand.

Raster type charts

A raster chart is a scanned image of a paper chart. In raster-based systems, the data is stored as picture elements (pixels. Each pixel is a component of the chart image with a defined colour and brightness level. Raster-scanned images are derived by video or digital scanning techniques, which result in a computer photograph of paper charts.

Further reading

The intention of this chapter was to provide an insight into the use of complex electronic navigation systems on board ship. It is necessarily brief and only touches the surface of many complex issues. For those readers with a desire for greater knowledge, more information can be found on the internet from a variety of sources: all system manufacturers and government authorised hydrographic offices have their own web sites with varying amounts of technical information. Other information can be found using appropriate search engines.

For more information on the electronic chart, its construction and potential, the following publication is highly recommended:

Hecht/Berking/Büttgenhach/Jonas/Alexander, "*The Electronic Chart – functions, potential and limitations of a new marine navigation system*," published by GITC by, Lemmer, The Netherlands, ISBN: 90 806205-1-3.

Notes

1 IMO Model Course 1.27, 'The Operational Use of Electronic Chart Display and Information Systems (ECDIS)', Introduction, p.1: IMO Requirements, § (B) l: Competence Requirements.

2 IMO Model Course 1.27, p.2.

3 ibid. p.6

4 'The International Code for the Safe Operation of Ships and for Pollution Prevention', now Ch... IX of SOLAS 2001.

5 ISM Code. §6.33.

6 ibid. §6.4.

7 ibid. §6.5.

8 Own suggestion.

9 ISM Code. §8.3

10 IMO Model Course, p4.

11 Australian Maritime Safety Agency ECDIS Policy (Consult), Nov. 2001.

12 AMSA Marine Notice 14/2002.

13 1974 SOLAS Convention, as amended, Chapter V, Reg. 19.2. (bold text inserted for emphasis).

14 IMO Circular SM/Circ.217.

15 UK MCA has published guidelines on the use of risk assessment methodology to determine the level of paper charts to he carried in conjunction with ECS/ECDIS – MGN 194(M). This can be downloaded from their website: www.mcga.gov.uk Note that it is 32 pages.

16 1974 SOLAS Convention, as amended, Chapter V, Reg. 2. (bold text inserted for emphasis).

17 (Definition: IEC 1290 Integrated Bridge Systems).

Chapter 9

GUIDANCE ON KEEPING A NAVIGATIONAL WATCH WITH REFERENCE TO STCW'95 Code Part B Chapter VIII Part 3–1 – with COMMENTARY

Introduction

The relevant sections of the International Code are laid out in the left hand column. The author's commentary based upon the principles contained in *Bridge Team Management* are laid out in the right hand column.

The exercise has been designed to provide access to the test of the relevant part of the STCW'95 Code. The commentary is presented as a recapitulation of the key points which need to be observed if risks are to be minimised and safe navigation assured.

IMO guidance	Author's Commentary
3. It is essential that officers in charge of the navigational watch appreciate hat the efficient performance of their duties is necessary in the interests of the safety of life and property at sea and of preventing pollution of the in arm e environment.	3. This clearly shows that the first task of the master, as team manager, is to ensure that his watchkeeping officers are fully aware of their responsibilities to their own ship, to other aspects of the industry and, not least, to the safety of the environment. Such responsibilities need to be clearly laid down, discussed and queried individually and collectively, before the commencement of the voyage and maintained by further discussion during the voyage. The officers entrusted with the charge of the navigational watches need to be considered as parts of a team. On occasion the watch will require more than one officer on the bridge; sometimes the officer of the watch OOW will be supporting the master and / or the pilot. In some high risk areas there may be more than one officer carrying out these roles. Under such circumstances the master will obviously be the team leader, but in other circumstances the OOW will be working alone, unsupervised, in sole charge of the watch. This last point makes the above statement even more important. The watchkeeper in charge of the navigational watch is responsible to the master for the safekeeping of the ship and needs to be aware of the responsibilities of this task. If the ship is not kept safe the liabilities can be awesome. Not only may the ship itself he damaged, further repercussions may include endangering personine1 to the extent of causing death, causing damage to other property, other traffic, shore establishments etc. and possibly causing untold damage to the environment. Such consequences can involve the shipowners and others in enormous costs and involve personnel in loss of certification and career prospects. **Although the master can delegate authority he cannot delegate responsibility**. The OOW has the authority to conduct the safe navigation of the ship, during his watch. Such conduct can only be to the requirements of the master, who carries the ultimate responsibility' for the safety of the ship.

IMO guidance	Author's Commentary
5.1 A sufficient number of qualified individuals should be on watch to ensure all duties can be performed effectively,	5.1 It is very easy for the OOW to fall into (he mental trap that he is able to cope with anything that watchkeeping presents to him. This may be a result of misunderstanding; an assumption (hat it is quite normal for a watchkeeper to do it all himself; or even a fear that he may be seen to be inadequate by calling for assistance. Careful passage planning will have pre determined the need to call for more watchkeepers in most cases, as high workload areas will have been established and the necessity for a full team will have been taken into account. The problem arises when a low-key situation becomes critical and the OOW finds he needs support and assistance. In particular familiarity with an area may have accustomed the OOW to carry out much of the bridge routine himself. This may range from not calling a helmsman and leaving the helm in automatic, to not calling a lookout and having to keep such a detailed lookout that he has to ignore more pressing requirements on his time and expertise. In some cases the pressure of his workload will require additional help in the form of calling the master to the bridge. This situation should be no problem. The master's standing and night orders should have made it quite clear when he should be called to the bridge, though this may not always be the case. Such a situation will not arise if there has been a correct briefing of the OOW by the master acting in his managerial role. Sometimes though it may be necessary for the OOW to point out to the master that assistance is required to maintain a safe ship.
5.2 All members of a navigational watch should be appropriately qualified and fit to perform their duties efficiently and effectively or the officer in charge of the navigational watch should take into account any limitations in qualifications or fitness of the individuals available when making navigational and operational decisions.	5.2 Despite the requirement that members of the watch should be appropriately qualified and fit, this may not be a situation over which the COW has any control. Appropriate qualification is a subject that should have been established at the signing-on stage. Fitness to perform required duties may be beyond anyone s control. However the second part of the requirement makes it quite clear that the 00% can exercise some control by modifying his approach to a problem and taking into account any such limitation in qualification or fitness. For example, it may be normal for the bosun to stand by the anchors when proceeding through constrained waters. Should he not be available due to sickness, then it must be taken into account that if the individual appointed to replace him does not have the experience of the bosun then it may be better to appoint two people to the role. Such operational modifications will have to take into account the limitations imposed and the circumstances of the case such as proximity of dangers and traffic, weather, size and condition of ship, etc.

IMO guidance	Author's Commentary
5.3 Duties should be clearly and unambiguously assigned to specific individuals, who should confirm that they understand their responsibilities.	5.3 This is a most important part of the recommendation. Generally, personnel have little objection to being told what they are responsible for or what is required of them. Confusion can be easily prevented by there being a frank and even discussion as what is specifically required of the individual before taking watch keeping duties. This will include but not be limited to: • The circumstances under which the master requires to be called to the bridge. • A clear understanding that the OOW retains the con of the ship until such time as the master assumes the con. • A knowledge of the bridge manning levels required during the voyage and a clear understanding under what conditions such levels may be modified. • Navigational responsibilities. • Level of support required when the master or pilot has the con. Obviously discussions will take place over a long period of time and will include such items as general briefings of the watch officers prior to commencing the voyage, more specific briefings prior to and during a passage and personal discussion between the master and the individual officer. It is also a requirement that the individual officer confirms that the responsibilities are understood; consequently any points that are not clear need to be discussed and mutually agreed. Similarly it is a requirement of the OOW that he makes it clear to his watchstanders what he requires and expects of them in the performance of their duties.
5.4 Tasks should be performed according to a clear order of priority.	5.4 This would appear to be obvious, but is not necessarily the case. Apart from the safe keeping of the ship there are a large number of other tasks requiring attention and a watchkeeping officer is required to carry out an extensive variety of duties. These can range from items such as attending to internal and external communications to cargo care and attention or even responding to passenger requests. At the same time he will have no control over ambient conditions, visibility, wind, weather or sea conditions. Often watch keeping may require little activity especially when on a transoceanic part of the voyage. The other extreme may be approaching a busy area such as Japan in snow, with a big sea running, heavy traffic and traffic separation schemes to be negotiated. Under these latter circumstances the situation may get a little out of hand and tasks may tend to not be prioritised leading to further confusion and difficulty.

IMO guidance	Author's Commentary
	This situation can be made worse by not observing 5.1. A sufficient number of qualified individuals should be on watch to ensure all duties can be performed effectively. Properly briefed watch members will have no hesitation in pointing out to the OOW the fact that an overlooked item is becoming a high priority problem, just as the officer can and would if a senior officer or pilot had the con.
5.5 No member of the navigational watch should be assigned more duties or more difficult tasks than can be perform ed effectively.	5.5 This section addresses the problem of personnel becoming overloaded and consequently unable to carry out their duties correctly. It usually occurs when a watch member has been given too many tasks to carry out. This may be a result of inadequate assessment of the constraints prevailing and should have been overcome at the stage when the execution of the passage was discussed. This discussion would have indicated the anticipated workload and the number and distribution of personnel required. The second cause may occur when the 00W becomes overloaded during his own watch keeping period, yet remains unaware of the fact. On a well-structured watch another watchstander would have pointed this out to the overloaded individual thus giving him the opportunity to correct the situation.
5.6 Individuals should be assigned at all times to locations at which they can most efficiently and effectively perform their duties, and individuals should be reassigned to other locations as circumstances may require.	5.6 It is very easy, particularly on regular trading vessels, to fall into work patterns that may have been formulated 'ears previously by people no longer on the ship. Indeed, work patterns may become established at an early stage of the current voyage and debriefs and meetings show that they are not necessarily the best. An onlooker may see that these patterns are nut optimal vet not make any suggestions, most probably' because of a reluctance to interfere.
5.7 Members of the navigational watch should not be assigned to diff- erent duties, tasks or locations until the officer in charge of the navigational watch is certain that the adjustment can he accomplished efficiently and effectively;	5.7 Among the requirements of efficient bridge management is the ability to recognise that plans or systems may have to be changed during a passage and to accept and incorporate such changes) having first established that such changes can he carried out safely and efficiently.

IMO guidance	Author's Commentary
5.8 Instruments and equipment considered necessary for effective performance of duties should be readily available to appropriate members of the navigational watch.	5.8 This is a relatively new suggestion arid reminds watchkeepers that in order to keep a safe watch, personnel need to be provided with the necessary tools.
5.9 Communications amongst members of the navigational watch should be clear, immediate, reliable, and relevant to the business at hand.	5.9 Communications within the team are a principal item of the methods used to keep the ship safe and must not be interrupted by conversation that has no relevance to (he (ask in hand. "Packages" of information need to be communicated from person to person in a clear, uniform and understandable way. This needs to be practised to achieve a consistent system.
5.10 Non essential activity and dist-ractions should be avoided, suppressed or removed;	5.10 It is essential to understand that the bridge of a ship, during watchkeeping conditions, is a workplace and that activities irrelevant to such a workplace must be avoided, suppressed or removed.
5.11 All bridge equip-ment should be operating properly and if not the officer in charge of the navigational watch should take into account an malfunction which may exist in making operational decisions.	5.11 Correct watchkeeping will include a routine whereby navigational equipment is regularly checked, ensuring that it is operating correctly. Such routines will normally be in standing and, if necessary, night orders. In any case a proficient watchkeeper will be aware of such checks as are necessary and will carry them out for his personal satisfaction. When detected, malfunctions need to be corrected, either by repairing or adjusting faulty equipment or by mathematically allowing for discrepancy in readouts. If none of these alternatives is possible then the 00W, in consultation with the master, must modify the proposed plan so that the safety of the ship is not jeopardised. E.g. areas of low UKC would need to be avoided if the echo sounder has proved to be unreliable and accurate fixing is not possible.

IMO guidance	Author's Commentary
5.12 All essential information should he collected, processed and interpreted, and made conveniently available to those who require it for the performance of their duties.	5.12 Essential data needs be collected regularly, processed, turned into relevant information and passed to whosoever has the con or needs it for the performance of their duties. Such passing of information should be in a format readily understood by the recipient and in an unchanging manner so that it does not come as a surprise. This may need to be practised to attain a regular routine, particularly where personnel do not have the same first language.
5.13 Non essential materials should not be placed on the bridge or on any work surface.	5.13 This underlines 5.10 and the fact that the bridge is a workplace and that it is essential to keep it as such.
5.14 Members of the navigational watch should at all times be prepared to respond efficiently and effectively to changes in circumstances.	5.11 Serves as a reminder that no matter how much voyage/ passage planning has been done; and no matter how well organised the bridge team is, circumstances can change without warning and the bridge team has to be prepared to take such action as is necessary.

Chapter 10

IMO GUIDELINES FOR PASSAGE PLANNING with COMMENTARY

IMO STCW 78 (early thoughts on passage planning)

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, quoted below, was adopted by IMO in July 1978 and entered into force in April 1984. Since then three amendments have been adopted in 1991, 1994 and 1995.

STCW code Section A-VIII/2 part 2 para.3 states "The intended voyage shall be planned in advance, taking into consideration all pertinent information, and any course laid down shall be checked before the voyage commences.

Planning prior to each voyage

Para.5 states "Prior to each voyage the master of every ship shall ensure that the intended route from the port of departure to the first port of call is planned using adequate and appropriate charts and other nautical publications necessary for the intended voyage, containing accurate, complete and up to date information regarding those navigational limitations and hazards which are of a permanent or predictable nature and which are relevant to the safe navigation of the ship.

Note: Industry guidelines in the *ICS Bridge Procedures Guide* recommend passage planning from bent to berth and this is incorporated in the following Annex.

Verification and display of planned route

Para.6 states 'When the route planning is verified taking into consideration all pertinent information, the planned route shall be clearly displayed on appropriate charts and shall be continuously available to the officer in charge of the watch, who shall verify each course to be followed prior to using it during the voyage."

Deviation from planned routes

Para.7 states "If a decision is made, during a voyage, to change the next port of call of the planned routes, or if it is necessary for the ship to deviate substantially from the planned route for other reasons, then an amended route shall be planned prior to deviating substantially- from the route originally planned.

The extracts above, quoted from the STCW Code were the first, formal suggestions of a voyage/passage planning system. IMO has now developed a new set of guidelines, quoted overleaf with explanations.

IMO guidelines	Author's Commentary
1. ADOPTS the Guidelines for voyage planning set out in the Annex to the present resolution;	
2. INVITES Governments to bring the annexed Guidelines to the attention of masters of vessels flying their countries' flag, shipowners, ship operators shipping companies, maritime pilots, training institutions and all other parties concerned, for information and action as appropriate.	
3. REQUESTS the Maritime Safety Commitee to keep the said Guidelines under review and to amend them as appropriate.	
ANNEX	
DRAFT GUIDELINES FOR VOYAGE PLANNING	
1 Objectives	
1.1 The development of a plan for voyage or passage, as well as the close and continuous monitoring of the vessel's progress and position during the execution of such a plan, are of essential importance for the safety of life at sea, safety and efficiency navigation and protection of the marine environment.	1.1 Points out why it is considered necessary to have a passage plan. It is part of the whole concept of Bridge Team Management and is made particularly significant by the IMO Resolution STCW B VIII/Part 3-1 5.3 which states: *"Duties should he clearly and unambiguously assigned to specific individuals, who should confirm that they understand their responsibilities".* The passage plan is part of this statement in that it advises the OOW, and others, of what is intended to happen. and how they are expected to go about making it happen. At this stage tile OOW is also given the opportunity to query what is expected of him, prior to the commencement of the voyage and to give his approval of the planned voyage.
1.2 The need for voyage and passage planning applies to all vessels. There are several factors that may impede the safe navigation of all vessels and additional factors that may impede the navigation of large vessels or vessels carrying hazardous cargoes. These factors need to he taken into account in the preparation of the plan and in the subsequent monitoring and the execution of the plan. Voyage and passage planning includes appraisal, i.e. gathering all information	1.2 This is the first significant difference between the previous guidelines and those of 1999 in that it is clearly stated that planning is not only a requirement for all vessels but is required for both voyages and passages. Previously it could have been interpreted as being only for the ocean part of the voyage and then only from the port of departure to the first port of call. This paragraph explains the four separate parts of the plan : -

IMO guidelines	Author's Commentary
relevant to the contemplated voyage or passage; detailed planning of the whole voyage or passage from berth to berth, including those areas necessitating the presence of a pilot; execution of the plan; and the monitoring of the progress of the vessel in the implementation of the plan. These components of voyage/passage planning are analysed below.	The appraisal i.e. the gathering of all the information relevant to the intended passage or voyage; The detailed planning of the voyage or passage, as shown on the chart and various booklets or kept in a computer; The execution of the plan, depending on timings of entry of passages and arrival at ports and Predetermining the monitoring of the vessel and the timings and frequency of same. See below for further details on appraisal.
2 Appraisal 2.1 All information relevant to the contemplated voyage or passage should be considered. The following items should be taken into account in voyage and passage planning	2.1 Emphasises that all information relevant to the contemplated voyage/passage needs to be considered.
.1 the condition and state of the vessel, its stability, and its equipment; any operational limitations; its permissible draught at sea in fairways and in ports, its manoeuvring data, including any restrictions;	2.1.1 This includes the physical state of the vessel, its stability and the state of its equipment; operational limitations which could prohibit its entry into certain ports or areas, the draught of the vessel, both at sea and in restricted areas or ports and its manoeuvring data.
.2 any special characteristics of the cargo (especially if hazardous) and its distribution, stowage and securing on board the vessel;	2.1.2 The cargo carried may need to be taken into account, particularly if it is dangerous, as must its distribution and stowage on the vessel.
.3 the provision of a competent and well rested crew to undertake the voyage or passage;	2.1.3 Competent crew availability will need to have been taken into account when the ship signed on, though subsequent illness or changes may affect the situation. In the USA, OPA 90 may affect a ship's departure if the crew is not sufficiently' rested.
.4 requirements for up-to-date certificates and documents concerning the vessel, its equipment. crew, passengers or cargo;	2.1.4 Documentation concerning the vessel should he held in a secure location and should not vary' between voyages. however, this will need to be verified to ensure authenticity. Documentation concerning crew and passengers will need to be treated the same, but in most cases cargo information will vary from voyage to voyage and will need to be checked prior to departure.
.5 appropriate scale, accurate and up-to-date charts to be used for the intended voyage	2.1.5 Hard and fast rules concerning charts cannot be taken for granted. Many ships

IMO guidelines	Author's Commentary
or passage, as well as any relevant permanent or temporary notices to mariners and existing radio navigation warnings;	will carry' British Admiralty charts but it must not be assumed that they will necessarily be the best for every voyage. The British Admiralty guarantees to produce charts to traverse all oceans and navigate any coast, but does not necessarily produce the largest scale charts for all ports. It may be necessary to consult catalogues of other hydrographic offices to be quite sure that the latest and largest scale charts are available. Permanent and temporary notices to mariners will normally be available from the notices to mariners produced by! hydrographic offices and can be obtained from chart suppliers. Navtex and radio navigational warnings will also supplement these ton the appro-priate area.
.6 accurate and up to date sailing directions, lists of lights arid lists of radio aids to navigation; and	2.1.6 Sailing directions (Pilot Books) would normally be carried by ships. but it will be necessary to ensure that they are up to date. List of lights and lists of Radio Aids will need similar treatment as will such lists held on CD ROMs.
.7 any relevant up to date additional information, including:	
.1 mariner's routing guides and passage planning charts, published by competent authorities;	2.1.7.1 Mariner's routing guides and passage planning charts are available from the *Admiralty Passage Planning Guide* to IMO Routeing Charts, none of which should be ignored at the appraisal stage.
.2 current and tidal atlases and tide tables;	2.1.7.2 Tide tables may be in the written form or may he obtained in CD form. which can give tidal times and Freights for any port, primary or secondary, in the world. Tidal atlases are published by the British Admiralty giving hourly tidal information for N.W. European Areas and information no U.S. port approaches can be obtained from the USHO.
.3 climatological, hydrographical and oce-anographic data as well as other appropriate meteorological information;	2.1.7.3 Such information can he obtained from a variety of sources showing meteorological and hydrographic patterns of the oceans and more immediate information concerning impending weather systems may he obtained from weather forecasts and Satnav.

IMO guidelines	Author's Commentary
.4 availability of services for weather routing (such as that contained in Volume D of the World Meteorological Organization Publication No. 9);	2.1.7.4 In cases where the vessel will be transiting high latitudes, storm bound areas it will be advantageous to obtain weather routeing services as it will when owners or charterers require it,
.5 existing ship's routing and reporting systems, vessel traffic services, and marine environmental protection measures;	2.1.7.5 IMO Routeing Charts, both ocean and coastal, will need to be consulted as will information on VTS and environmental protection services.
.6 volume of traffic likely to be encountered during the voyage or passage;	2.1.7.6 Volume of traffic likely to be encountered will depend largely upon personal knowledge, though information may be obtainable from pilot books.
.7 if a pilot is to be used information relating to pilotage and embarkation and disembarkation including the exchange of information between master and pilot; .	2.1.7.7 Details of pilotage areas and embarkation and disembarkation will be available from large-scale charts and pilot books. Master/ pilot information should be made up on a master/pilot exchange form, prior to arrival or departure.
8 available port in formation, including information pertaining to the availability of shore-based emergency response arrangements and equipment;	2.1.7.8 Port information may be obtained from charterers, Pilot Books, and such books as Guide to Port Entry.
.9 any additional items pertinent to the type of vessel or its cargo. the particular areas the vessel will traverse, and the type of voyage or passage to be undertaken.	
2.2 On the basis of the above information, an overall appraisal of the intended voyage or passage should be made. This appraisal should provide a clear indication of all areas of danger, those areas where it will be possible to navigate safely, including any existing routeing or reporting systems and vessel traffic services; and any areas where marine environmental protection considerations apply.	2.2 Although drafting the voyage plan may well be the task of the navigating officer, probably the second mate, it is the responsibility of the master and it will be at this stage that he needs to be consulted. The strategy of the voyage or passage is at his discretion and he will know company requirements on such details as distances off dangers, preferred straits and passages. and company and charterers requirements on arrival times etc.
3. Planning 3.1 On the basis of the fullest possible appraisal, a detailed voyage or passage plan should be prepared which will cover the entire voyage or passage from berth to berth. including those areas where the services of a pilot will be used.	3.1 Having appraised the voyage/passage from the above information and the requirements of the master, the owners and charterers, the flag state and international conventions, the navigating officer is now in a position to plan the anticipated voyage/passage from berth to

IMO guidelines	Author's Commentary
3.2 The detailed voyage or passage plan should include the following factors:	berth including areas where a pilot will be engaged.
.1 the plotting of the intended route or track of the voyage or passage on appropriate scale charts: the true direction of the planned route or track should be indicated, as well as all areas of danger, existing ship's routeing and reporting systems, vessel traffic services and any areas where marine environmental protection considerations apply; 2. the main elements to ensure said of life at sea. safety and efficiency of navigation, and protection of the marine environment during the intended voyage or passage; such elements should include, but not be limited to:	3.2.1 In general the largest scale charts available will be used, though this will depend upon the area to be used, the proximity of land and dangers, the accuracy of navigation and monitoring required and the actual period of time the vessel will be on a chart. Ocean charts will, of necessity, be the first to require attention if only to determine the points of departure and arrival. Crossing the oceans will require the least arduous part of planning, a Great Circle will often he sufficient but dangers such as land and less water will have to be taken into account as will weather routeing advice and other meteorological situations. Special areas where the marine environment needs in be protected will also have to be observed and IMO routeing have to he follow ed.
.1 safe speed, having regard to the proximity of navigational hazards along the intended route or track, the manoeuvring characteristics of the vessel and its draught in relation to the available water depth;	3..2.2.1 Safe speeds will always have to be considered especially when there is a risk of the vessel striking the bottom through squat or rolling in areas of low UKC.
.2 necessary speed alterations en route. e.g., where there may he limitations because of night passage, tidal restrictions, or allowance for the increase of draught due to squat and heel when turning;	3.2.2.2 Speed alterations where necessary to achieve a given time of passage or to keep the vessel safe need to be shown on the track line, to ensure that they are not overlooked and also to give ample warning to the engine room.
.3 minimum clearance required under the keel in critical areas with restricted water depth;	3.2.2.3 Where UKC becomes critical the minimum acceptable UKC needs to he shown on the chart. Coastal charts will obviously require similar treatment but will contain much greater detail as navigation monitoring and proposed plans need to he shown more precisely.
.4 positions where a change in machinery status is required;	3.2.2.4 Showing positions where change in machinery status is required not only reminds bridge personnel of such details but also acts as a reminder to warn the engine room, especially on vessels where

IMO guidelines	Author's Commentary
	the engine room personnel need such warning.
.5 course alteration points, taking into account the vessel's turning circle at the planned speed and any expected effect of tidal stream and currents;	3.2.2..5 Showing a position where a course alteration is to take place serves to ensure that such alterations occur where and when required. This particularly applies in narrow waters where the wheel over may need to be made before the actual alteration of course to ensure that the new track is achieved.
.6 the method and frequency of position fixing, including primary and secondary options, and the indication of areas where accuracy of position fixing is critical and where maximum reliability in must be obtained.	3.2.2.6 Method and frequency of position should not be left to the individual watchkeeper. Junior watchkeepers may not have the experience to decide the best method to use under all circumstances and the master, as team manager will need a uniform method in operation so that he does not have to reappraise the situation each time he comes to the bridge. To accomplish this the frequency of observations (depending on proximity of danger etc) and best method to be using, both primary and secondary methods, needs to be decided beforehand. Situations where maximum reliability and accuracy are needed also need to be decided well in advance and extra personnel advised should they be required. This condition encourages fixing as the only way to ensure that the passage plan is being followed; however in coastal waters and narrow passages pilotage techniques and parallel indexing may need to be used, bearing in mind that P.1. is not a substitute for regular fixing.
.7 use of ship's routeing and reporting systems and vessel traffic services.	3.2.2.7 Situations where ship routeing has to lie used and where reporting s stems arid VTS are required also need to he noted so that they do not come as a surprise to the OOW
.8 considerations relating to the protection of the marine environment; and	3.2.2.8 Areas where the environment requires certain protective actions also need to be noted in addition w standing orders.
.9 contingency plans for alternative action to place the vessel in deep water or proceed to a port of refuge or safe anchorage in the event of any emergency necessitating abandonment of the plan, taking in to account existing shore-based emergency response arrangements and equipment	3.2.2.9 Events can go wrong, however carefully preplanned, especially in confined and congested waters. Contingency plan such as alternative tracks, safe anchorages or waiting areas need to be shown on the chart to ensure that the vessel will be kept safe at all times.

IMO guidelines	Author's Commentary
and the nature of the cargo and of the emergency itself.	
3.3 The details of the voyage or passage plan should be clearly marked and recorded, as appropriate, on charts and in a voyage plan notebook or computer disk.	3.3 Most of the passage planning can be shown on the relevant charts. In some areas there may not be sufficient space to show everything but even so details can be shown on areas of land or water where the ship cannot go. A voyage plan notebook may he used to detail parts of the plan and in any case, such details should be permanently recorded in the notebook or on a computer disk. This allows recall at a later date, should the vessel revisit the port.
3.4 Each voyage or passage plan as well as the details of the plan, should be approved by' the ship's master prior to the commencement of the voyage or passage.	3.4 On completion of the passage plan it needs to be approved by the master. The other ship's officers also need to scrutinise it in order to familiarise themselves with the plan and to offer suggestions where they may not agree.
4. Execution	
4.1 Having finalised the voyage or passage plan, as soon as time of departure and estimated time of arrival can be determined with reasonable accuracy, the voyage or passage should be executed in accordance with the plan or any changes made thereto.	4.1 Any voyage plan depends upon the actual time of commencement. Very often this cannot be determined whilst the plan is being made. In general the only feature that will change is tidal information, which may of course, completely alter the planned passage. In many eases though the planned passage will hold good, the main adjustment being made to times and ETA's.
4.2 Facts which should be taken into account when executing the plan. or deciding on any departure there from include:	
.1 the reliability and condition of the vessel's navigational equipment;	
.2 estimated time of arrival at critical points for tide height and flow;	4.2.2 It may be necessary. on occasion, to adjust the ship's speed to arrive at a given point at a specific time thus effecting a passage at certain times to achieve required tidal heights or streams.
.3 meteorological conditions, (particularly in areas known to be affected by frequent periods of low visibility as well as weather routeing information	4.2.3 Speeds and passage times may need to be adjusted for weather conditions including areas of storm, poor visibility and a weather routeing information.
.4 day time versus night - time passing of danger points. and any effect this may have on position fixing accuracy; and	4.2.4 Certain areas may be better transited at given times of the day particularly with reference to position fixing and
.5 traffic conditions, especially at naviga-tional focal points.	4.2.5 Traffic conditions may also require speed alterations. Such corrections can be allowed for at the execution stage, i.e.

IMO guidelines	Author's Commentary
4.3 It is important for the master to consider whether any particular circumstances, such as the forecast of restricted visibility in an area is here position fixing by visual means at a critical point is an essential feature of the voyage or passage plan, introduces an unacceptable hazard of the safe conduct of the passage and thus whether that section of the passage should be attempted under the conditions pre ailing or likely to prevail. The master should also consider at which specific points of the voyage or passage there might be a need to utilize additional deck or engine personnel.	prior to the passage commencing or may become reactive, as necessary.
5. Monitoring	
5.1 The plan should be available at all times on the bridge to allow officers of the navigational watch immediate access and reference to details of the plan.	5.1 Having previously examined it, the watch keeping officers should be familiar with the plan. particularly the sections relevant to their own watch. Being their working tools the charts will, of necessity, always be available on the chart table and the written parts of the plan will be instantly available for reference.
	5.2 Monitoring of the progress of the vessel will be in accordance with the method as laid down in the plan. Inevitably though, officers will have their own way of fixing the ship, provided it complies with the overall plan as set out at the beginning of the voyage. Timings will, of course, have to comply with the predetermined timings, but particular techniques such as anticipatory DRs and confirmation of fixes by using GPS will obviously he at the discretion of the officer. He must of course, be prepared to justify his methods to the master. Necessary changes to the plan will be made in accordance with methods used to make the plan and nearly shown.

ANNEX I

Watchkeeping arrangements and principles to be observed as defined in STCW'95 Code Section A-VIII/2

Part 1 — Certification

1 The officer in charge of the navigational or deck watch shall be duly qualified in accordance with the provisions of chapter II, or chapter VII appropriate to the duties related to navigational or deck watchkeeping.

2 The officer in charge of the engineering watch shall be duly qualified in accordance with the provisions of chapter III, or chapter VII appropriate to the duties related to engineering watchkeeping.

Part 2 — Voyage Planning

General requirements

3 The intended voyage shall be planned in advance, taking into consideration all pertinent information, and any course laid down shall be checked before the voyage commences.

4 The chief engineer officer shall, in consultation with the master, determine in advance the needs of the intended voyage, taking into consideration the requirements for fuel, water, lubricants, chemicals, expendable and other spare parts, tools, supplies and any other requirements.

Planning prior to each voyage

5 Prior to each voyage the master of every ship shall ensure that the intended route from the port of departure to the first port of call is planned using adequate and appropriate charts and other nautical publications necessary for the intended voyage, containing accurate, complete and up-to-date information regarding those navigational limitations and hazards which are of a permanent or predictable nature and which are relevant to the safe navigation of the ship.

Verification and display of planned route

6 When the route planning is verified taking into consideration all pertinent information, the planned route shall be clearly displayed on appropriate charts and shall be continuously available to the officer in charge of the watch, who shall verify each course to be followed prior to using it during the voyage.

Deviation from planned route

7 If a decision is made, during a voyage, to change the next port of call of the planned route, or if it is necessary for the ship to deviate substantially from the planned route for other reasons, then an amended route shall be planned prior to deviating substantially from the route originally planned.

Part 3 - Watchkeeping at Sea

Principles applying to watchkeeping generally

8 Parties shall direct the attention of companies, masters, chief engineer officers and watchkeeping personnel to the following principles, which shall be observed to ensure that safe watches are maintained at all times.

9 The master of every ship is bound to ensure that watchkeeping arrangements are adequate for maintaining a safe navigational watch. Under the master's general direction, the officers of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they will he particularly concerned with avoiding collision or stranding.

10 The chief engineer officer of every ship is bound, in consultation with the master, to ensure that watchkeeping arrangements are adequate to maintain a safe engineering watch.

Protection of the environment

11 The master, officers and ratings shall be aware of the serious effects of operational or accidental pollution of the marine environment and shall take all possible precautions to prevent such pollution, particularly within the framework of relevant international and port regulations.

Part 3-1 — Principles to be observed in keeping a navigational watch

12 The officer in charge of the navigational watch is the master's representative and is primarily responsible at all times for the safe navigation of the ship and for complying with the International Regulations for Preventing Collisions at Sea, 1972.

Lookout

13 A proper lookout shall be maintained at all times in compliance with rule 5 of the International Regulations for Preventing Collisions at Sea, 1972 and shall serve the purpose of:

.1 maintaining a continuous state of vigilance by sight and hearing as well as by all other available means, with regard to any significant change in the operating environment;

.2 fully appraising the situation and the risk of collision, stranding and other dangers to navigation; and

.3 detecting ships or aircraft in distress, shipwrecked persons, wrecks, debris and other hazards to safe navigation.

14 The lookout must be able to give full attention to the keeping of a proper lookout and no other duties shall he undertaken or assigned which could interfere with that task.

15 The duties of the lookout and helmsperson are separate and the helmsperson shall not be considered to be the lookout while steering, except in small ships where an unobstructed all round view is provided at the steering position and there is no impairment of night vision or other impediment to the keeping of a proper lookout. The officer in charge of the navigational watch may be the sole lookout in daylight provided that on each such occasion:

.1 the situation has been carefully assessed and it has been established without doubt that it is safe to do so;

.2 full account has been taken of all relevant factors, including, but not limited to;
- state of the weather,
- visibility,
- traffic density,
- proximity of dangers to navigation, and
- the attention necessary when navigating in or near traffic separation schemes; and

.3 assistance is immediately available to be summoned to the bridge when any change in the situation so requires.

16 In determining that the composition of the navigational watch is adequate to ensure that a proper lookout can continuously be maintained, the master shall take into account all relevant factors, including those described in this section of the Code, as well as the following factors:

.1 visibility, state of weather and sea;

.2 traffic density, and other activities occurring in the area in which the vessel is navigating:

.3 the attention necessary when navigating in or near traffic separation schemes or other routeing measures;

.4 the additional workload caused by the nature of the ships functions, immediate operating requirements and anticipated manoeuvres;

.5 the fitness for duty of any crew members on call who are assigned as members of the watch;

.6 knowledge of and confidence in the professional competence of the ships officers and crew;

.7 the experience of each officer of the navigational watch, and the familiarity of that officer with the ships equipment. procedures. and manoeuvring capability;

.8 activities taking place on hoard the ship at any particular time, including radiocommunication activities, and the availability of assistance to be summoned immediately to the bridge when necessary.

.9 the operational status of bridge instrumentation and controls, including alarm s stems;

.10 rudder and propeller control and ship manoeuvring characteristics;

.11 the size of the ship and the field of vision available from the conning position;

.12 the configuration of the bridge, to the extent such configuration might inhibit a member of watch from detecting by sight or hearing any external development; and

.13 any other relevant standard, procedure or guidance relating to watchkeeping arrangements and fitness for duty which has been adopted by the Organization.

Watch arrangements

17 When deciding the composition of the watch on the bridge, which may include appropriately qualified ratings, the following factors, inter alia, shall be taken into account:

.1 at no time shall the bridge be left unattended;

.2 weather conditions, visibility and whether there is daylight or darkness;

.3 proximity of navigational hazards which may make it necessary by the officer in charge of the watch to carry out additional navigational duties;

.4 use and operational condition of navigational aids such as radar or electronic position- indicating devices and any other equipment affecting the safe navigation of the ship;

.5 whether the ship is fitted with automatic steering;

.6 whether there are radio duties to be performed;

.7 unmanned machinery space (UMS) controls, alarms and indicators provided on the bridge, procedures for their use and limitations; and

.8 any unusual demands on the navigational watch that may arise as a result of special operational circumstances.

Taking over the watch

18 The officer in charge of the navigational watch shall not hand over the watch to the relieving officer if there is reason to believe that the latter is not capable of carrying out the watchkeeping duties effectively, in which case the master shall be notified.

19 The relieving officer shall ensure that the members of the relieving watch are fully capable of performing their duties, particularly as regards their adjustment to night vision. Relieving officers shall not take over the watch until their vision is fully' adjusted to the light conditions.

20 Prior to taking over the watch, relieving officers shall satisfy themselves as to the ships estimated or true position and confirm its intended task, course and speed, and UMS controls as appropriate and shall note any dangers to navigation expected to be encountered during their watch.

21 Relieving officers shall personally satisfy themselves regarding the:

.1 standing orders and other special instructions of the master relating to the navigation of the ship;

.2 position. course, speed and draught of the ship;

.3 prevailing and predicted tides, currents, weather, visibility and the effect of these factors upon course and speed;

.4 procedures for the use of main engines to manoeuvre when the main engines are on bridge control; and

.5 navigational situation, including but not limited to:

.5.1 the operational condition of all navigational and safety equipment being used or likely to be used during the watch,

.5.2 the errors of gyro- and magnetic compasses.

.5.3 the presence and movement of ships in sight or known to be in the vicinity,

.5.4 the conditions and hazards likely to be encountered during the watch, and

.5.5 the possible effects of heel, trim, water density and squat on under-keel clearance.

22 If at any time the officer in charge of the navigational watch is to be relieved when a manoeuvre or other action to avoid any hazard is taking place, the relief of that officer shall be deferred until such action has been completed.

Performing the navigational watch

23 The officer in charge of the navigational watch shall:

.1 keep the watch on the bridge;

.2 in no circumstances leave the bridge until properly relieved;

.3 continue to be responsible for the safe navigation of the ship, despite the presence of the master on the bridge, until informed specifically that the master has assumed that responsibility and this is mutually understood; and

.4 notify the master when in any doubt as to what action to take in the interest of safety.

24 During the watch the course steered, position and speed shall he checked at sufficiently frequent intervals, using any' navigational aids necessary, to ensure that the ship follows the planned course.

25 The officer in charge of the navigational watch shall have full knowledge of the location and operation of all safety and navigational equipment on board the ship and shall be aware and take account of the operating limitations of such equipment.

26 The officer in charge of the navigation a] watch shall not be assigned or undertake any duties which would interfere with the safe navigation of the ship.

27 Officers of the navigational watch shall make the most effective use of all navigational equipment at their disposal.

28 When using radar, the officer in charge of the navigational watch shall hear in mind the necessity to comply at all times with the provisions on the use of radar contained in the International Regulations for Preventing Collisions at Sea, in force.

29 In cases of need, the officer in charge of the navigational watch shall not hesitate to use the helm, engines and sound signalling apparatus. However, timely notice of intended variations of engine speed shall be given where possible or effective use made of UMS engine controls provided on the bridge in accordance with the applicable procedures.

30 Officers of the navigational watch shall know the handling characteristics of their ship, including its stopping distances, and should appreciate that other ships may have different handling characteristics.

31 A proper record shall be kept during the watch of the movements and activities relating to the navigation of the ship.

32 It is of special importance that at all times the officer in charge of the navigational watch ensures that a proper lookout is maintained. In a ship with a separate chartroom the officer in charge of the navigational watch may visit the chartroom, when essential, for a short period for the necessary performance of navigational duties, but shall first ensure that it is safe to do so and that proper lookout is maintained.

33 Operational tests of shipboard navigational equipment shall he carried out at sea as frequently as practicable and as circumstances permit, in particular before hazardous conditions affecting navigation are expected. Whenever appropriate, these tests shall be recorded. Such tests shall also be carried out prior to port arrival and departure.

34 The officer in charge of the navigational watch shall make regular checks to ensure that:

.1 the person steering the ship or the automatic pilot is steering the correct course;

.2 the standard compass error is determined at least once a watch and, when possible, after any major alteration of course; the standard and gyro compasses are frequently compared and repeaters are synchronized with their master compass;

.3 the automatic pilot is tested manually at least once a watch;

.4 the navigation and signal lights and other navigational equipment are functioning properly;

.5 the radio equipment is functioning properly in accordance with paragraph 86 of this section; and

.6 the UMS controls, alarms and indicators are functioning properly.

35 The officer in charge of the navigational watch shall bear in mind (he necessity to comply at all times with the requirements in force of the International Convention for the Safety of Life at Sea (SOLAS), 1974. The officer of the navigational watch shall take into account:

.1 the need to station a person to steer the ship and to put the steering into manual control in good time to allow any potentially hazardous situation to be dealt with in a safe manner: and

.2 that with a ship under automatic steering it is highly dangerous to allow a situation to develop to the point when the officer in charge of the navigational watch is without assistance and has to break the continuity of the lookout in order to take emergency action.

36 Officers of the navigational watch shall be thoroughly familiar with the use of all electronic navigational aids, including their capabilities and limitations, and shall use each of these aids when appropriate and shall hear in mind that the echo sounder is a valuable navigational aid.

37 The officer in charge of the navigational watch shall use the radar whenever restricted visibility is encountered or expected, and at all times in congested waters, having due regard to its limitations.

38 The officer in charge of the navigational watch shall ensure that range scales employed are changed at sufficiently frequent intervals so that echoes are detected as earl>' as possible. It shall be borne in mind that small or poor echoes may escape detection.

39 Whenever radar is in use, the officer in charge of the navigational watch shall select an appropriate range scale and observe the display carefully, and shall ensure that plotting or systematic analysis is commenced in ample time.

40 The officer in charge of the navigational watch shall notify the master immediately:

.1 if restricted visibility is encountered or expected;

.2 if the traffic conditions or the movements of other ships are causing concern;

.3 if difficulty is experienced in maintaining course;

.4 on failure to sight land, a navigation mark or to obtain soundings b the expected time;

.5 if, unexpectedly, land or a navigation mark is sighted or a change in sounding occurs;

.6 on breakdown of the engines, propulsion machinery remote control, steering gear or any essential navigational equipment, alarm or indicator;

.7 if the radio equipment malfunctions;

.8 in heavy weather, if in any doubt about the possibility of weather damage;

.9 if the ship meets any hazard to navigation, such as ice or a derelict; and

.10 in any other emergency or if in any doubt.

41 Despite the requirement to notify the master immediately in the foregoing circumstances, the officer in charge of the navigational watch shall in addition not hesitate to take immediate action for the safety of the ship, where circumstances so require.

42 The officer in charge of the navigational watch shall give watchkeeping personnel all appropriate instructions and information which will ensure die keeping of a safe watch, including a proper lookout.

Watchkeeping under different conditions and in different areas

Clear weather

43 The officer in charge of the navigational watch shall take frequent and accurate compass hearings of approaching ships as a means of' early detection of risk of collision and hear in mind that such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large ship or a tow or when approaching a ship at close range. The officer in charge (if the navigational watch shall also take early and positive action in compliance with the applicable International Regulations for Preventing Collisions at Sea, 1972 and subsequently check that such action is having the desired effect.

44 In clear weather, whenever possible, the officer in charge of the navigational watch shall carry out radar practice.

Restricted visibility

45 When restricted visibility is encountered or expected, the first responsibility of the officer in charge of the navigational watch is to comply with the relevant rules of the International Regulations for Preventing Collisions at Sea, 1972 with particular regard to the sounding of fog signals, proceeding at safe speed and having the engines ready for immediate manoeuvre. In addition, the officer in charge of the navigational watch shall:

.1 inform the master;

.2 post a proper lookout;

.3 exhibit navigation lights; and

.4 operate and use the radar

In hours of darkness

40 The master and the officer in charge of the navigational watch, when arranging lookout duty, shall have due regard to the bridge equipment and navigational aids available for use, their limitations; procedures and safeguards implemented.

Coastal and congested waters

47 The largest scale chart on board, suitable for the area and corrected with the latest available information, shall be fixed. Fixes shall be taken at frequent intervals, and shall be carried out by more than one method whenever circumstances allow.

48 The officer in charge of the navigational watch shall positively identify all relevant navigational marks.

Navigation with pilot on board

49 Despite the duties and obligations of pilots, their presence on board does not relieve the master or officer in charge of the navigational watch from their duties and obligations for the safety of the ship. The master and the pilot shall exchange information regarding navigation procedures, local conditions and the ship’s characteristics. ‘The master and/or the officer in charge of the navigational watch shall cooperate closely with the pilot and maintain an accurate check on the ship’s position and movement.

50 If in any doubt as to the pilot’s actions or intentions, the officer in charge of the navigational watch shall seek clarification from the pilot and, if doubt still exists, shall notify the master immediately and take whatever action is necessary’ before the master arrives.

Ship at anchor

51 If the master considers it necessary, a continuous navigational watch shall be maintained at anchor. While at anchor, the officer in charge of the navigational watch shall:

.1 determine and plot the ship’s position on the appropriate chart as soon as practicable;

.2 when circumstances permit. check at sufficiently frequent intervals whether the ship is remaining securely at anchor by taking bearings of fixed navigation marks or readily identifiable shore objects;

.3 ensure that proper lookout is maintained;

.4 ensure that inspection rounds of the ship are made periodically;

.5 observe meteorological and tidal conditions and the state of the sea;

.6 notify the master and undertake all necessary measures if the ship drags anchor;

.7 ensure that the state of readiness of the main engines and other machinery is in accordance with the masters instructions;

.8 if visibility deteriorates, notify the master;

.9 ensure that the ship exhibits the appropriate lights and shapes and that appropriate sound signals are made in accordance with all applicable regulations; and

.10 take measures to protect the environment from pollution by the ship and comply with applicable pollution regulations.

ANNEX II

UPKEEP OF THE CHART OUTFIT

Chart outfit management

Extract from *The Mariner s Handbook*, reproduced with the permission of the Hydrographer of the Navy

Chart outfits

An Outfit of Charts, in addition to the necessary Standard Admiralty Folios, or selected charts made up into folios as required, should include the following publications.

Chart Correction Log and Folio index

Admiralty Notices to Mariners, Weekly Editions, subsequent to the last *Annual Summary of Admiralty Notices to Mariners*. Earlier ones may be required to correct a volume of A*dmiralty List of Lights* approaching its re-publication date, see 1. 111.

Chart 5011 — Symbols and Abbreviations used on Admiralty Charts.

Appropriate volumes of:

Admiralty Sailing Directions;

Admiralty List of Lights;

Admiralty List of Radio Signals;

Admiralty Tide Tables;

Tidal Stream Atlases;

The Mariner's handbook.

The supplier of the outfit will state the number of the Last Notice to Mariners to which it has been corrected.

Chart management system

A system is required to keep an outfit of charts up-to-date. It should include arrangements for the supply of New Charts, New Editions of charts and extra charts, as well as new editions and supplements of *Admiralty Sailing Directions* and other nautical publications, if necessary at short notice.

On notification by *Admiralty Notice to Mariners* that a new edition of one of the books, or a new Supplement to one, has been published, it should be obtained as soon as possible. Corrections to a book subsequent to such a Notice will refer to the new edition or to the book as corrected by the Supplement.

Arrangements should be made for the continuous receipt of Radio Navigational Warnings, *Admiralty Notices to Mariners*, and notices affecting any foreign charts carried.

A system of documentation is required which shows quickly and clearly that all relevant corrections have been received and applied, and that New Charts, New Editions and the latest editions of publications and their supplements have been obtained or ordered.

Method. For users of Standard Admiralty Folios of charts, the following is a convenient method to manage a chart outfit. Where only a selection of the charts in the Standard Admiralty Folios are held, the method can be readily adapted.

Chart Correction Log and Folio Index (NP 133a) is suitable. It contains sheets providing a numerical index of charts, indicates in which folio they are held, and has space against each chart for logging Notices to Mariners affecting it.

It is divided into three parts:

Part I Navigational Charts (including Omega and Loran-C).

Part II Admiralty reproductions of Australian and New Zealand charts.

Part III Miscellaneous charts.

At the beginning of Part I are sheets for recording the publication of New Charts and New Editions, and instructions for the use of the Log.

On receiving a chart outfit

Charts. Enter the number of the Notice to which the outfit has been corrected in the Chart Correction Log. Insert the Folio Number on the thumb-label of each chart. If not using Standard Admiralty Folios, enter the Folio Number against each chart of the Log.

Consult the Index of Charts Affected in the Weekly Edition of Notices to Mariners containing the last Notice to which the outfit has been corrected, and all subsequent Weekly Editions. If any charts held are mentioned, enter the numbers of the Notices affecting them against the charts concerned in the Log, and then correct the charts.

Consult the latest monthly Notice Listing Temporary and Preliminary Notices in force, and the Temporary and Preliminary Notices in each Weekly Edition subsequent to it. If any charts are affected by those Notices, enter in pencil the numbers of the Notices against the charts in the Log, and then correct the charts for them (also in pencil).

Extract all Temporary and Preliminary Notices from Weekly Editions subsequent to the current *Annual Summary of Admiralty Notices to Mariners* and make them into a 'Temporary and Preliminary Notices' file.

Radio Navigational Warnings. From all Weekly Editions of the current year, detach Section HI and file, or list the messages by their areas. Determine which messages are still in force from the Weekly Edition issued monthly, which lists them. Insert the information from these messages on any relevant charts.

Sailing Directions. From Weekly Editions subsequent to the current *Annual Summary of Admiralty Notices to Mariners*, detach Section IV and file.

Admiralty List of Lights. From Weekly Editions subsequent to those supplied with the volumes, detach Section V and insert all corrections in the volumes.

Admiralty List of Radio Signals. From Weekly Editions subsequent to those announcing publication of the volumes, detach section VI and insert all corrections in the volumes.

Admiralty Tide Tables. From the Annual Summary of Admiralty Notices to Mariners for the year in progress, insert any corrigenda to the volume.

Chart 5011 — Symbols and Abbreviations used on Admiralty Charts. Use any Notices supplied with the pamphlet to correct it.

On notification of the publication of a New Chart or New Edition

When a New Chart or New Edition is published, this is announced by a Notice giving the Date of Publication and the numbers of any Temporary and Preliminary Notices affecting it. From such Notices, enter on the appropriate page of Part I of the Log:

- Number of the Chart;
- Date of Publication;
- Number of the Notice announcing publication;
- Numbers of any Temporary and Preliminary Notices affecting the chart (in pencil).

Until the chart is received, the numbers of any subsequent Permanent, Temporary or Preliminary Notices affecting it should be recorded with the above entry.

On receiving a New Chart or New Edition

Enter the following details in the Log.

- If a New Chart, the Folio Number against the Chart Number in the Index.
- On the sheet at the beginning of Part I, the date of receipt of the chart.
- Against the Chart Number in the Notices to Mariners column of the Index Sheet, 'NC' or 'NE' with the date of publication, followed by a double vertical line to close the space.
- In the Notices to Mariners column of the chart in the Index, the numbers of any Notices recorded against the chart on the sheet at the beginning of Part I.

Enter the Folio Number on the thumb-label of the chart. Correct the chart for any Notices transferred from Part I as described above, and for any Radio Navigational Warnings affecting it. Destroy any superseded chart.

On receiving a chart additional to the outfit

Enter the Folio Number on the thumb-label of the chart. If not using Standard Admiralty Folios, enter the Folio Number against the chart in the Index of the Log.

Enter the number of the last Notice to which the chart has been corrected against the chart in the Index of the Log.

Consult the index of Charts Affected in each Weekly Edition of Admiralty Notices to Mariners from the one including the last Small Correction entered on the chart. if any Notices affecting the chart have been issued since the last Notice for which it has been corrected, enter them against the chart in the Log and correct the chart for them.

Consult the file of Temporary and Preliminary Notices. If an> Notices affect the chart, enter then numbers against the chart in the Log, and correct the chart for them.

From the file or list of Radio Navigational Warnings, see if any Warnings affect the chart. If so annotate the chart accordingly.

On receiving a replacement chart

Insert the Folio Number on the thumb label of the chart.

From the record kept in the Log, correct the replacement chart for any Notices affecting it published after the last Notice entered on it under Small Corrections.

Consult the file of Temporary and Preliminary Notices, enter any affecting the chart in the Log, and correct the chart if relevant.

Consult the file or list of Radio Navigational Warnings. If any of the Warnings affect the chart and are required on it, annotate it accordingly.

On receiving a Weekly Edition of Admiralty Notices to Mariners

Check that the serial number of the Weekly Edition is in sequence with Editions already received, then:

From the Index of Charts Afflicted, enter in the Log the numbers of the Notices affecting the charts held.

Turn to the end of Section II to see if any Temporary or Preliminary Notices have been published or cancelled. If they have been, add to or amend the entries in the Log against the charts accordingly.

Examine the ‘Admiralty Publications’ Notice to see if any relevant New Charts or New Editions have been published, or charts withdrawn. If they have, take action.

Detach and use Sections III to VI as follows:

Section III. Check printed text of messages against any signalled versions. File Section, or note down messages by their areas, and bring up to-date previous information on the file and any notations made on charts;

Section IV: Add to file or list;

Section V: Cut up and use to correct *Admiralty List of Lights*;

Section VI: Cut up and use to correct *Admiralty List of Radio Signals;*

Resecure chart correcting blocks to Section II.

From folios affected, extract and correct charts for the appropriate Notices in Section II.

Correction of charts

General information

No correction, except those given in Section II of *Admiralty Notices to Mariners*, Weekly Editions, should be made to any chart in ink.

Corrections to charts from information received from authorities other than the Hydrographic Department may be noted in pencil, but no charted danger should be expunged without the authority of the Hydrographer of the Navy.

All corrections given in Notices to Mariners should be inserted on the charts affected. When they have been completed the numbers of the Notices should be entered clearly and neatly; permanent Notices in waterproof violet ink, Temporary and Preliminary Notices in pencil.

Temporary and Preliminary Notices should be rubbed out as soon us the Notice is received cancelling them.

Chart 5011 — Symbols and Abbreviations used on Admiralty Charts should be followed to ensure uniformity of corrections. These symbols are invariably indicated on Overlay Correction Tracings.

If several charts are affected by one Notice, the largest scale chart should be corrected first to appreciate the detail of the correction.

Last correction

When correcting a chart; first check that the last published correction to it, which is given at the end of the new Notice, has been made to the chart.

Detail required

The amount of detail shown on a chart varies with the scale of the chart. On a large scale chart, fur example, full details of all lights and fog signals are shown, but on smaller scales the order of reduction of information is Elevation, Period, Range, until on an ocean chart of the area only lights with a range of 15 miles or more will normally be inserted, and then only their light-star and magenta flare. On the other hand, radio beacons are omitted from large scale charts where their use would be inappropriate, and, unless they are long range beacons, from ocean charts.

Notices adding detail to charts indicate how much detail should he added to each chart, but Notices deleting detail do not always make this distinction, if a shortened description would result in ambiguity between adjacent aids, detail should be retained. The insertion of excessive detail not only clutters the chart, but can lead to errors, since the charts quoted as affected in each Notice assume (he Mariner has reduced with the scale of the charts the details inserted by previous Notices.

Alterations

Erasures should never be made. Where necessary, detail should be crossed through, or in the case of lines, such as depth contours or limits, crossed with a series of short double strokes, slanting across the line. Typing correction fluids, such as ‘Tipp-Ex’, should not be used.

Alterations to depth contours, deletion of depths to make way for detail, etc., are not mentioned in Notices unless they have some navigational significance.

Where tinted depths contours require amendment, the line should be amended, but the tint, which is only intended to draw attention to the line, can usually remain untouched. Where information is displaced for clarity, its proper position should he indicated by a small circle and arrow.

Blocks

Some Notices are accompanied by reproductions of portions of charts (known as ‘Blocks’). When correcting charts from blocks, the following points should he home in mind.

- A block may not only indicate the insertion of new information, but also the omission of matter previously shown. The text of the Notice should invariably be read carefully’.
- The limiting lines of a block are determined for convenience of reproduction. They need not be strictly adhered to when cutting out for pasting on the chart, provided that the preceding paragraph is taken into consideration.
- Owing to distortion the blocks do not always lit the chart exactly. When pasting a block on a chart, therefore, care should be taken that the more important navigational features fit as closely as possible. This is best done by fitting the block while it is dry and making two or three pencil ticks round the edges for use as fitting marks after the paste is applied to the chart.

Completion of corrections

Whenever a correction has been made to a chart the number of the Notice and the year (if not already shown) should be entered in the bottom left hand corner of the chart: the entries for permanent Notices as Small Corrections, and those for Temporary and Preliminary Notices, in pencil, below the line of Small Corrections.

NB This example covers UK Admiralty charts. Appropriate guidance from other charting authorities should he studied for their chart correcting system.

GLOSSARY

Glossary of Abbreviations

AIS	Automatic Identification System
BA	British Admiralty
brg.	Bearing
DR	Dead Reckoning Position
DMA	Defence Mapping Agency (USA)
dist	Distance
EOP	End of Sea Passage
EP	Estimated Position
ERBL	Electronic Range & Bearing Line
ETA	Estimated Time of Arrival
GPS	Global Positioning System
GMDSS	Global Maritime Distress and Safety System
HMSO	Her Majesty's Stationery Office (UK)
ICS	International Chamber of Shipping
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite
MF	Medium Frequency
NLT	Not Less Than
NMT	Not More Than
OOW	Officer of the Watch
P/L	Position line
PI	Parallel Index
RDF	Radio Direction Finding
SAR	Search and Rescue
UMS	Unattended Machinery Space
UKC	Under Keel Clearance
VHF	Very High Frequency Radio
VTS	Vessel Traffic Services

Glossary of Words

Air draught	The height from the waterline to the highest point of the ship. Normally the masthead but if crane jibs or derricks are raised it could be significantly higher.
Abort	The final point at which a ship can take action to avoid passing the point of no return.
Clearing bearing	The limiting bearing of a mark to one side of which the ship will be safe. Defined by 'not more than' (NMT) or 'not less than' (NLT) a given bearing.
Conning officer	The person who has control of the ship. This may he the master, the pilot or the OOW, as appropriate.
Course to steer	The compass course steered to achieve a required track, allowing for set, leeway and compass error.
Current	Non-tidal movement of the sea surface due mainly to meteorological, oceanographical or topographical causes.
DR position	Dead reckoning position — the position obtained by the resultant of the true course steered and the speed through the water
EP position	Estimated position — the position derived from the D.R. position adjusted for leeway and set and drift.
Heading	The horizontal direction of the ships head at a given moment measured in degrees clockwise from North. (This term does not necessarily require movement of the ship).
Leeway	The angular effect on the ship's track caused by the prevailing wind. it is always downwind and varies according to the ship's speed. the wind speed, the ship's draught and freeboard and the relative direction of the wind.
Parallel indexing	A radar based constant up date of cross track tendency.
Point of no return	The position after which the ship is committed to enter a constrained area.
Racon	Radar beacon which transmits when triggered by a ship's own radar transmission.
Range	see Transit.
Reporting point	A position where the ship is required to report to local harbour control.
Set and drift	The effect of the tidal stream and/or current on the ship's track. It is always downstream and varies according to the ship's speed and the relative direction and the strength of the stream. Set is the direction that the stream runs towards, Rate is the speed of the stream and Drift is the resulting distance (drift — rate x time). Some ARPA manufacturers define drift as the speed of the stream.
Squat	The bodily sinkage of a ship in the water when making headway. Varying from ship to ship, it is often greater forward than aft and is more pronounced in shallow water.

Tidal stream	The periodic horizontal movement of the sea surface caused by the gravitational forces of the sun and moon.
Tidal window	The times between which, the tide having achieved a required height, it is safe for the ship to transit an area.
Track	The path followed, or to be followed, between one position and another.
Track made good	The mean ground track actually achieved over a given period.
Transit	Known in the US and Canada as a Range. When two objects are seen to be in line, they are said to be in transit.
UKC	Under keel clearance. The vertical distance between the sea bed and the deepest part of the ship.
Waypoint	A reference point on the ships planned track.
Wheel over position	The point at which helm must be applied to achieve a required course alteration.

Please note that within this book the following terms are to he read as:

Navigator	The ships officer tasked to produce the passage plan. He will also normally be responsible for all aspects of navigational equipment except where another officer has been delegated for this task.
Officer of the Watch .... (OOW)	The ship's officer responsible for the watch at a specific time.
Watch stander	An uncertificated crew member tasked with bridge watch keeping duties.
He/Him	The masculine person is to include personnel of whatever gender.

THE BRIDGE OPERATIONS PROGRAMME

This training programme has been produced by Videotel Marine International in collaboration with The Nautical Institute and comprises 8 videos and related study materials covering:

1 Voyage planning

2 Bridge watchkeeping

3 The master/pilot relationship

4 Accident prevention, the human factor

5 Emergency procedures

6 Navigational charts and associated publications

7 Working with VTS

8 Five case studies

The book *Bridge Team Management* by Captain A J Swift is used to reinforce the videos and is supplied with the series. Additional back up material entitled Bridge Watchkeeping also published by the Institute can be purchased separately as part of the programme (see overleaf for details).

Parts 4-7 were produced with the support of The Danish Maritime Academy and carry their recommendations for Bridge Resource Management.

Newly introduced is a package of five case studies on either video or CD ROM. The cases relate to collisions and near misses and the objective is to explore the mistakes, misunderstandings, inaccuracies and slip-ups that occurs everyday, even amongst the best trained and competent watchkeepers.

Full details of the programme as supported by Mr W A O'Neil can be obtained from

Videotel Marine International

84 Newman St, London W1J 3EU UK

Tel 44 (0) 207 7299 1800

email: mail@videotelmail.com

THE NAUTICAL INSTITUTE
Navigational Safety Publications

About The Nautical Institute

The Nautical Institute was founded in 1972 with the aim of promoting high standards of knowledge, competence and qualifications amongst those in control of sea going craft. The Institute has some 7000 members and 40 branches throughout the world. It publishes the monthly journal *SEAWAYS* which contains MARS, the international confidential marine accident reporting scheme. The institute is a major publisher of professional guide books covering the nautical discipline and is represented on governmental and industry committees. Its internet forum seeks to provide feed back from seafarers into technical legal and operational standards. The following books cover navigational safety:

***Bridge Watchkeeping* Second edition** **ISBN 1 870077 17 2**

This self study guide examines the duties of a junior watchkeeping officer and covers; Preparing for sea; Watchkeeping in pilotage waters; Watchkeeping in coastal waters; Making a landfall; Anchoring and anchor watches; Watchkeeping in reduced visibility; Taking over the watch; Calling the master; Responding to emergencies; Error management; Collision avoidance; Record keeping; Automated bridges. The book also contains comprehensive annexes and the latest updated COLREGS. The book is designed to complement Bridge Team Management

***Collisions and their Causes* by Captain R A Cahill** **ISBN 1 870077 60 1**

The book examines cases which have been documented in court proceedings and there is a commentary on the standards of seamanship by the author with lessons to be learnt. The incidents cover; Nearly end on; Restricted visibility; Forestalling close quarters; The role of VHF; The use and misuse of ARPAs; In extremis; Starboard bow meetings; Crossing meetings; Special circumstances; Converging overtaking; Close overtaking; Narrow channels; Interaction; Collisions at pilot stations; At anchor; With tows; Not under command; Proper lookout; Conclusions and appendices. There are sonic 90 cases making this volume an authoratative reference.

***Strandings and their Causes* by Captain R A Cahill** **ISBN 1 870077 61 X**

The book examines the record of enquiries into major incidents and covers; The Torrey Canyon; Negligent navigation; Casual attitudes; Neglect of fundamentals; The unanticipated landfall; At anchor; Stranding and salvage; Loss of propulsion; Inadequate manning; Seaworthiness; Care and correction of charts; Inadequacies of passage planning; Risk analysis; Master pilot relationships; Approaching pilot stations; Who has the con; Techniques; Discipline and initiative; Conclusions and comprehensive references.

Pilotage and Shiphandling **ISBN 1 870077 07 5**

This is an authoratative hook on pilotage written by practicing pilots supported by naval architects and operational managers. It is designed to fill the need of bringing together the best of pilotage practices throughout the world and is divided into six main sections; Pilotage organisation; Planning and techniques; Traffic management; Shiphandling; Bridge design and Ship control.

The book consists of seventy chapters and 300 pages making it an essential reference for pilots and shipping companies.

Other books for the specialist include: *The Shiphandlers Guide*, *Tug Use in Port* and *The Admiralty Manual of Navigation Vol* 2 which is now published by The Nautical Institute.

For further information contact:

The Publications Department

The Nautical Institute

202 Lambeth Road, London SEI 7LQ

Tel 44(0) 207 928 1351

Fax 44 (0) 207 101 2817

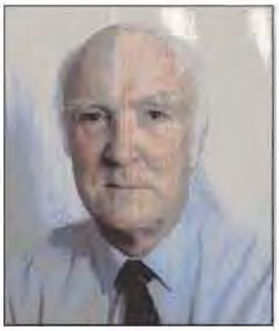
Email: pubs@nautinst.org

INDEX

NOTES

NOTES

THE AUTHORS



Captain A. J. Swift FNI

Captain A. J. Swift FNI, served 18 years at sea, including five years in command, before joining the Navigation Department of Brunel Technical College, Bristol.

He transferred to the Simulator Section at Warsash in 1980, and has specialised in the use of simulation to reinforce Bridge Team Management. In common with the other members of the section, he has kept his practical experience updated by regularly returning to sea in an observing role on vessels of all types and by riding with pilots in major British ports. He retired in 1999.

He has conducted research into the use of manned models, has prepared a number of company manuals and has completed a variety of research projects into shipping and bridge operations.

Since retiring he has continued to conduct seminars on Bridge Team Management in conjunction with the West of England P & I Club in Greece, Turkey, Korea and Japan.

Captain Swift is a Fellow of The Nautical Institute and a member of the Southampton Master Mariners Club as well as a Member of the Royal Society for the Prevention of Accidents.

Captain Trevor Bailey FNI, started his sea-going career in 1971 with BP Tanker Co. Ltd and gained his Master's Certificate in 1982. He was promoted to Master in 1984.

After service in tankers, container and RoRo container vessels he joined Sealink British Ferries in 1988. He served aboard 'conventional' vessels as well as various high-speed craft, serving as Master and Senior Master from 1992. Latterly he served as Training Master on board HSS '*Stena Explorer*'.

In April 1988 he left Stena Line and established YG consultants – an independent marine consultancy. Areas of business and expertise include electronic charts and integrated bridge systems and Trevor regularly delivers operator training for Sperry Marine on their bridge equipment. YG Consultants also have has close involvement with the ISPS Code, the ISM Code, maritime law and claims, High-Speed Craft, life-saving appliances and safety training.

Captain T J Bailey FNI

From September 2000 to end January 2001 he sat as one of the two Nautical Assessors on the Formal Inquiry into the collision in August 1989 between the dredger '*Bowbelle*' and the passenger vessel '*Marchioness*'.

Trevor Bailey is a Fellow (and a former member of Council) of the Nautical Institute and is a Younger Brother of the Corporation Trinity House. He has been a Member of the Honourable Company of Master Mariners since 1994 and was elected to the Court of Assistants in April 2002.

The Nautical Institute,
202 Lambeth Road,
London SE1 7LQ, UK.
Telephone: +44 (0)20 7928 1351
Fax: +44 (0)20 7401 2817

ISBN 1 870077 66 0