ECDIS

Procedures Guide

2021–2022 Edition **Volume 1**

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ECDIS **Procedures Guide** 2021–2022 Edition **Volume 1**

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2021–2022 Edition
Volume 1

By: **ECDIS Ltd**

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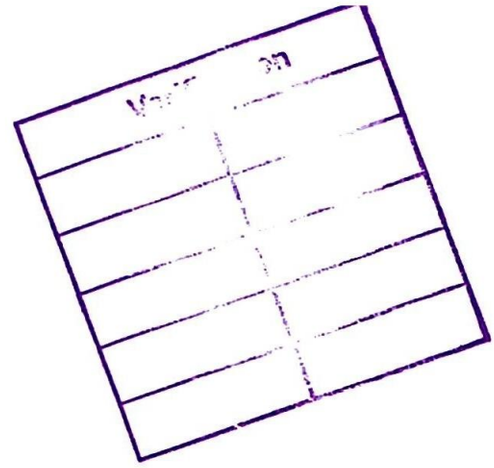

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MV:_____

ECDIS 1 – Make:_____ Model:_____

ECDIS 2 – Make:_____ Model:_____

Signature Page

The undersigned are stating that they have read and understood these ECDIS Procedures.

Name	Position	Date	Signature

Contents

Definitions List

Admiralty Information Overlay (AIO)
The UKHO provides the Admiralty Information Overlay (AIO) service, which delivers T&P information worldwide using NTMs available from every ENC producing nation.

Anti-Grounding Cone/Safety Frame/Look-Ahead
This function monitors a detection area ahead of the ship for hazards to navigation. This detection area may have a different name depending on the manufacturer, but common terms include 'safety frame', 'safety cone', 'look-ahead window', 'anti-grounding cone' and 'danger detection'.

Best Scale
The IMO priority for chart selection is ENC over all other formats (ie RNC). The IMO state that where ENCs are not available or are not of appropriate scale, RNC charts should be carried. 'Appropriate Chart' is considered the largest scale chart available and the most up to date. Therefore, if a scale 5 ENC is up to date, it would be considered 'Best Scale' chart for a harbour. If there is no ENC for that harbour, the RNC harbour chart equivalent would be considered 'Appropriate Chart' and the ship would be navigating in RCDS mode.

CATZOC (Category of Zone of Confidence)
CATZOC provides the user with an indication of data accuracy and survey type conducted for the area.

ECDIS (Electronic Chart Display and Information System)
The IMO ECDIS Performance Standards (IMO Resolution A.817(19)) defines ECDIS as:
Electronic Chart Display and Information System (ECDIS) means a navigation information system which, with adequate back up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/19 & V/27 of the 1974 SOLAS Convention, by displaying selected information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information if required.

ENC (Electronic Navigational Chart)
An ENC is a Government Hydrographic Office approved vector chart.

Hover-over Function
This function was introduced by PL 4.0 and enables the navigator to access information by hovering the cursor over the item to be interrogated. This function is limited to buoys, beacons, lights, landmarks, information and date dependent symbols.

NMEA (National Marine Electronics Association)
NMEA is the standard data exchange format used by bridge equipment.

PL 4.0 (Presentation Library 4.0)
The required version of the Presentation Library that replaced PL 3.4 containing updates such as improved alert managements, new symbols and mandated the inclusion of a date-dependent object function and use of the hover-over function.
PL 4.0 of the IHO ECDIS Presentation Library came into effect from 1st September 2017.

Presentation Library (PL)
The PL provides details and procedures for implementing the specifications contained in Annex A of S-52, by decoding and symbolising the elements of the SENC.

Radar Information Overlay (RIO)
This is an overlay of radar data on an ECDIS. It can be used to monitor own ship's position relative to the planned route in coastal and pilotage waters.

S-52
S-52 specifies the IHO standards for Chart Content and Display Aspects of ECDIS.

S-57
S-57 specifies the IHO Transfer Standard for Digital Hydrographic Data.

S-63
S-63 is the IHO Data Protection Scheme.
(This scheme is designed to prevent unauthorised use of data by encrypting the ENC information and restricting access to only those cells that a customer has been licensed for.)

S-100
S-100 is the IHO Universal Hydrographic Data Model that provides a contemporary hydrographic geospatial data standard that can support a wide variety of hydrographic-related digital data sources.

S-101
S-101 is a forthcoming ENC Product Specification.
(The S-101 Edition 1.0.0 Feature and Portrayal Catalogues are currently being refined by the IHO.)

S-Mode
The sixth session of the IMO sub-committee on Navigation, Communications and Search and Rescue (NCSR) held in 2019 agreed to revised guidelines for the presentation of navigation-related symbols, terms and abbreviations. It will apply to all ECDIS installed before January 2024. This is commonly being referred to as Standard Mode, or S-Mode.

Safety Depth/Safety Contour
The Safety Depth function visually highlights soundings that are less than the Safety Depth. For the Safety Contour, if the chart does not provide a contour for the depth you specify, the system selects the next available deeper contour.

The Safety Depth/Safety Contour is used to define safe navigable water. These safety values should be calculated during the planning phase and entered in the ECDIS by the navigator.

SCAMIN (Scale Minimum) Feature
Scale minimum, or SCAMIN, is the smallest scale at which an object is displayed. A SCAMIN value attributed to an object specifies the display scale at which it must be drawn.

SENC (System Electronic Navigational Chart)
A system electronic navigational chart (SENC) is the electronic chart derived from the core S-57 data that a specific ECDIS uses to link with the S-52 Presentation Library.

XTD
Cross track distance or XTD is a common term used for the Port and Starboard navigation limits assigned to a route. It is also referred to as; 'The Corridor', 'Channel Limits', 'Track Limits' or 'Channel Width'. It is the limit of safe water given to the OOW to manoeuvre within, on passage. This limit will have been checked by both the automatic scan route and as part of the Master's passage plan approval.

Updates to the 2021–2022 ECDIS Procedures Guide

The 2021–2022 Guide has been updated to reflect the latest software and procedural changes. Additional features include:

1. The first Type Specific Quick Reference Guides for all of the leading manufacturers. These take the ECDIS operator 'click by click' through every aspect of their safety critical ECDIS functions and include familiarisation, setting up and calibrating the system, route planning, monitoring, verifying, fixing, chart updating and VDR playback.

   The Quick Reference Guides are in Volume 2 and are for:

Manufacturer	Model
ChartWorld	eGlobe G2 ECDIS
FURUNO	FEA-2107
	FEA-2807
FURUNO	FMD 3100
	FMD 3200
	FMD 3300
JRC	JAN-701B
	JAN-901B
	JAN-2000
JRC	JAN-7201
	JAN-9201
Kelvin Hughes	Manta Digital ZM ECDIS
OSI	ECPINS
	ECPINS Warship (commercial options)
	ECPINS Submarine (commercial options)
Sperry	VisionMaster FT
Tokyo Keiki	EC-8100
	EC-8600
	EC-8000-A
	EC-8500-A
Wärtsilä SAM	MULTIPILOT NACOS Platinum
	ECDISPILOT NACOS Platinum
Wärtsilä (Transas)	Navi-Sailor 4000 ECDIS MFD
	Standard, Standard+, Premium, Premium+

2. The 2021 ISM ECDIS Audit template has been added to Chapter 2 – ECDIS Documentation and Compliance. It has been developed to allow ships to document that their ECDIS software does not perform to their requirement. For example, some manufacturers' software cannot produce berth to berth planning in confined pilotage waters due to the limitations of the software. The internal ISM audit ensures all ships recognise and document any software shortcomings.

3. Volume 1 contains all ECDIS navigation principles, standards and documentation compliance, as well as PSC preparation, known ECDIS/ENC issues and solutions to the problems.

4. Updated imagery, which replaces S-57 charting and is now available to download and use in 2021.

5. An introduction to bridge alert management (BAM), which comes into effect on ECDIS from 1st September 2021.

6. Documentation of, and solutions to, a series of known chart issues that include CATZOC, WGS 84, vertical and horizontal datum safety concerns, safety issues regarding SCAMAX and ENC production concerns. These have been added to the Guide to make ECDIS operators more aware of ECDIS limitations.

7. All new Type Specific familiarisations, checklists and bridge cards are updated to 2021 standards, including a new ECDIS pilot exchange card and pre-sailing checklist.

8. A further update to IMO member State adoption of T&P notices in ECDIS updates and manufacturer adoption of AIO.

Foreword

The world's fleet is predominantly navigating through digital means and the ECDIS manufacturers are at the heart of keeping ships safe and vital trade moving. There is no doubt that the systems are continually improving, with new functions and charting options. However, the negative aspect of these improvements is that the end user may struggle to keep constantly updated with new safety critical features. For this reason, this edition introduces Type Specific ECDIS Quick Reference Guides that should help the navigator to quickly pinpoint the differences between systems and increase the speed of familiarisation.

About the Author

The lead author of this 2021 edition is Mark Broster of ECDIS Ltd. After making the transition from paper to ECDIS navigation at sea himself in 2004, Mark spent the next decade developing the IMO 1.27 ECDIS model course and writing the first of many 'Type Specific' syllabuses, including the Type Specific White Paper. He has always been clear to point out that equipment alone in no way makes a ship safer or more efficient. In his words, "Robust training and procedures make ECDIS navigation safe".

In 2016, HRH The Duke of Edinburgh presented Mark with his Fellowship into the Royal Institute of Navigation "In recognition of his significant and innovative contribution to the development of modern digital navigation and bridge team training in the global maritime industry".

Mark is also an Associate Fellow of the Nautical Institute and a Committee member of the London branch, a Fellow of the Institute of Marine Science and Technology and a Fellow of the Institute of Leadership and Management. He is a Freeman in the Honourable Company of Master Mariners and winner of the prestigious annual Navigators and Directors award for his contribution to the safe integration of ECDIS to the Royal Navy Fleet.

About ECDIS Ltd

ECDIS Ltd was established in 2008 by traditionally trained 'paper' seafarers. They had successfully made the digital transition to ECDIS on various ships throughout their careers at sea. They produced the White Paper on ECDIS Type Specific in August 2008 and began a relationship with all the leading ECDIS manufacturers. In 2009 they developed the world's first IMO 1.27 Generic Course to be completed over the full 5 days, including the additional modules on operating ECDIS without GNSS. Their course was awarded approval by the MCA the same year, and from 2010 they developed a client base of over 200 international shipping companies, providing their ECDIS training. In 2011 their Type Specific course was accredited by the Nautical Institute. In 2012 they produced 'The ECDIS Manual', published by Witherby Seamanship International. Since then, they have developed several other ECDIS publications including this ECDIS 2020 Procedures Guide. In 2014 they began an ongoing international programme training Inspectors in ECDIS, and in 2017 they produced and distributed the course updates for the new PL 4.0 ECDIS software. Their Headquarters is in Hampshire, UK. Their website is ***www.ECDIS.org***

ECDIS Procedures Guide

1 Equipment/Software Upgrades and Latest Standards

1.1 Introduction

This Guide provides recommendations for how ECDIS should be configured and used as a ship's primary means of navigation.

The IHO Standards affecting ECDIS that must be understood include:

S-Mode – MSC.191(79), the Guidelines in SN.1/Circ.243
The sixth session of the IMO sub-committee on Navigation, Communications and Search and Rescue (NCSR) held in 2019 agreed to revised guidelines for the presentation of navigation-related symbols, terms and abbreviations. During the same year, the Maritime Safety Committee (MSC), at its 101st session, agreed with the NCSR and approved the revised guidelines for the presentation of navigation-related symbols and the revised guidelines for the presentation of navigation-related terms and abbreviations. A revised circular, SN.1/Circ.243/Rev.2, was issued at this time (MSC.466(101)). This is covered in Annexes 1 and 2 of the document, SN.1/Circ.243/Rev.2.

The SN.1/Circ.243 guidelines apply to ECDIS installed before 1st January 2024. Many manufacturers have already begun the process to S-Mode.

IHO Standard S-52 – Specifications for Chart Content and Display Aspects of ECDIS (chart symbols, etc)
S-52 is the standard used by ECDIS manufacturers that determines how ENC data (lines, styles, colours) are displayed on an ECDIS screen. This ensures that all ECDIS users see data displayed on screen in the same manner across all type approved makes and models of ECDIS. *(The Presentation Library is key to S-52 and all ships were expected to update to the latest Presentation Library (PL 4.0) in August 2017.)*

IHO Standard S-57 – Transfer Standard for Digital Hydrographic Data
S-57 is the data format that was adopted in 1992 to transfer digital hydrographic data between Hydrographic Offices, ECDIS manufacturers and other data users. S-57 was developed primarily to meet the ENC requirements for an IMO compliant ECDIS. The S-57 ENC Product Specification defines how Hydrographic Offices must construct an Electronic Navigational Chart, ensuring that all electronic charts contain all the chart information that is necessary for safe navigation.
(Migration from S-57 to S-100, the IHO advise that S-57 3.1 will continue to be used for many years even with S-100 release and that S-57 3.1.1 data will be usable in S-101 compliant ECDIS systems.)

IHO Standard S-100 – Universal Hydrographic Data Model
S-100 will become the new base standard for hydrography data. This new base will allow for a wider variety of applications to be layered. It has a wider geospatial standard and is not specific to ECDIS and is intended for the development of digital products and services for hydrographic, maritime and GIS communities. Its compilation included 10 years' worth of deferred S-57 corrections and extensions. In January 2019 it was agreed at the IMO (NSCR6) that all maritime services should conform with the IHO S-100 framework standard, which specifies the method for data modelling and development of product specifications.

IHO Standard S-101 – Product Specification for Electronic Navigational Chart (ENC) datasets
S-101 compliant ENCs will replace S-57 compliant ENCs as official chart data for ECDIS. However, it is not a radical reengineering of the S-57 concept, but will help integrate other types of products used within the maritime domain, such as aids to navigation, vessel traffic services, oceanography, meteorology, etc. While S-101 retains most of the characteristics that are currently used in S-57 ENCs, it will improve those elements of S-57 that benefit from the flexibility that the overarching S-100 framework standard of the IHO offers.
(ECDIS which are upgraded to use S-101 ENCs will continue to be able to use S-57 Edition 3.1 ENCs.)

To achieve compliance with international regulations, a ship may navigate with ECDIS as its primary means of navigation if:

- Sufficient official data adequate for the intended passage is installed (ENC and RNC)
- the installed ECDIS is type approved
- a second type approved ECDIS is installed as a backup (or a flag State approved portfolio of paper charts is carried)
- adequate generic and Type Specific training has taken place
- any additional requirements laid down by the flag State are fulfilled.

When used correctly, ECDIS enhances navigation and improves situational and spatial awareness compared to navigation using paper charts. It is a system that can display the past, present and predicted position of a ship by utilising all available sensor information. However, the techniques required to use ECDIS differ, in part, to those required when using paper charts. For safe navigation using ECDIS:

- All ECDIS operators must have completed generic and Type Specific ECDIS training
- official and up to date ENCs must be used
- all available sensors and navigation aids to support accurate, safe navigation must be used to prevent the over-reliance on any one sensor
- all techniques and equipment to cross-check GNSS derived positions must be used
- dead reckoning (DR) and estimated position (EP) should be used in the event of GNSS equipment failure
- there must be an appropriate configuration and an understanding of all safety settings.

ECDIS operational techniques and methods of cross-checking will vary, depending on the area of navigation:

a. **Pilotage and Confined Waters**. During pilotage and confined waters navigation, the system is to be used in conjunction with radar information overlay (RIO), if available, to confirm GNSS positions. The ECDIS operator is to ensure that additional fixing methods, such as visual and radar, are used to confirm GNSS positions. During restricted visibility, the ECDIS operator should use ECDIS together with a dedicated radar display.

b. **Coastal Navigation**. While operating in coastal waters, the ECDIS operator should monitor the radar coastline layer on the chart using the RIO, where practical, and cross-check the position of the ship using visual or radar means to prove the accuracy of GNSS.

c. **Ocean Navigation**. The primary source of positional information will be GNSS, checked periodically using celestial means when possible.

The ECDIS operator must be acutely aware of the danger of over-reliance on single sources of information. It is dangerous to ignore information indicating that the ship is standing into danger even if the ECDIS position indicates that the ship is safe, or vice versa. Procedures for navigation require that ECDIS operators use all available positional information to cross-check the GNSS positions on ECDIS. When using ECDIS, in the same way as with traditional methods of navigation, the ECDIS operator should always seek to confirm assessment of the ship's position relative to the planned track or hazards, and the distance to run to wheel over or critical points, by at least two independent methods.

Updates to software and standards require the ECDIS operator to reinforce their understanding of the system through continual training. S-Mode, and the transition to S-100 in particular, will require ECDIS operators to consider re-training or adding more robust procedures to their ship's SMS.

1.2 Equipment and Sensors

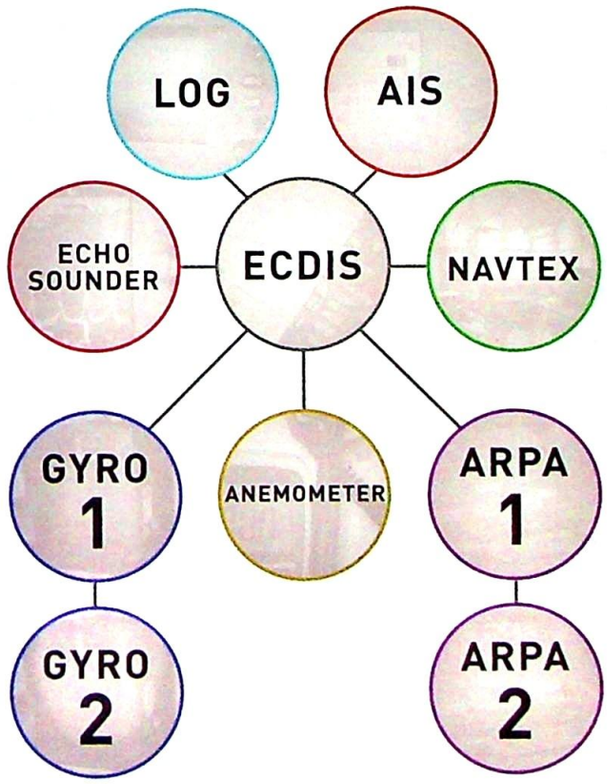
Type approved ECDIS units can display the full range of official electronic charts in conjunction with navigation sensor information. Each ECDIS unit will be capable of independent operation and provided with an uninterruptible power supply (UPS) to ensure continued operation in the event of short power failures (minimum UPS of 30 minutes).

Sensor Inputs
There are three mandatory sensor inputs to ECDIS, as stated in IMO MSC.232(82):

- ECDIS should be connected to systems providing continuous position fixing capability (GNSS)
- ECDIS should be connected to the ship's gyro compass. For ships not fitted with a gyro compass, ECDIS should be connected to a marine transmitting heading device
- ECDIS should be connected to the speed and distance measuring device (log).

Apart from the three mandatory inputs prescribed by the IMO, there are many other sensors that may have an interface. However, ECDIS should not degrade the performance of any equipment providing sensor inputs, nor should the connection of optional equipment degrade the performance of ECDIS to below the IMO MSC.232(82) standard. ECDIS may also be used to provide ENC information to external equipment, such as radar.

To provide redundancy of sensors, a typical ECDIS configuration may be as follows:



The ECDIS operator should be aware of how to select a backup or manual input available on their system.

It is critical that all sensor inputs to ECDIS are properly configured and calibrated during ECDIS installation. Failure to do so will result in errors in the system.

The ECDIS operator should regularly check the accuracy of sensors using all available means, such as the methods listed below, to detect any errors. If an error is discovered, the ECDIS operator must investigate it and take appropriate action.

- GNSS – cross-check accuracy by regularly conducting operator fixes using visual and other means
- gyro – maintain an awareness of gyro errors, repeater errors, availability of backup heading information
- log – check accuracy by using the measured mile method or a similar technique
- echo sounder – check accuracy using lead line or reference depth method
- radar – check accuracy by regularly conducting Index Error checks and operator fixes. RIO can be used to check the radar against GNSS.

Flag and Class Equipment Requirements

Flag and Class may add their own recommendations to the requirements mandated by the IMO. For example, some Classification Societies may require connection to radar and ARPA.

It is important that the ship conforms not only to IMO mandated requirements, but also to any relevant Flag, Class and industry body recommendations.

Further information on Flag requirements can be found here: **www.ECDISregs.com**

Note that it has been clarified by STCW.7/Circ.24 that the seafarers are not required to provide documentation of generic and type specific training in ECDIS. However, they must be familiar with the ECDIS equipment installed on board. It is recommended that a certificate and/or record certifying the completion of the training should be provided.

Evidence of familiarisation may be demonstrated by the successful completion of the type specific familiarisation checklists found in this Guide.

1.3 The S-52 4.0 Upgrade

The responsibility for the portrayal of an ENC on an ECDIS screen is controlled by the ECDIS standard 'S-52'. This was authored by the International Hydrographic Organization (IHO). Owners were expected to switch to the new Presentation Library (PL) by 31st August 2017. At inspection, there will be a requirement to provide evidence that ECDIS units are upgraded to PL 4.0.

Overview of Changes
A number of significant changes to the PL reflected mariner feedback. For example, the names of fairways and anchorage areas appear on the ENC display. A 'hover-over' function for certain charted features was also introduced.

New symbols were added to the PL to help draw attention to features that need to be highlighted, including the location of automatic ENC updates and ENC features that have a temporal (time-based) attribute.

To support the complex process of ECDIS type approval, the IHO worked closely with a number of prominent Notified Bodies to improve the ENC tests and test datasets. The restructuring of the datasets and the inclusion of more specific tests ensure that the proper display of ENCs is more thoroughly checked during the type testing process.

The IHO updated S-63, the ENC data protection scheme, to include specifications for an ENC update status report. The update status report allows mariners and Port State Control (PSC) inspectors to confirm that the ENCs installed in an ECDIS are up to date.

ECDIS manufacturers and national authorities moved towards type approval of ECDIS based on the revised Standards, which enabled ship owners and operators to update existing systems to conform with Standards in accordance with the requirements of IMO circular MSC.1/Circ.1503/Rev.1.

What Changes Were Included?

- Detection and notification of navigation hazard
- standardised automatic update symbols
- temporal attributes symbol
- ECDIS display date dependent features
- ability to turn ON/OFF Isolated Dangers in shallow water
- shallow water pattern
- SCAMIN
- hover-over function
- anchorage area, fairways, nautical publications
- chart legend
- ECDIS Chart 1.

Detection and Notification of Navigation Hazard
The previous edition of the PL included the detection of rocks, wrecks and obstructions, with the Safety Contour resulting in an alarm.

Rocks, wrecks and obstructions, as per the PL 4.0 standards, should result in an indication. This will reduce the number of alarms but still ensure the mariner remains aware of the hazard.

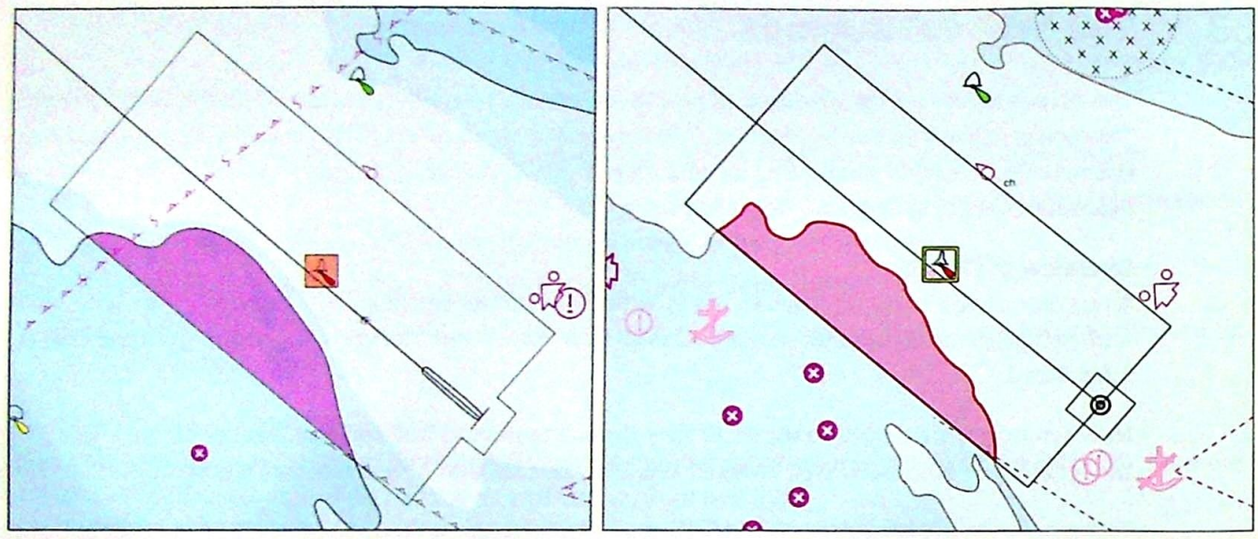
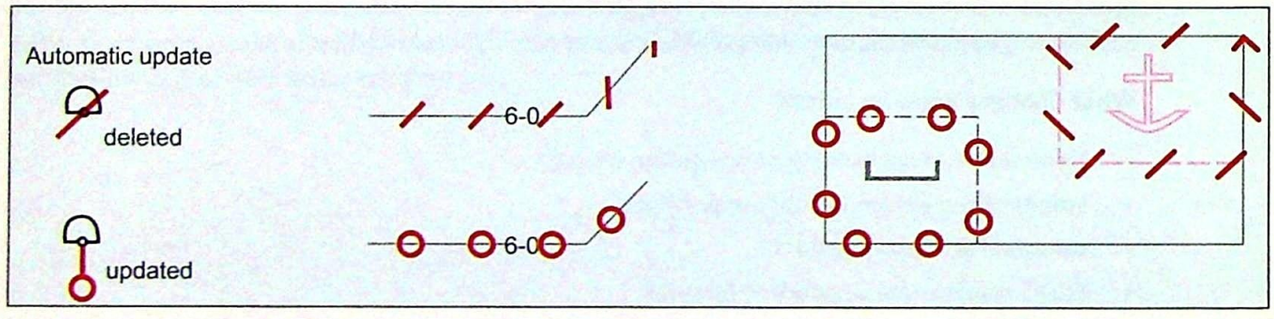


Figure 1.1 – A comparison of an ECDIS with PL 3.4 (on the left) showing an obstruction as an alarm, with an ECDIS with PL 4.0 (on the right) showing only a warning

Detection and notification of navigation hazards in PL 4.0 was designed to give the mariner the option to choose the priority of the alert for navigational hazards by viewing group category.

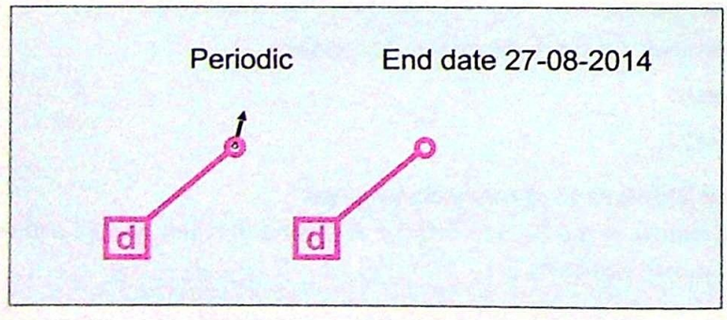
Standardised Automatic Update Symbols

Automatic update symbols have been standardised to help the mariner to identify and view where automatic updates have been applied.



Temporal Attributes Symbol

This symbol helps the ECDIS operator to quickly identify features that have temporal attributes, eg seasonal buoys, traffic separation schemes.



ECDIS Display Date Dependent Features

The ability to insert a date or date range to plan and check routes with date dependent features allows the mariner to view the conditions they will encounter on the date set. This allows inspection of the route for the actual ETA at any given point.

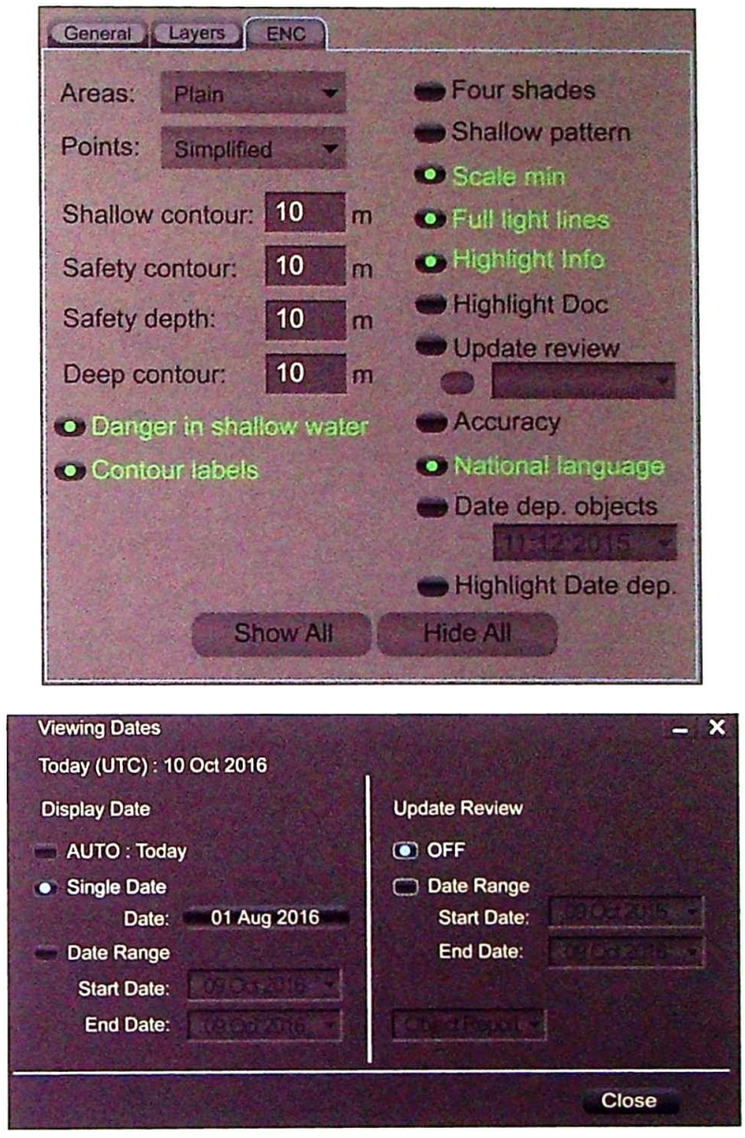


Figure 1.2 – ECDIS settings allowing objects to be shown at all times or at specific times.
ECDIS operators must be aware of the location of this menu on their system and know how to configure it

Ability to Turn ON/OFF Isolated Dangers in Shallow Water

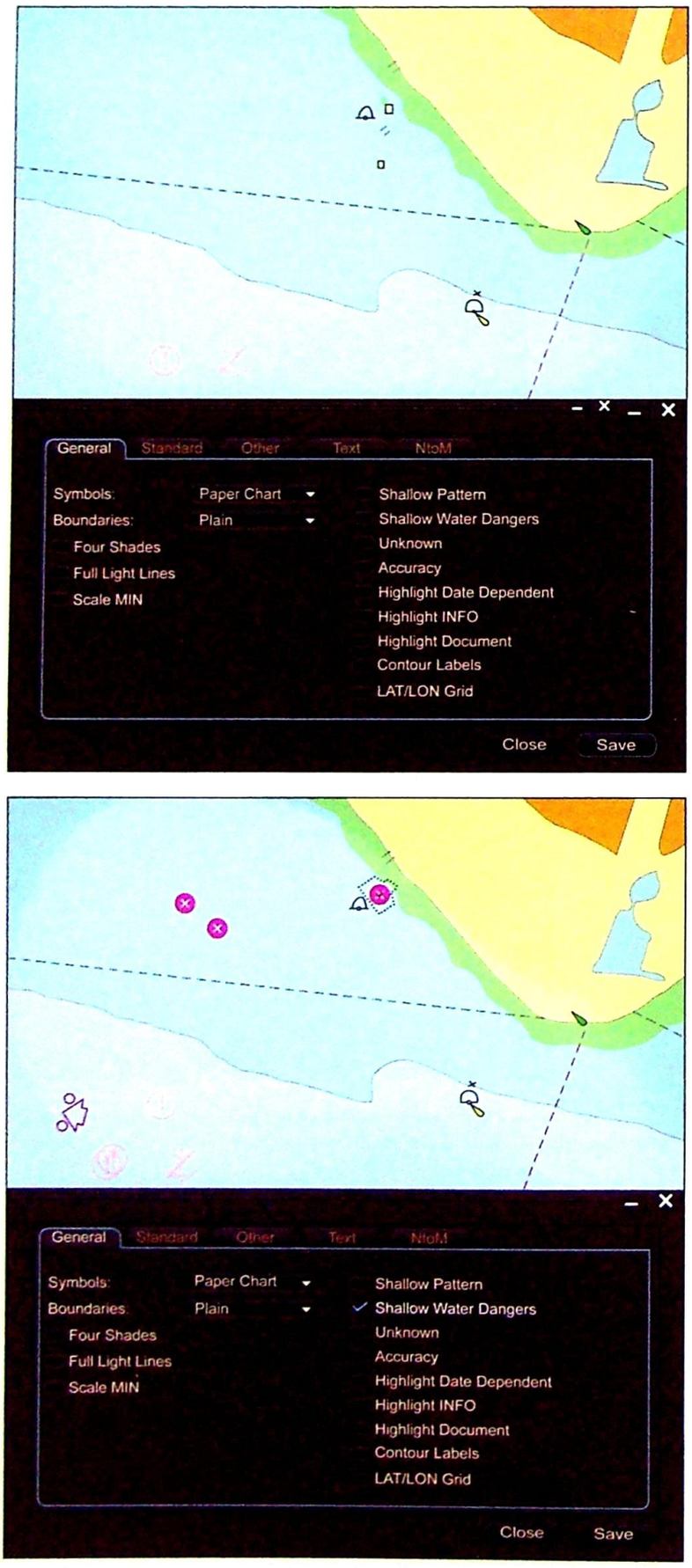


Figure 1.3 – Images comparing ECDIS with Isolated Dangers not selected for display, and then enabled for display. Since the upgrade to PL 4.0, the ECDIS operator must be aware of how and when to use these settings

Shallow Water Pattern

In PL 3.4, the shallow water pattern was optional. In PL 4.0, it is mandatory. This is to help with visual detection of shallow water in the night palette.

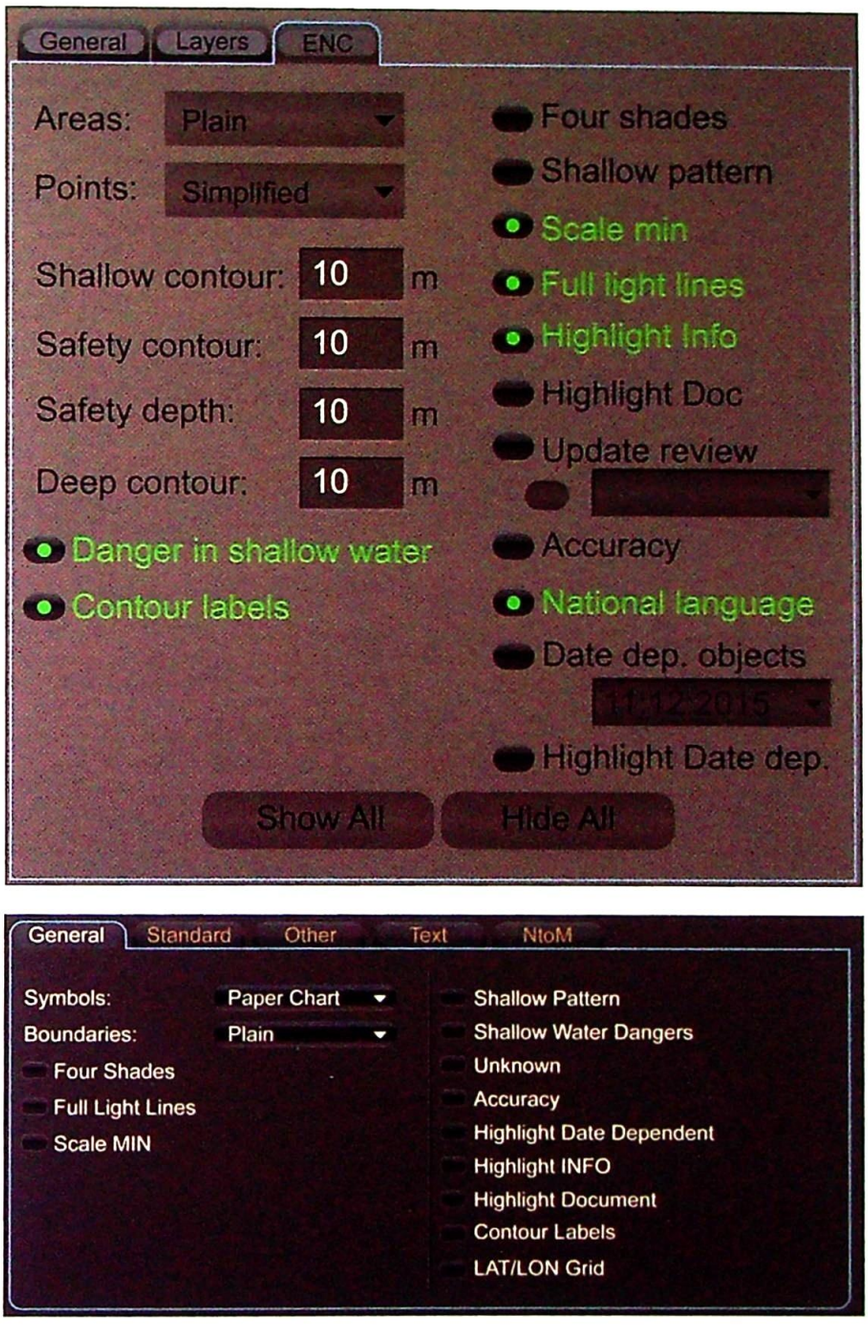


Figure 1.4 – Example of the menus on different ECDIS types, allowing the operator a choice for viewing shallow water pattern

SCAMIN

It is mandatory for manufacturers to allow ECDIS operators to apply the SCAMIN (scale minimum) feature and to be able to turn SCAMIN ON/OFF.

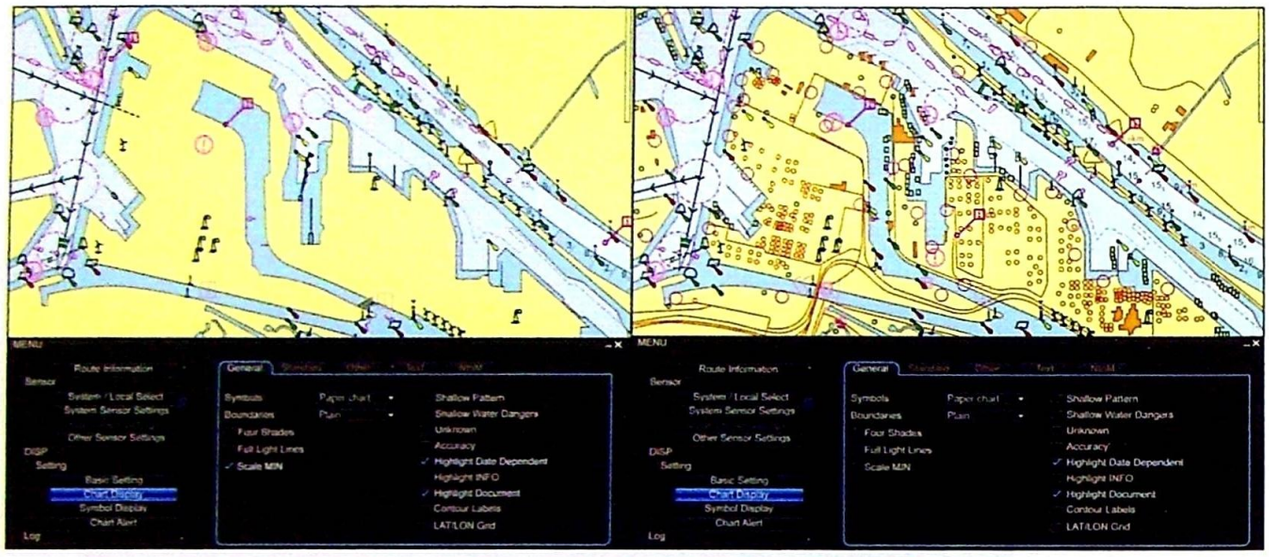


Figure 1.5 – Showing the same area with SCAMIN enabled and then disabled

Hover-over Function

PL 4.0 has given guidance on the implementation of the optional hover-over functions for a number of ENC features. This attribute may not be available on all ENCs.

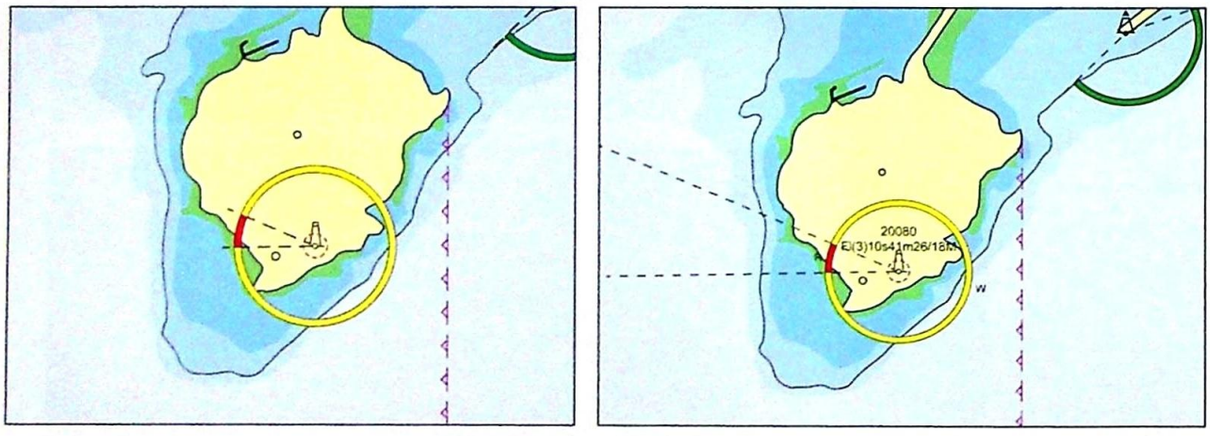


Figure 1.6 – Using the hover-over feature

Anchorage Area, Fairways, Nautical Publications

Anchorage and fairway names appear when text is selected for viewing. This helps with quick identification of locations and anchorages without the need to interrogate each area of the ENC.

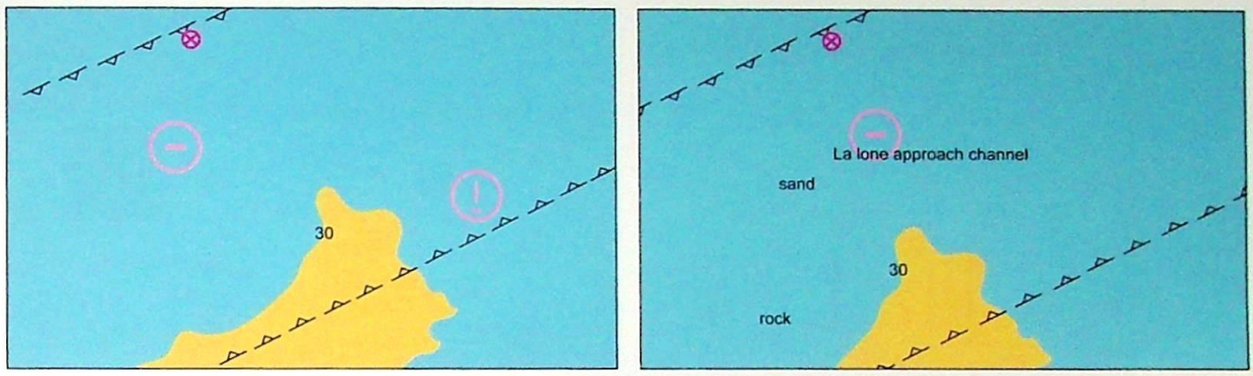


Figure 1.7 – Naming of anchorages and fairways

ECDIS Legend

ECDIS legend is made available at the position selected by the mariner. This reduces the confusion about the data that should be displayed when the own ship position is not on the ECDIS chart screen. Interaction is possible directly on the ENC display, with less confusion caused by menu structures.

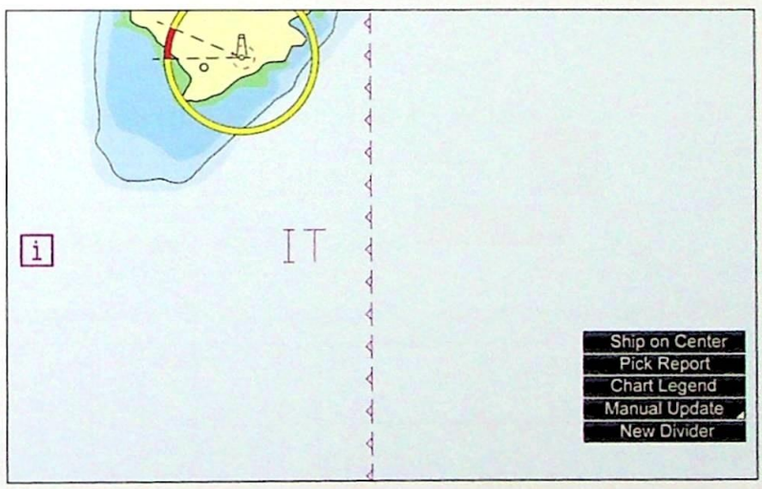


Figure 1.8 – ECDIS legend position selection

ECDIS Chart 1

ECDIS Chart 1 is a legend of symbols that may be used within the ENC. ECDIS Chart 1 can check for the correct display of symbols introduced in PL 4.0.

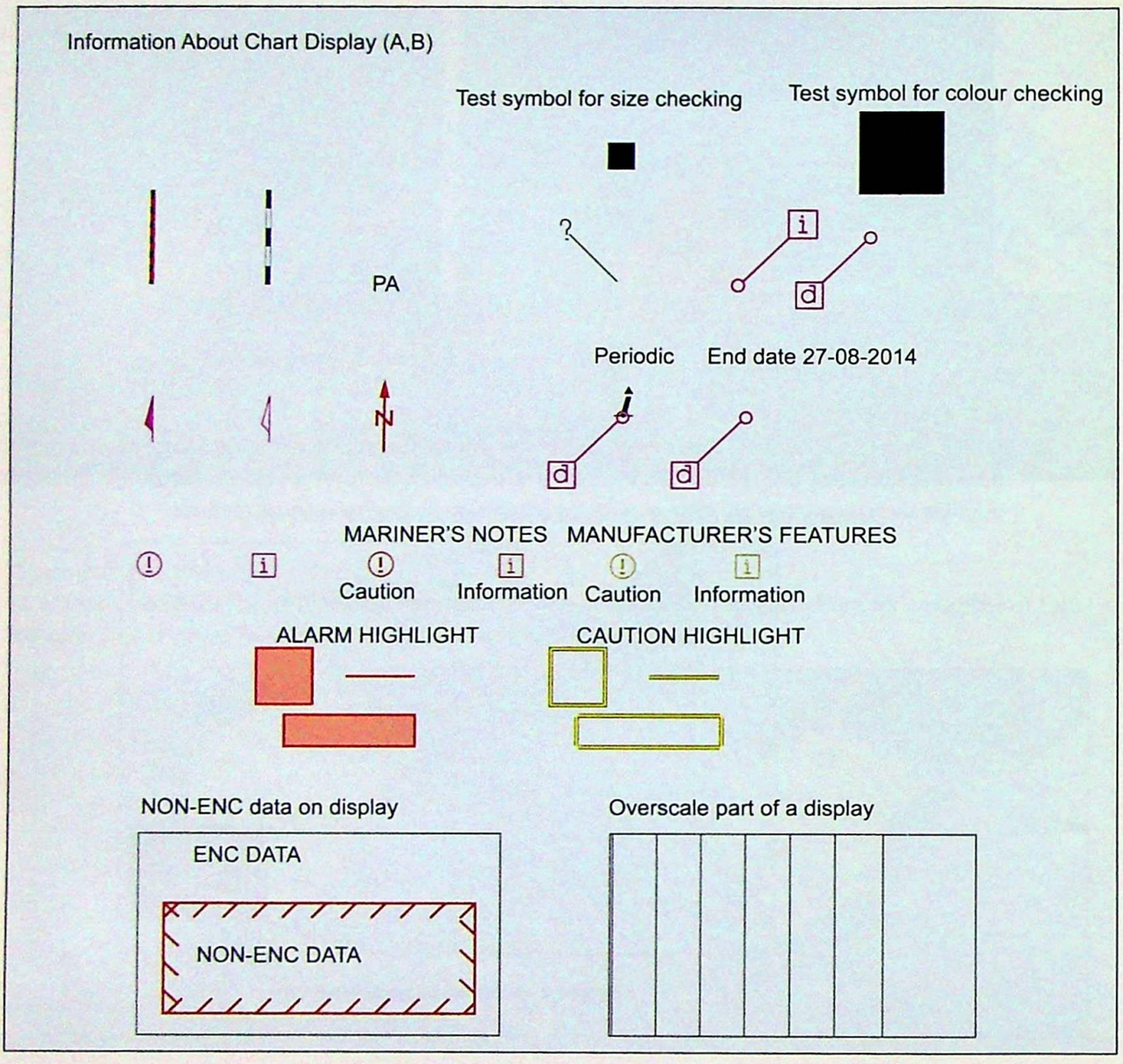


Figure 1.9 – ECDIS Chart 1

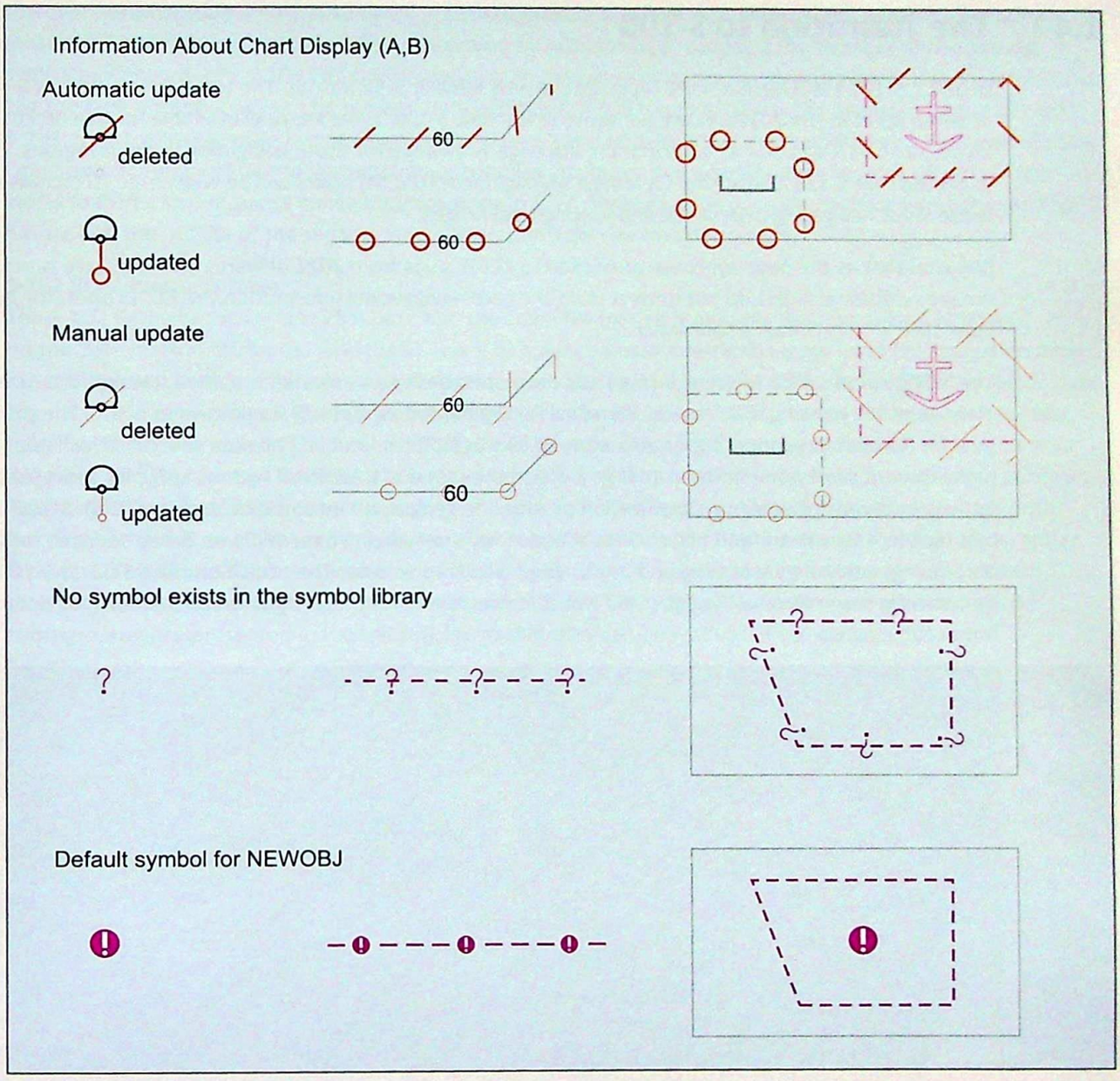


Figure 1.10 – ECDIS Chart 1(b)

1.4 The Transition to S-100

In 2021, S-101 ENCs have not yet replaced the now familiar S-57 format. The termination date of S-57 remains at some point in the 2020s. However, some of the new S-100 layers are now available for use on ECDIS. Certain layers, such as S-411 Sea Ice Information, are eagerly awaited for those navigating in polar regions. Equally it is expected that S-129 Under Keel Clearance Management (UKCM) layers will be welcomed to increase safety for those ships navigating in dynamic and varying tidal ranges.

It is vital that as the new layers are presented to ECDIS ships from 2021 onwards and that care is taken to ensure additional layers do not detract form the core navigational information the ECDIS operator needs to view clearly to maintain a safe watch.

The S-100 standard for ENC production was developed based on experience gained through the development and use of the existing IHO Transfer Standard for Digital Hydrographic Data (known as S-57). The primary goal for S-100 is to support a greater variety of hydrographic related digital data sources. It will enable the development of new applications that go beyond the scope of traditional hydrography, for example high density bathymetry, seafloor classification and marine geographic information systems (GIS). S-100 is designed to adapt to future requirements, such as 3D charting, time varying data and web based services for acquiring, processing, analysing, accessing and presenting hydrographic data. The transition from S-57 to S-100 will be carefully monitored by the IHO. S-57 will continue to exist as the designated format for ENC data for the foreseeable future.

Figure 1.11 – BAG is now added over the sea area. The advantages of this data to confined water planning and execution are significant, particularly when considering and planning for bank effect, etc

S-101 ENC Product Specification to Replace S-57

The S-101 ENC Product Specification (PS) specifies the content, structure, data encoding and metadata required for compiling S-101 ENC data. The PS also includes the portrayal requirements for use within an ECDIS. The S-101 PS will supersede the S-57 ENC PS. S-101 is a new PS for the ENC. It is currently under development by the IHO Transfer Standards and Maintenance Applications Development Working Group (TSMAD). S-101 ENCs will remain the basic navigation tool for ECDIS and, therefore, most of the features of the S-57 ENC will be retained.

S-101 draws heavily upon the concepts of S-100, such as exchangeable and dynamic feature and portrayal catalogues and richer geometric models, information types and complex attributes. The use of these new feature types will allow ENC producers to overcome encoding shortcomings in S-57-based ENCs, such as

the overuse of caution areas. In addition, improved functionality will lead to more efficient data handling and better portrayal definition in ECDIS equipment by eliminating or reducing the number of conditional symbology procedures. S-101 ENCs will eventually be the base navigation layer within an S-100-enabled ECDIS, but the true potential will not be realised until additional S-100 based products are available to interact with S-101. S-101 will also make use of new structures and features to improve the encoding and portrayal of data. One improvement will be the introduction of complex attributes that simplify the encoding of certain real-world features that required convoluted solutions in S-57. Some examples are the relationship between the nature and the quality of the seabed, light sectors and tidal stream information.

S-102 Bathymetric Surface

The S-102 Bathymetric Surface PS is based on the Open Navigation Standards Working Group (ONSWG) work on the Bathymetric Attributed Grid (BAG). It will be used as a bathymetric coverage layer for navigation and other purposes. With the full adoption of electronic navigation, the need for high resolution bathymetric data has become a requirement. There is an opportunity to enhance navigation further with inputs such as tidal heights. Having such a model allows an ECDIS or ECS to make other intelligent adjustments, such as contour intervals. The Bathymetric Surface data product described here incorporates the Navigation Surface concept. This means that, in addition to an estimation of depth and an estimate of the uncertainty associated with the depth, there is an ability to override any automatically constructed depth estimates with 'Hydrographer Privilege'. This allows ships to update their ENCs directly from real-time data, eg for ships equipped with their own survey equipment, open source data portals, etc. The original values that are replaced by the hydrographer are preserved in the tracking list so that they can be restored if required.

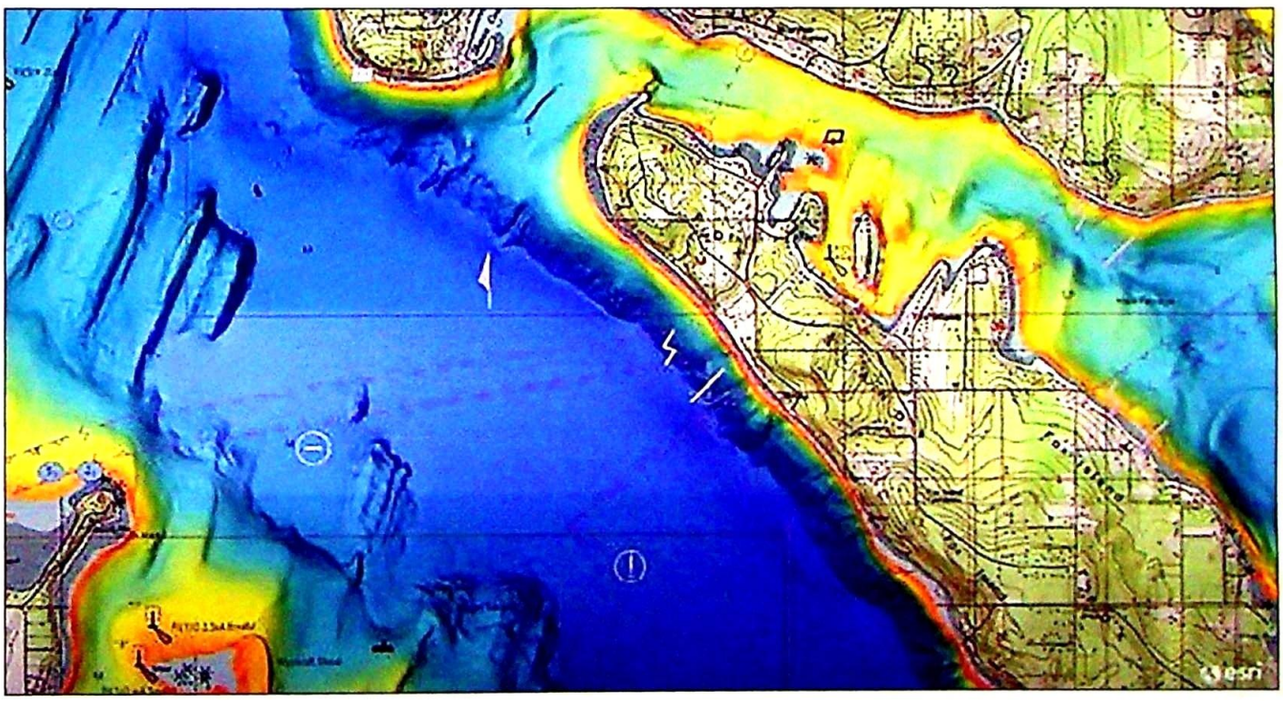


Figure 1.12 – Navigation data from the ENC has been raised more to the surface (eg restricted areas, cables/pipelines, etc). To complete the picture of the new enhanced ENC chart, original safety related ENC data is added on top of the BAG data

S-104 Water Level Information for Surface Navigation

The S-104 Water Level Information for Surface Navigation is the standard intended for the transfer of tidal and water level data for use in an ECDIS or any proposed dynamic tide application. Tidal and water level predictions are fundamental in route planning and entry to ports for navigation and other purposes. This layer is still under development.

S-111 Surface Currents

An understanding of surface currents is an important factor in the safety of navigation as currents affect the motion of ships. Surface current information may be considered auxiliary information that complements the S-101 ENC. This layer is still under development.

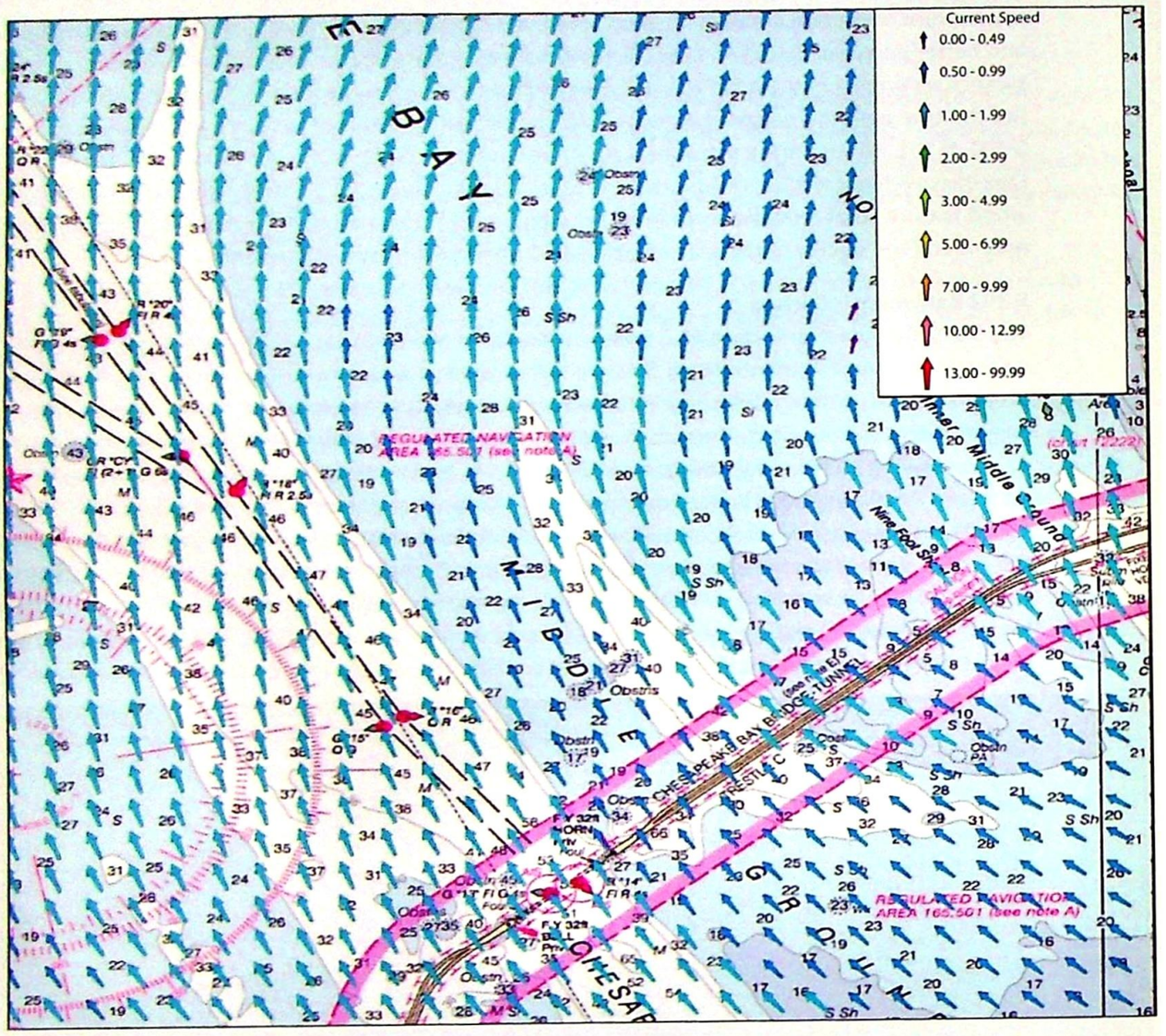


Figure 1.13 – Surface currents layers onto an ENC. Source: Univ. of New Hampshire, USA

S-121 Maritime Limits and Boundaries

The Maritime Limits and Boundaries Product Specification is intended for the encoding and exchange of digital maritime boundary information, including maritime limits, zones and boundaries as described under the United Nations Convention on the Law of the Sea (UNCLOS). This layer is still under development.

S-122 Marine Protected Areas (MPAs)

The S-122 Product Specification is intended to encode Marine Protected Area (MPA) information for use in ECDIS and other information systems. MPAs are protected areas of seas, oceans, estuaries or large lakes. MPA information may be considered supplementary additional information that complements the S-101 ENC. UNCLOS identifies certain categories of MPA that may require higher standards of environmental protection.

S-123 Marine Radio Services

S-123 Marine Radio Services will indicate the location, availability, type of radio communications, frequencies and content of radio services for navigational information and other maritime radio communications. Radio services describe the availability and reliability of radio stations and services offering navigational warnings and weather forecasts. This includes their service areas, services offered and instructions for contacting or utilising them.

S-124 Navigational Warnings
This PS is developed for creating datasets containing navigational warning information primarily targeting use in ECDIS. Navigational Warning means a message containing urgent information relevant to safe navigation broadcast to ships in accordance with SOLAS. This is being produced by the IHO Worldwide Navigational Warning Service Sub-Committee (WWNWS-SC). The purpose of this is to respond to requests to produce a data product that can be used in a Navigational Warning Information Overlay (NWIO) within an ECDIS. It is a vector PS that is primarily intended for encoding the nature and extent of Navigational Warnings, for navigational purposes.

S-124 Navigational Warning is based on the guidelines set for navigational warnings in the Joint IHO/IMO/ WMO Manual on Maritime Safety Information (MSI), IHO Publication S-53. It should be noted that although S-53 covers the full spectrum of MSI, S-124 focuses only on Navigational Warnings. S-124 has been designed to create Navigational Warnings for traditional Radio Broadcast, NAVTEX and SafetyNET messages.

S-125 Navigational Services
This PS describes navigational features, including lights and other navigation aids, both physical and virtual, temporary and seasonal marks and local AIS messages. The project is currently on hold.

S-126 Physical Environment
This PS describes marine and terrestrial topography, prevailing, seasonal and hazardous currents, tides, weather, and other environmental conditions. The project is currently on hold.

S-127 Marine Traffic Management
PS for vessel traffic services, pilotage, routeing systems and ship reporting systems. It is a vector PS that is primarily intended for encoding the extent and nature of Marine Traffic Management (MTM), for navigational purposes. This includes their service areas, services offered and instructions for contacting or utilising these services. MTM is intended to be a supplement to an ENC, and, therefore, does not describe the geographic information in detail equal to an ENC.

S-128 Catalogue of Nautical Products
S-128 is the PS for the exchange of catalogues of nautical product information. It includes information about printed and digital products, online resources, and access to metadata (ie data on all other S-100 data). Catalogue of Nautical Products (CNP) datasets describe the availability and reliability of paper chart, ENC, S-100 based nautical products, application for navigational purpose, online service and e-Navigation service. This includes their issue date, publication status, producing agency, source indication. CNP is intended to exchange status of nautical products and to be a supplement to ENC, and therefore does not describe the geographic information in detail equal to ENC, rather it is shown as a coverage of nautical products.

S-129 Under Keel Clearance Management (UKCM)
This PS is intended to provide a suitable format for the exchange of digital data pertaining to maritime safety and efficiency of marine traffic. It includes a digital format with the necessary attribution features to enable the exchange of information between an Under Keel Clearance Management (UKCM) System and an onboard navigation system such as ECDIS.

S-129 is a vector PS intended for encoding the extent and nature of UKCM information products for navigational purposes. Use of UKCM products conformant to this specification is not limited to navigation systems. A ship's Master has an obligation under SOLAS regulation V/34 to plan their ship's passage from berth to berth. This PS enables UKCM information to be provided to ECDIS operators and navigators to:

- Conduct Initial voyage planning to navigate through a UKC operational area. A ship or UKCM planning its voyage needs to determine the time periods when there are suitable tidal conditions for it to transit a UKCM operational area
- refined voyage planning to navigate through a UKC operational area. A ship's Master selects a time window to transit through a UKCM operational area and advises the UKCM service provider. A ship also sends the UKCM service provider updated information about its particulars (for example stability and draught information). The UKCM service provider uses specialised ship and waterway specific

modelling that includes predicted and observed environmental conditions (for example tide, wind, swell, tidal stream, etc) to generate an actual plan for a ship. An actual plan contains a route for the ship to take through the UKCM operational area and one or more control points. Control points are, in effect, waypoints and include time window information. They provide the ship with the necessary navigation information to safely pass through the UKCM operational area at a given time. To facilitate logistics planning the actual plan can be shared with other parties, such as the ship's owners, management company, charterers or the ship's agent at the relevant port.

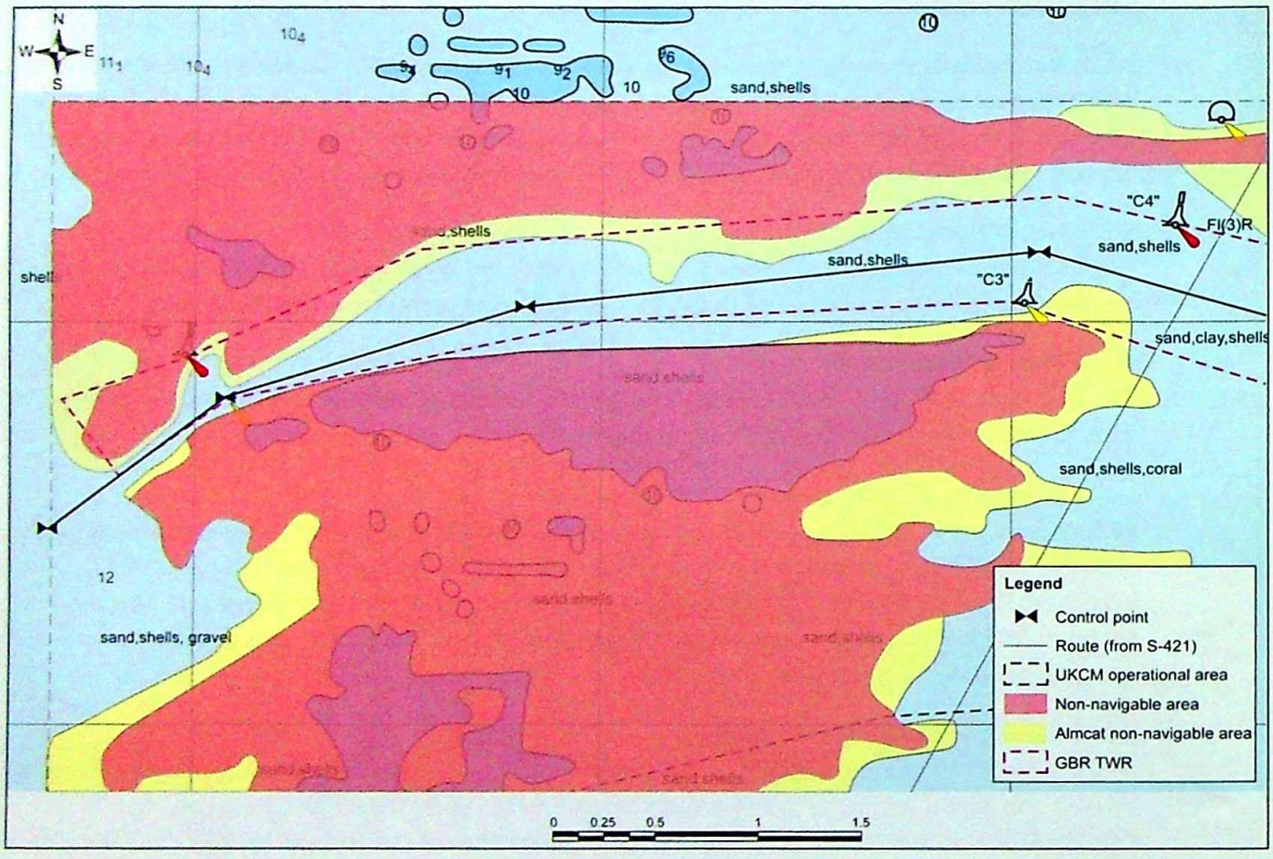


Figure 1.14 – Portrayal of S-129 symbology

The actual plan update contains details of the earliest and latest times at which the ship can safely commence navigating shallow areas in the UKCM operational area, while maintaining the required UKC (note that waterway authorities may specify a minimum UKC requirement for ships operating within a UKCM operational area). The actual plan update also includes any relevant non-navigable areas.

- Voyage monitoring. When the ship embarks its pilot (if applicable) and enters the UKCM operational area, the actual update can be displayed on the ship's navigation system. The pilot (if applicable) will generally be using a portable pilot unit (PPU) that also shows the ship's UKC plan, including non-navigable and almost non-navigable areas that are also provided by the UKCM service provider. This same information displayed on a ship's navigation system helps a ship's crew support a pilot to navigate the ship through a UKCM operational area while maintaining at least the required UKC. The UKCM service provider tracks the ship, allowing them to send actual updates.

S-201 Aids to Navigation Information

The Aids to Navigation (AtoN) PS provides a common structure for the exchange of information about AtoNs. This includes buoys, beacons, racons, lights, sound signals and AIS AtoNs. The product contains the positions, properties, operational status and general comments related to an AtoN. The PS can be used to exchange AtoN information in a consistent form between Lighthouse Authorities, Hydrographic Offices and other organisations (to include commercial and professional agencies). This product is currently under development.

S-211 Port Call Message Format

The S-211 Port Call Message (PortCDM) Format has been developed to enable the coordination of stakeholder activities associated with port calls by providing a standard format to share the necessary information, particular time stamps, for example on estimated time of arrival (ETA) and estimated time of departure (ETD). This product is currently under development.

S-240 DGNSS Station Almanac

The S-240 DGNSS Station Almanac PS comprises a model and XML exchange format for encoding and exchanging Differential GNSS (DGNSS) station information. This product is currently under development.

S-401 Inland ENC

The S-401 PS will supersede the S-57 based Inland ENC PS. This product is currently under development.

S-402 Bathymetric Contour Overlay for Inland ENC

The Bathymetric Contour Overlay for Inland ENC PS specifies the content, structure, data encoding and metadata required for compiling bathymetric contours for Inland ENC data. This product is currently under development.

S-411 Sea Ice Information

The S-411 Sea Ice Information PS is a vector PS primarily intended for encoding the extent and nature of sea ice for navigational purposes. Data is provided in the geography markup language (GML) encoding format.

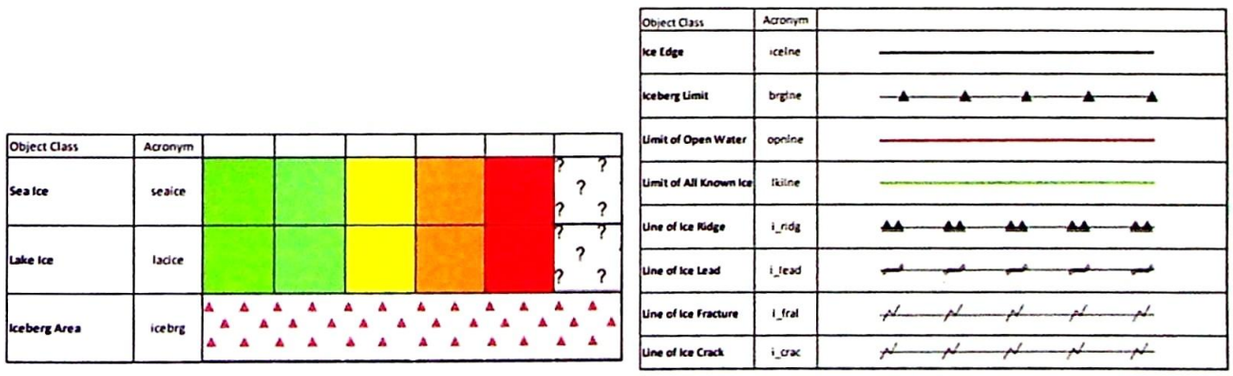


Figure 1.15 – An indication of how S-411 layers may appear on ECDIS

S-412 Weather Overlay

The features portrayed in the S-412 Weather Overlay are designed to replicate and enhance the existing surface pressure charts currently used.

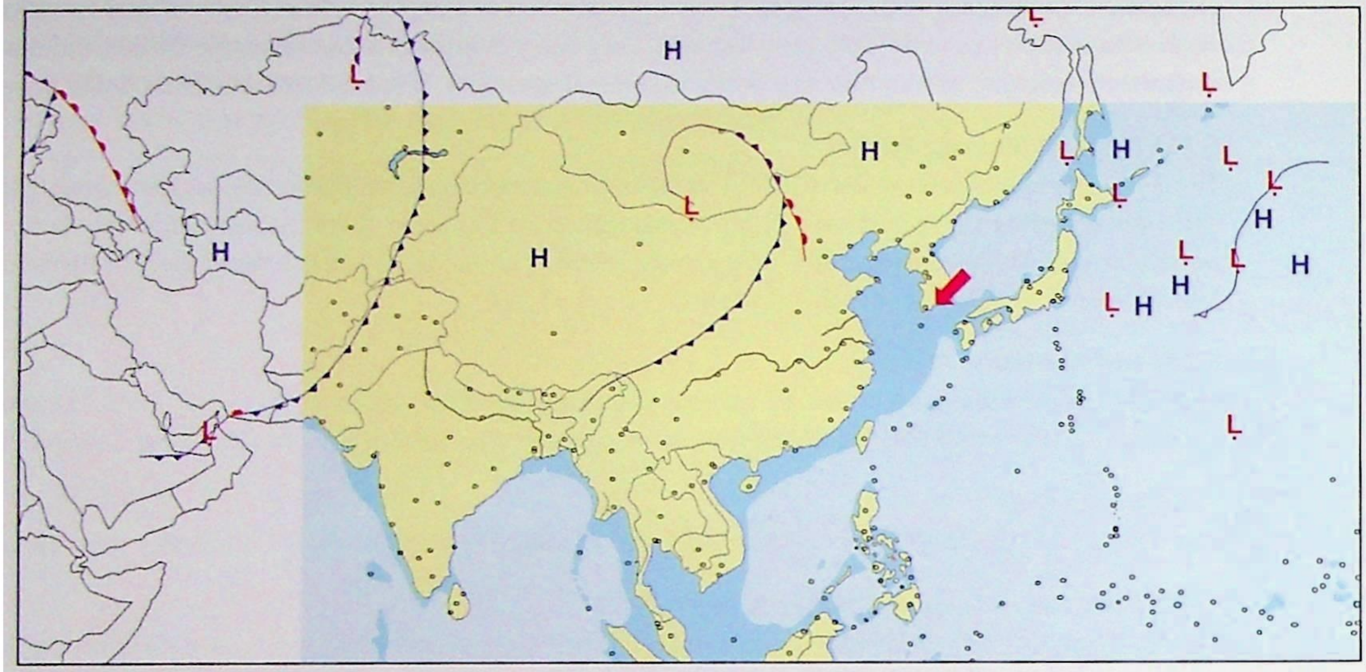


Figure 1.16 – An indication of how weather overlay may appear on the ENC

It is important for the ECDIS operator to remember that new overall data enhances situational awareness, but for some users, it may 'clutter' and confuse the original chart more. A careful balance needs to be considered by the Master when applying the new available layers.

1.5 The Transition to S-Mode

There are currently inconsistencies between manufacturers for simplified symbology, terminology, onscreen abbreviations and terms. The sixth session of the IMO sub-committee on Navigation, Communications and Search and Rescue (NCSR), held in 2019, agreed to revised guidelines for the presentation of navigation-related symbols, terms and abbreviations.

During the same year, the Maritime Safety Committee (MSC), at its 101st session, agreed with the NCSR and approved the revised guidelines for the presentation of navigation-related symbols, terms and abbreviations. This is covered in Annexes 1 and 2 of the document, SN.1/Circ.243/Rev.2.

It is recommended that all ECDIS operators review and understand the software changes that may be slowly affecting the display of their ECDIS through software patches provided by the manufacturer.

The MSC.191(79), the Guidelines in SN.1/Circ.243/Rev.1 applies to ECDIS installed before 1st January 2024. Many manufacturers have already begun the transition to S-Mode.

As an example of the changes, Cardinal Marks will appear as below. A North Cardinal will consist of a *"Solid diamond with 2 triangles, one above the other, point upward, on top of diamond (Shown with chart symbol. Chart symbol not required for radar). Virtual: Dotted diamond with cross hair centred at reported position and 2 triangles, one above the other, points upward, on the top of diamond."*

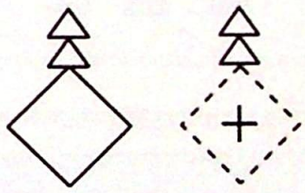


Figure 1.17 – Example of North Cardinal Mark as per new 'S-Mode' presentation

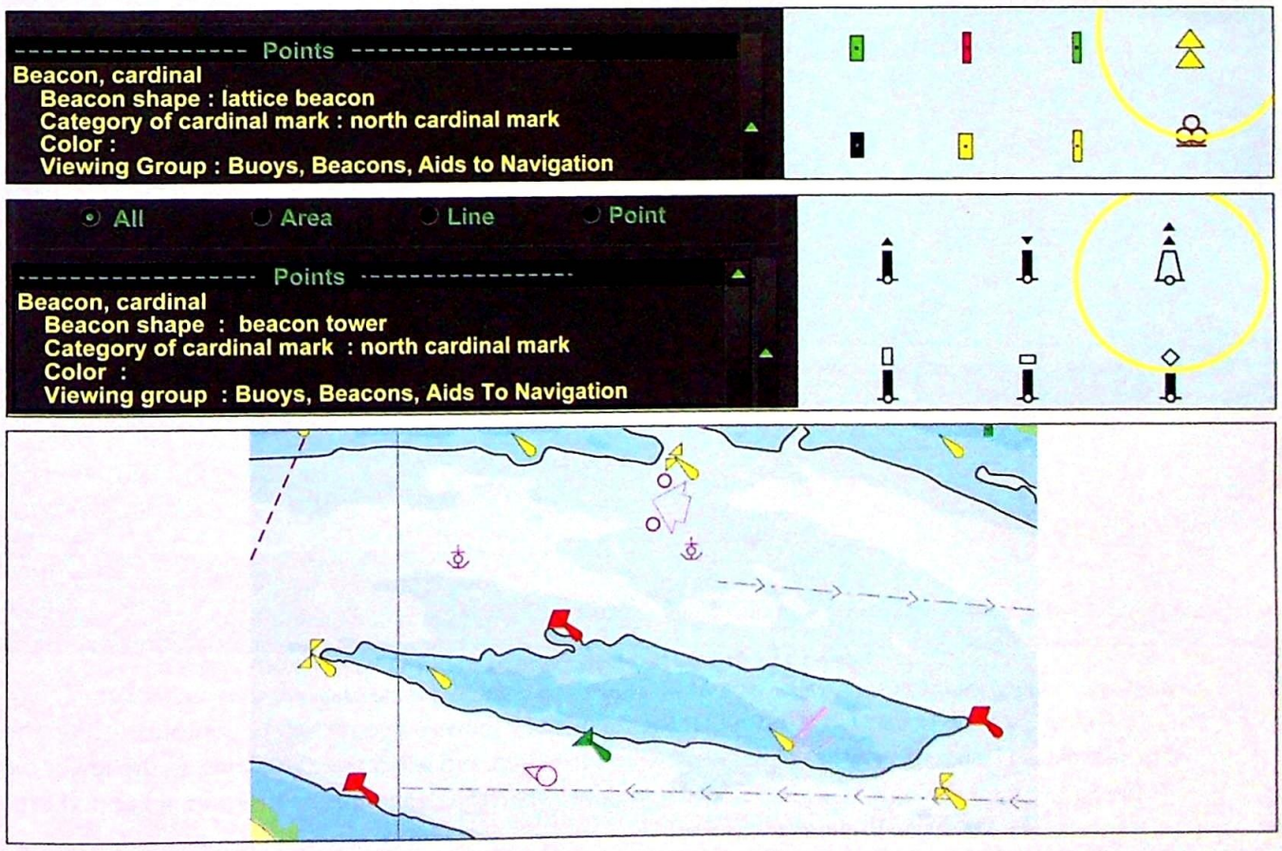


Figure 1.18 – Examples of aids to navigation, as seen on several ECDIS systems

S-52 4.0 (as discussed in Section 1.3 of this Procedures Guide) harmonised the alarm or indicator setting on the look-ahead. The illustration of S-Mode shows how this will look:

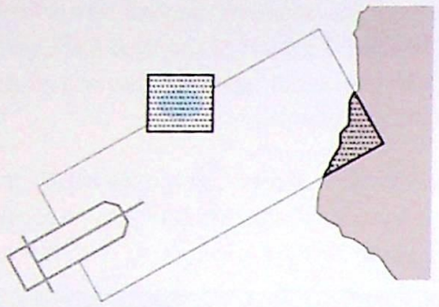


Figure 1.19 – Example shows a look-ahead alarm for depth area shallower than Safety Contour and a dangerous wreck within the look-ahead safety check area

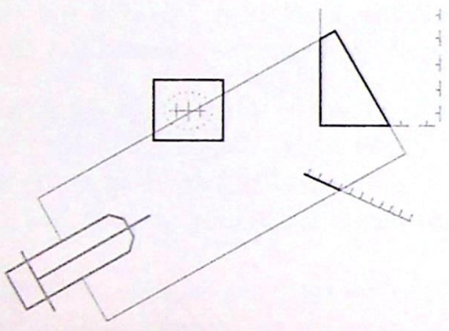


Figure 1.20 – Example shows a look-ahead Indication for a point (wreck), restricted area and line (fish stakes)

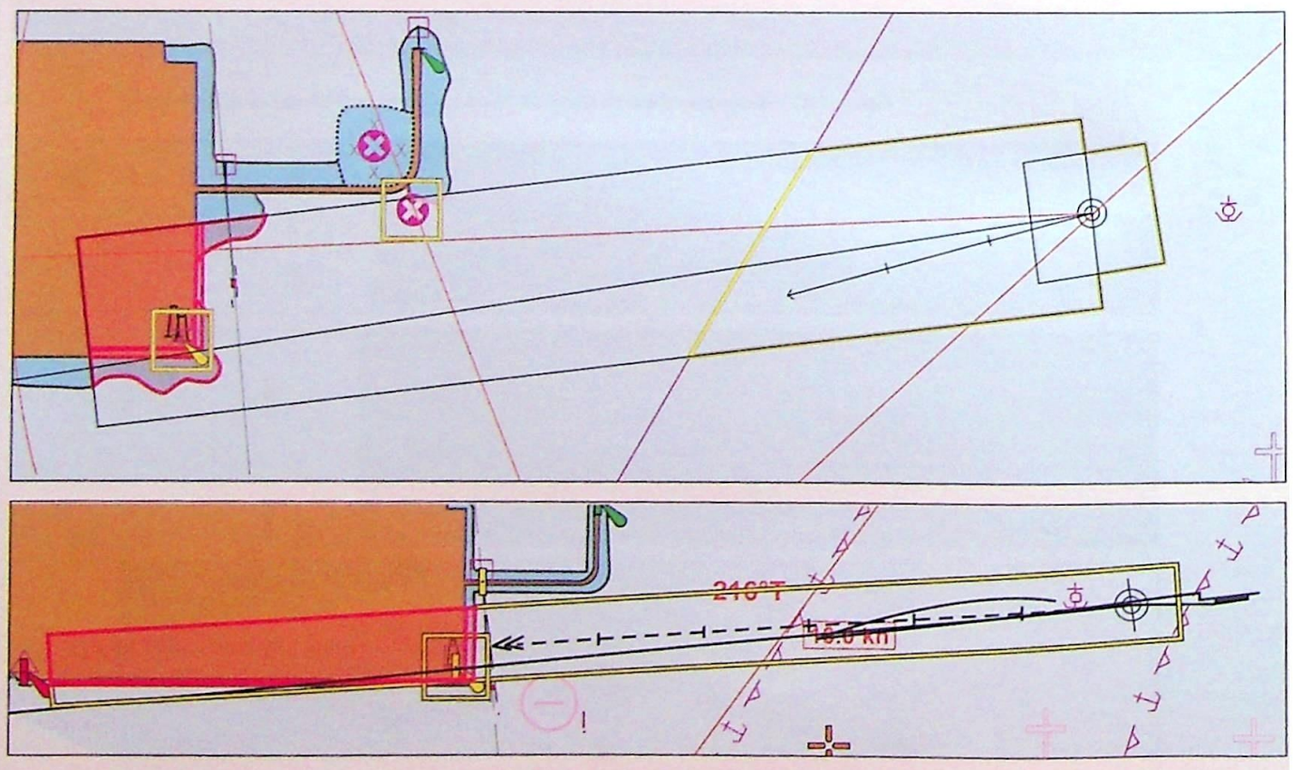


Figure 1.21 – How the look-ahead appears on several manufacturers at PL 4.0

In Figure 1.21 it is important to note that the top picture shows a deeper Safety Contour setting, therefore the Isolated Danger (magenta cross) is shown on the chart and will trigger an alarm. In the lower picture, the Safety Contour is set to a shallower depth (lower than the dangerous spot sounding) and, therefore, will generate an indication and not a warning.

PL 4.0 Safety Depth and Safety Contour issues are discussed further in Section 1.3.

User Interphase Standardisation

One of the main requirements for S-Mode development was to improve standardisation of the user interface and information used by ECDIS operators. There is currently a significant variation in icons and menu structures, increasing the time required for equipment familiarisation.

S-Mode and S-52 4.0 does not limit the capabilities of the varying manufacturers but it does affect the appearance of displayed items.

Figure 1.22 – PL 4.0 showing three different manufacturers with different icons for MOB

Over the next few years, it is very likely that 'icons' will be introduced to your ECDIS via software updates. The IMO guidelines for their presentation is not prescriptive in how the menus and icons will be ordered or grouped, and it is highly likely that extra familiarisation training will be required as software is updated.

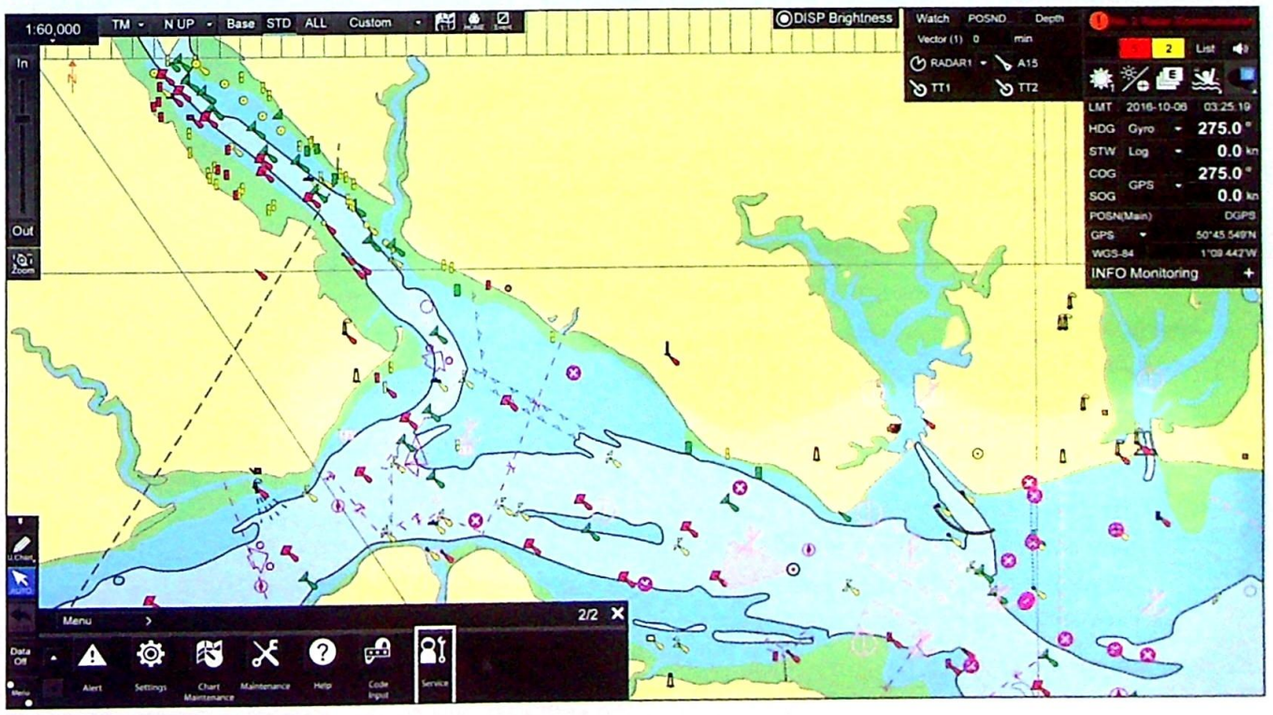


Figure 1.23 – Many manufacturers have started the move towards 'icon' menus, and the gradual phasing out of text

1.6 Introduction to Bridge Alert Management (BAM)

BAM is a critical safety initiative, intended to reduce the number of similar alert signals on a ship's bridge. It is a concept defined by the IMO for: *"the management, handling and harmonized presentation of alerts on the bridge."*

From 30th August 2021 compliance with IEC 62923-1/IEC 62923-2 is mandated for the installation of new navigation equipment on ships, for compliance under the EU Marine Equipment Directive (MED).

The first ECDIS manufacturers conformed to this new requirement in Summer 2020. All ECDIS installed after 1st September 2021 need to comply with these requirements.

It is important, particularly for new ECDIS installations, that all Performance Standards are met by the ship.

1.7 Software Updates

The ECDIS operator must ensure that all mandatory updates are installed and tested on all ECDIS units and recorded, for example Presentation Library updates.

It is recommended that the ship's SMS ensures that any software updates provided by the manufacturer are installed and tested on all ECDIS and recorded. Ship operators should develop a relationship with ECDIS manufacturers to ensure that appropriate standards are maintained.

1.8 Updating Charts

NTMs are produced on a weekly basis for both ENCs and RNCs. Updates may need to be loaded sequentially or, alternatively, only the latest update may need to be applied. ECDIS operators must be familiar with their update procedure, as discussed in Section 5.1.

ENC updates should never be applied on an ECDIS used for active route monitoring. It must be noted that updating ENCs while under way introduces serious risks, such as:

- Some systems only permit updating to take place if safety monitoring is turned off
- updating utilises capacity of the computer and, therefore, is diverting from its primary task
- all outstanding routes will need to be re-checked following an update
- the ECDIS display will be occupied by the updating process and will be unavailable to the ECDIS operator.

If it is unavoidable to update ENCs while underway, then it is recommended that the ECDIS units are updated one at a time to ensure that at least one ECDIS unit is dedicated to route monitoring. Once the update is complete, the ECDIS operator should ensure that the updated ECDIS unit is performing correctly with the new data prior to conducting the update on the next ECDIS unit or synchronising across the LAN. This process requires a carefully documented risk assessment and the ECDIS operator should be aware of approximately how long it takes to update all systems.

Once all ECDIS units have been updated, a spot-check should be conducted on a random selection of charts, in both ENC and RNC formats, to check that corrections, new editions and new charts have updated correctly on all systems. A summary of all updates applied is provided in the Read Me text file with each weekly update. An example of a spot-check log for all ECDIS units is provided in Annex A. All outstanding routes should be checked to ensure that they remain navigationally safe. This check should also include a manual compilation scale check of the entire route, in accordance with route checking procedures in Section 4.2.3.

The ECDIS operator is responsible for ensuring that all ECDIS units are updated correctly. Under the guidance of the navigator responsible for chart updates, all ECDIS operators are to conduct routine spot-checks.

The ECDIS operator is responsible for safeguarding the latest update disc, permit file, licence file and the last set of ENC and RNC base discs. Additionally, ECDIS operators must be aware of how to demonstrate to inspectors that the latest available updates have been successfully applied to the ECDIS ENC portfolio.

1.9 Licences and Permits

Separate ENC and RNC licences are produced by the relevant government authorised Hydrographic Office to limit access to only those charts that users are authorised to operate. The licence is system specific for each ECDIS installation and the licence number is also used to order additional charts for that system.

RNCs and encrypted ENCs require a chart specific permit to be used in the system. Each chart permit is associated with the licence for a particular system. The permits can be provided on a CD or by email and are updated to reflect changes in permit permissions or when new charts and new editions of charts are published. Only the most recent permits should be installed on the system.

The system of licence and permit means that the user may be able to carry more ENCs and RNCs than they have active permits for. Additional permits can be obtained rapidly to allow the user to activate ENCs and RNCs. This allows activation of necessary charts in case of diversion, emergency or a change of destination. All ECDIS operators should know the process by which additional charts are activated.

The ECDIS operator should ensure that permit updates arrive in a timely manner and on the required media. Expiry dates of licences and permits should be documented and renewed in a timely manner. Each passage plan should ensure that permits are valid for the duration of the planned voyage.

If a planning station or chart management system is fitted on a ship, the procedures for installing ENC data and permits must be understood. Manufacturer's guidance must be followed to ensure chart management software correctly interfaces with ECDIS. It may be useful to develop onboard guidance, noting experience gained, due to the complexity of integrating external planning software with the ECDIS units. Understanding these procedures should be part of bridge familiarisation.

1.10 Pay as You Sail (PAYS)

ECDIS operators have selected and purchased charts prior to each voyage by placing a chart order online or via a local sales office. This method is commonly called 'pre-licensing' and the ECDIS operator must have purchased a licensed chart to be able to view any chart data other than just the chart border.

With Pay As You Sail, the ship will have licensed access to view and pre-plan using all ENCs at no cost. The ship will only be charged for ENCs used for actual navigation monitoring. In other words, charts that have been displayed on the screen during the ship's passage. In principle, they will be charged for best scale charts only, not all charts under the keel. Recording and reporting of charts used is completed by either extraction from the ECDIS logbook or by the fitting of an independent GNSS tracker.

PAYS service is an online only service for access to license charts and corrections. Chart licensing, management and chart activity recording are integrated with ECDIS, usually through a third-party planning terminal.

2 ECDIS Documentation and Compliance

2.1 ISM ECDIS Audit Template

The following is a template ECDIS navigation audit for internal use. An internal navigation audit should assess how the ECDIS is currently being used. This is likely to take approximately 4 hours.

Particulars	
Company Name:	
Company Point of Contact for Audit:	
Ship Name:	
Location:	
Names of Crew Audited:	
Audit Date:	
Audit Start and Finish Time:	
Auditor(s) Names:	
Auditor(s) Digital Signatures:	

Questions	Auditor Observations
Executive Summary *In this section the auditor makes a clear risk assessment that the ship is either safe to continue navigating with ECDIS as the primary means or that immediate rectification is required and considered safety critical. This assessment is based on a summary of any key points raised in the following detailed report.*	
Key Notes of Concern *In this section the auditor should highlight any non-compliant observations. For example, a missing mandated sensor (GNSS, GYRO, LOG), or ship's officers who are missing the required STCW or ISM certification (ECDIS 1.27 Generic, Type Specific and Familiarisation). This section would also reflect any key deviations from SMS or significant skill gaps.*	
Key Recommendations *In this section the auditor will make any key recommendations to either improve safety based on the observations or to mitigate a potential future incident. For example, "crew require re-training" or "request manufacturer visit to configure sensors correctly".*	

Detailed Report

In this section the auditor has the opportunity to check the technical knowledge of the ECDIS operators by asking leading questions that all OOWs should be able to answer once trained. Some questions may be considered subjective and the answers are to be based on the opinion of the auditor as to the competency of the ship's officers. For example, the look-ahead settings are different to those recommended in the SMS because autonomy is granted to the OOW.

Some questions may be considered objective, for example, if none of the ship's officers know how to produce or automatically check a route, this would be considered a significant skill gap and such observations would be included in the 'Key Notes of Concern' section on the previous page. All internal audits should attempt to be as objective as possible.

Questions	Auditor Observations
Bridge Set-up	
1. What are the primary means of navigation and ECDIS configuration in force at the time of the audit?	
Sensor Integration	
2. How were the ship's sensors configured into ECDIS?	
Navigational Records	
3. Were height of tide, tidal stream, planned Safety Depth and 'No Go' area calculations carried out by the ECDIS operator? If so, how were they plotted?	
4. Was this in accordance with documented procedures?	
Planning – General	
5. Was the last route manually checked prior to execution? - Did the ECDIS operator use the system to conduct a route scan? - Was the route checked by the ECDIS operator at 1:1 scale? - Was the route checked by the Master? - Did the route contain ENC, RNC or a combination of both chart formats?	
6. If dangers were highlighted by the system check, how was the route amended?	
7. If no dangers were highlighted during the route scan, is the ECDIS operator able to configure the system so that only certain objects are highlighted during route scan? If yes, what were the settings in use and were they appropriate?	

8. If the ECDIS is connected to a planning terminal, has a system been established to ensure that all charts, nautical publications (paper and electronic) and other publications are up to date and made available on board?	
Planning – Charts	
9. Were environmental conditions incorporated in the passage plan? - Wind direction and speed? - Tidal stream? - Wave height? - Sea state? - Visibility?	
10. Were all the charts in all systems up to date?	
11. What was the last NTM held?	
12. Were all ECDIS software licences up to date at the time of the audit?	
13. When was the last time all chart permits updated?	
14. Is the ship using the latest version of ECDIS software?	
15. What is the latest Presentation Library held in the system? If an old version, is there evidence that allows this?	
16. What chart had the ECDIS operator planned to use at the time of the audit? If an RNC, was this the best type of chart available? - Was an ENC of the same area available? And was this the largest scale chart? - Was the chart up to date? - Was the chart the latest edition? - Were there any corrections outstanding to the chart?	
17. What display setting was used to plan the anchorage/route? Was this scale appropriate? Were any details hidden on the display due to the selected scale?	
18. Have all relevant navigation warnings, such as from NAVTEX or local notices, been inspected and acknowledged by the ECDIS operator? If so, were any displayed correctly on the ECDIS?	
Monitoring – General	
19. Was a planned route loaded into Route Monitoring at the time of the audit?	
20. Did the ship anchor/berth in the planned position?	
21. If the ship did not anchor/berth in the planned position, did this result in the inability to safely create a berth to berth passage plan?	

Monitoring – Charts	
22. Regarding the chart in use at the time of the audit: • What type of chart was in use? • what was the scale of the chart in use? • if an RNC, was it the best type of chart available? • was an ENC of the same area available? • was the chart in use up to date? • was the chart in use the latest edition? • were there any corrections outstanding to the chart? • if the vessel was required to use only ENC charts, can the ECDIS operator confirm that RCDS mode was not needed?	
23. Is there any inconsistency between RNC and ENC charts of the area?	
24. Was the chart on the best scale/compilation scale, ie 1:1, at the time of the audit? Was Chart Autoload/Autoscale activated?	
25. Which Chart Priority setting was in use?	
26. Have any new obstructions appeared on the most recent edition of the Chart?	
27. Were chart symbols involved in the audit understood by the ECDIS operator?	
28. Regarding the display mode (base, standard, All/Other) at the time of the audit, which display mode was set? Did additional layers create clutter that may have obscured any obstructions? Was this display mode sufficient to show any obstructions on the ENC?	
29. Which palette was in use at the time? Was this appropriate?	
30. What was the chart datum in use at the time? - Was the system displaying the datum information correctly? - Did the system warn of any chart related inconsistencies with the chart datum?	
31. Was the look-ahead function turned on at the time of the audit? Were the system alarms configured to alarm for hazards? - Can the ECDIS operator show any system alarms/alerts? - Was the look-ahead alarm activated?	
32. Was all additional information, mariner's notes and manual corrections input and/or loaded into the system?	

33. At the time of the audit, was there any information available from other sources such as NAVTEX or Local Notices?	
34. Were there any last-minute changes (eg pilot boarding time, berth) plotted on the chart in the run-up to the audit?	
35. Was it drawn to the attention of the ECDIS operator that any local area was prohibited in any way?	
System	
36. What was the primary position sensor in use at the time?	
37. Had GNSS or the primary position system been cross-checked by visual or radar means prior to getting underway/weighing anchor?	
38. Was the system displaying any inaccuracy that may have led to issues?	
39. Was the datum setting in the ECDIS and GNSS correlating?	
40. Was there an offset in the GNSS or the ECDIS?	
41. Had the system alarm been tested and proved correct?	
42. Were the system settings in accordance with the SMS and Master's standing orders?	
43. If settings were not in accordance with the SMS and Master's standing orders, for what reason were they modified?	
44. Were ECDIS set-up and checklist cards available on the bridge?	
Voyage Data Recording	
45. Have the ECDIS voyage data records been altered or deleted?	
46. If safe to do so, can the ECDIS operator demonstrate the playback function?	
Other	
47. Have all ECDIS operators conducted a recognised 5-day ECDIS training course?	
48. Have all ECDIS operators conducted suitable Type Specific or familiarisation training?	
49. Was the ship's SMS information on ECDIS reflective of the operators' knowledge?	
50. Does the ship have a cyber security policy in place regarding ECDIS?	

ECDIS Audit Summary Checklist

Not Checked = **NC** Recommendation = **R** Concern = **C**

1 Equipment and Administration		
1.1	IMO compliant ECDIS fitted	
1.2	Terminal and peripherals physically correct	
1.3	System licence and chart permits held	
1.4	Requisite ENCs and ARCs charting loaded	
1.5	Ship certified for ECDIS as the PMN	
1.6	System time correct (+/– 3 seconds)	
1.7	GNSS lever arm and aerial offsets correct to master datum	
1.8	Sensor integration correct and available for selection	
1.9	Ship dimensions (CCRP) correct in all terminals	
1.10	Backup paper charts corrected and available (dependent on flag State policy)	
1.11	All appropriate personnel to have completed ECDIS course, records to be sighted	
1.12	System security in accordance with company SMS	
1.13	Appropriate documentation available (checklist cards)	
1.14	Procedures and documentation updated and relevant	

2 Preparations		
2.1	Navigation warnings	
2.2	'No Go' areas	
2.3	Clearing lines/Parallel Index Lines	
2.4	Track	
2.5	Wheel over and advance/transfer or turn radius	
2.6	Fixing points (conspicuous landmarks) identified and marked	
2.7	Ephemeral data correct (eg tide/UKC)	
2.8	Safety Contour/manual contour, as applicable	
2.9	ECDIS display mode correct	
2.10	Berthing/unberthing plan	
2.11	Contingency area	

3 Execution		
3.1	Safety Depth settings correct	
3.2	Look-ahead settings verified	
3.3	Method of cross-checking of position/fixing frequency	
3.4	ECDIS prepared to assist visual navigation	
3.5	Transition from pilotage to coastal navigation	
3.6	OOW handover procedure	
3.7	Responses to warnings and alarms	
3.8	Tidal information integration (if applicable)	

4 Non-routine		
4.1	Use of ECDIS in reversionary modes (DR mode or similar)	
4.2	Use of Man Overboard (MOB) function	
4.3	Search and Rescue Planning	

2.2 Assessing ECDIS Software Suitability

It is important to document any inadequacies of a system during internal ISM audits, prior to PSC or vetting inspections. All manufacturers vary substantially in their software capability. An ECDIS that can perform the tasks the ship is required to do is needed. For example, if the ship often operates in pilotage conditions, it will require an ECDIS that can produce accurate advance and transfer predictions at wheel over, rather than an arbitrary turning circle. Equally, if the ship often conducts Great Circle navigation, it will require a system that allows creation of an equally subdivided composite Great Circle (perhaps equally divided by rhumb line length, or every 5° changes in course). Not all ECDIS systems are capable of this.

The following 5 sub-categories should be used to assess software suitability, to ensure that the ship has the correct ECDIS solution:

1.	Ship Specific Navigation Requirements:
	• Can berth to berth plan be created?
	• Can headmarks, sternmarks and beam marks be utilised when planning?
	• Can wheel over bearings be utilised?
	• Can the system construct accurate turns utilising Advance and Transfer?
	• Can the system calculate turns when a tidal stream is present?
	• Will it accept tidal and environmental information such as Admiralty Total Tide?
	• Can it utilise the ship's shape, characteristics and hydrodynamic data for precise navigation?
	• Who will produce and input ship specific (size, pivot points, CCRP) information into the system?
	• How will the ECDIS operator conduct the bridge team meeting if there is no paper chart to display? (Is there a larger display screen provided?)
	• Can it network a printer to print out screenshots, if required?
	• Can passage plans and related information be printed?
	• How will the ship operate in areas of GNSS denial?
	• Does it have both DR and EP capabilities?
	• Can it manually fix position with visual bearings easily?
	• Can it manually fix position with radar ranges?
	• Can it plot a position using transferred position lines?
	• Can it accurately define safe water in confined waters?
	• Can it construct adequate limiting danger lines (LDLs) or 'No Go' areas in accordance with our procedures?
	• Can it construct clearing bearings/PIs with ease?
	• How will navigation be conducted in emergency, for example, when operating from the emergency conning position without paper charts?
	• How are we going to plot our helicopter position or approach shoal on the chart?
	• How are we going to plot the location of our seaboat, craft or tenders?
	• Does it offer a cyber security solution?
	• Can it be used in conjunction with optimum route planning software and shipping databases?
	• Can the system predict an MOB position using set and drift, or is it just a reference point?
	• Will automatic SAR patterns plotting be needed?

Hidden costs and additional factors that affect the ECDIS throughout its lifespan must also be considered.

2.	Hardware/Upgrade Availability
	• Is the ECDIS for rent or pre-paid?
	• What is the cost of fitting, and is it provided by manufacturer?
	• Are software patches free (many are not)?
	• Are IMO/IHO required upgrades free?
	• Where are ships going to be fitted (fit cost may vary depending upon location)?
	• How many terminals are needed? Two per ship (eg remote terminal for planning or repeat terminal in the Master's cabin)?
	• What screen size is required for the display?
	• What are the requirements for display power, housings, brackets and network access?
	• What is the support package available?
	• How long does the warranty last?
	• Are additional software licences available if required for emergency purposes?

3.	Integration Options and Costs
	• Is integration with a Bridge Alarm Management System required?
	• Can it integrate with existing sensors such as GNSS, log, gyro and echo sounder?
	• Can it integrate with existing radar and provide radar image overlay (RIO)?
	• Can it integrate with NAVTEX?
	• Can it integrate with the existing autopilot or Track Control device?

4.	Charts and Miscellaneous Options
	• Can the manufacturer provide equipment procedures and check-off cards?
	• Can the system utilise the charts used?
	• Are ENCs/DNCs and RNCs required?
	• Are ice charts required?
	• Can it display the Admiralty Information Overlay (AIO)?
	• Are additional (appropriate) folio of paper charts required?
	• How will folios be updated?
	• Will the systems be linked to the internet for updating purposes? If connecting to the internet, an approved firewall and antivirus protector are required.
	• How easy is it to add T&Ps and local NMs?

5.	Training Solutions and Options
	• Is there 'on site' training available with the manufacturer or recognised provider? If not, where can I train my personnel on this equipment?
	• What standards of training are required (eg STCW)?
	• Is there an option to purchase the approved training courses?
	• Do we require technical training for our engineers?

2.3 List of Integrated Equipment

Due to the complexity of equipment now connected to ECDIS, it is vital to ensure the SOLAS (depending on size and Class) required navigation equipment that is connected to ECDIS is in good order:

Note, the following list is not exhaustive.

Equipment	Integration Status
NAVTEX receiver	
Properly adjusted standard magnetic compass(es) (transmitting)	
Satellite compass	
Means for taking bearings	
Automatic identification system (AIS)	
Gyro compass and repeaters	
Echo sounder	
Speed and distance indicator	
Rudder angle, RPM, variable pitch and bow/stern thruster indicators (manoeuvring screen to match actual indicators)	
ARPA	
Rate of turn indicator	
Receiver for a global satellite navigation system or terrestrial radio navigation system	
Steering systems (eg track control, DP, etc)	
9 GHz (3 cm 'X' band) radar	
3 GHz (10 cm, 'S' band) radar	
Secondary automatic positioning system	
Voyage data recorder (VDR)	
BNWAS	
Anemometer	
Periphery equipment (eg printer, etc)	

2.4 Performance Test Procedures for ECDIS

It is essential that regular checks are undertaken to ensure equipment maintains its Type Approval. This is not only for safe use, but for PSC inspection and warranty maintenance as well.

In September 2018, the CIRM ECDIS Working Group published 'Performance Test Procedure for Electronic Chart Display and Information System (ECDIS)'.

It is prudent for all operators to routinely ensure their equipment is recorded in this Annex and is still working as originally intended. The source document (Reference GL-001) can be found at **www.cirm.org/publications/**

The CIRM Guideline outlines a performance test procedure to be carried out on a ship's ECDIS installation. It is designed to determine whether the ECDIS meets the operational requirements defined by the International Maritime Organization (IMO). Ultimately, the purpose of the Guideline is to ensure that an in-service ECDIS is functioning properly, in the interests of safety of navigation. The Guideline describes a range of manufacturer recommended tests and checks, which correspond to the IMO's requirements for ECDIS as laid down in SOLAS regulations V/19.2 and V/27, MSC.232(82) and MSC.1/Circ.1503/Rev.1. Where a ship's ECDIS backup arrangements are met by a second independent ECDIS according to the safety equipment certificate, the performance test procedure described in Annex 2 of the circular should be carried out on the backup ECDIS installation.

Development of the Guideline was initiated in response to concerns raised by stakeholders across the maritime industry about the condition of in-service ECDIS, which are frequently found to have operational issues. Problems typically encountered include inadequate power supply arrangements, outdated software versions, disabled audio signals for alerts and incorrect functioning of interfaces to connected equipment. The Guideline was produced by CIRM's ECDIS Working Group, with the input of ECDIS manufacturers, system integrators and service providers. It is envisaged that many of the tests/checks described in the Guideline could be automated, minimising the time required for a surveyor/inspector to perform the test or check on board.

In 2018, 53 observations were made on ships where ECDIS equipment was not functioning in accordance with the IMO and SOLAS regulations. Both the Paris and Tokyo MOU list of detentions regarding ECDIS (discussed in Chapter 3) also indicate that ships are not maintaining their equipment to the standard required to 'replace paper' with ECDIS.

It is vital that all ECDIS operators and Masters ensure that their ECDIS equipment is operated as it was originally intended.

2.5 Manufacturers' User Guide

The manufacturer's user guide is to be available on the bridge in both hard and soft copy. The soft copy is to be installed on all ECDIS and available on screen via the status bar. A printed version of the user guide is also to be available.

The latest mandated changes to ECDIS software have, to some degree, further de-standardised ECDIS software. The chart display has been standardised more, but differences in menu access between manufacturers remain.

A free download illustrating the perils of not understanding the variations between different ECDIS systems is available from ***www.eMaritimeGroup.com*** *entitled 'Type Specific ECDIS – Explained and Uncovered'.*

The core issue of the complexity centres around the perceived varying standards of both the different ECDIS systems and the associated training standards for the safe and effective transition from paper to ECDIS. Although some of the 171 member States and the IMO have given guidance on ECDIS Type Specific procedures and training, there has been no definitive documentation addressing them. The download has been created to provide clarity on the issue.

2.6 Generic ECDIS Training

All ECDIS operators responsible for a bridge watch at sea are to have undertaken a 40-hour flag State approved generic ECDIS course, in accordance with the IMO 1.27 Model ECDIS course, to be in line with current STCW legislation. The following topics should be covered:

- Concept and capability
- familiarisation
- principal types of electronic chart
- legal aspects
- ECDIS data
- adding information and manual corrections
- defining safe water
- depth contour line and clearing bearings
- presentation of data
- route planning
- route monitoring
- chart updating
- sensors
- errors and alarms
- voyage data recording
- backup systems
- confined waters planning
- fixing.

2.7 The Evolution of IMO 1.27 Generic Training

It is important to understand that many flag States do not require re-training and certification after completion of the IMO 1.27 model course. However, it is equally important to acknowledge that ECDIS operators certificated before 2008 were unlikely to be trained in the use of ENCs and that before 2010 the course was approximately 3 days in length, while it now requires 40 hours. Furthermore, prior to 2018 the course was unlikely to have included the vital S-52 4.0 updates, S-Mode or S-100 charting.

The latest version of IMO 1.27 Generic Training was published in 2012. This is the basis of the required training course from most training establishments worldwide.

To assist with keeping course content updated, guidance is provided by other elements of the industry, and sometimes by flag States. For example, in the UK, the MNTB (part of the UK Chamber of Shipping) issues its own guidance. The latest (third) edition of MNTB ECDIS Training was published in November 2020. This updated the 1.27 model course for UK based training centres approved by the MCA to ensure all new learning objectives and software updates are met. It also ensures appropriate simulation training is given by the training centre. Original IMO 1.27 courses did not require the ECDIS operator to use ECDIS on the course and they were more PowerPoint and lecture based.

Below is an example of the latest certificate issued (MNTB 3rd Edition) used in the UK for generic ECDIS training.

Certificate No: 000102/21
MCA Approval Certificate No: 00909

ECDIS Ltd
Atlantic 3600 Building
Parkway
Solent Business Park
Whiteley
Fareham
PO15 7AN
United Kingdom

Tel: 01489 559677
Website:
www.ecdis.org

Electronic Chart Display and Information Systems (ECDIS)

This is to certify that **Joe Bloggs**

Date of Birth **22/08/1973**

has successfully completed Electronic Chart Display and Information Systems (ECDIS) simulator training approved by the Maritime and Coastguard Agency, meeting the requirements laid down in Regulation II/1, II/2 and II/3 of the STCW Convention, 1978, as amended, and Tables A-II/1, A-II/2 and AII/3 of the STCW Code

Use ECDIS to maintain safety of navigation

Maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making

This training also meets the learning outcomes of IMO Model Course 1.27 and was conducted in not less than 40 hours

This Certificate is issued under the authority of the Maritime and Coastguard Agency of the United Kingdom of Great Britain and Northern Ireland, an executive agency of the Department for Transport.

Signature and name of the Authorised Representative of the Approved Training Centre — Mark Broster

Signature of person to whom this certificate was issued — Joe Bloggs

Issuing Authority Stamp and Date

22 JAN 2021

ECDIS Ltd
Registered: 06711458

Enquiries concerning this certificate should be addressed to ECDIS Ltd at the address above

Figure 2.1 – Example of new wording used on ECDIS Generic Training Certification 2021 in the UK, adopting several changes including GDPR compliance

It is important to consider the date when the ECDIS operator completed their initial generic training. Re-training should be considered if significant time has lapsed since initial ECDIS training, as many software, charting and regulatory updates will have taken place. All ECDIS operators should ensure they hold valid certification for their flag State's requirements and that these conform to the flag State's latest course content, duration and regulations.

The latest UK MNTB requirement for ECDIS Generic Training is available from:
https://shop.witherbys.com/course-criteria-for-electronic-chart-display-and-information-systems-ecdis-simulator-training-3rd-edition/

2.8 Type Specific and Familiarisation Training

All ECDIS operators, after completing generic training, are required to undertake Type Specific ECDIS training to be familiar with the equipment in use on their ship. This is in line with ISM and flag State legislation (depending on flag State).

All ECDIS operators are to be familiar with the specific equipment in use on board their ship, having completed an appropriate Type Specific training course.

In addition to Type Specific training, onboard familiarisation training is considered best practice. Each manufacturer's software version and installation may vary from the type that the ECDIS operator has been trained on. Therefore, a familiarisation checklist can assist ECDIS operators in gaining and refreshing knowledge of ship specific installations.

Volume 2 of this Guide contains Type Specific familiarisation checklists.

2.9 Responsibility for Safe Navigation

In 2020 the Court of Appeal upheld the 2019 High Court decision for the *'CMA CGM Libra'* grounding. The results of the investigation into the high profile *'CMA CGM Libra'* grounding showed a lack of ECDIS passage planning and particularly, a lack of 'No Go' areas set. Investigations for such groundings in the past have often been based upon the quality of the ship's SMS and the ability to demonstrate due diligence in providing a seaworthy ship and trained crew.

However, in the recent case of the *'CMA CGM Libra'*, the owners were found to have failed to exercise due diligence at the commencement of the voyage as a "non-delegable duty". Previously, it was considered that the SMS was a delegation of duty.

In the 2019 case of the *'CMA CGM Libra'*, the court ruled that the defective passage plan rendered the ship unseaworthy. It was found that the passage plan was defective as it made no references to uncharted shallows/shoals and did not clearly mark 'No Go' areas.

The owners in this case had argued that the passage planning was part of navigation and did not form part of the seaworthiness of the ship. This was not accepted by the court, even though the owners may have well been diligent in having an SMS and ECDIS procedures, as required under ISM.

The court found that those 'servants or agents' relied upon by the owner to make the ship seaworthy must show themselves to have done so, as the duty is non-delegable. The provision of a proper passage plan is necessary to ensure, so far as reasonably possible, that the ship will be safely navigated. The court stated that the decision in this case did not represent a change in the law, but it did "serve as a useful reminder to vessel owners of their onerous and non-delegable duties in relation to seaworthiness".

Although the *'CMA CGM Libra'* case involved a grounding and, specifically, the lack of 'No Go' areas on ECDIS, it is conceivable that this ruling could extend into other areas of poor passage planning, including calculations of under keel clearances.

The *'CMA CGM Libra'* case reiterates the importance of the ISM Code. Regulation 12 of the ISM Code requires ship owners to carry out internal safety audits and to periodically evaluate the effectiveness of the SMS.

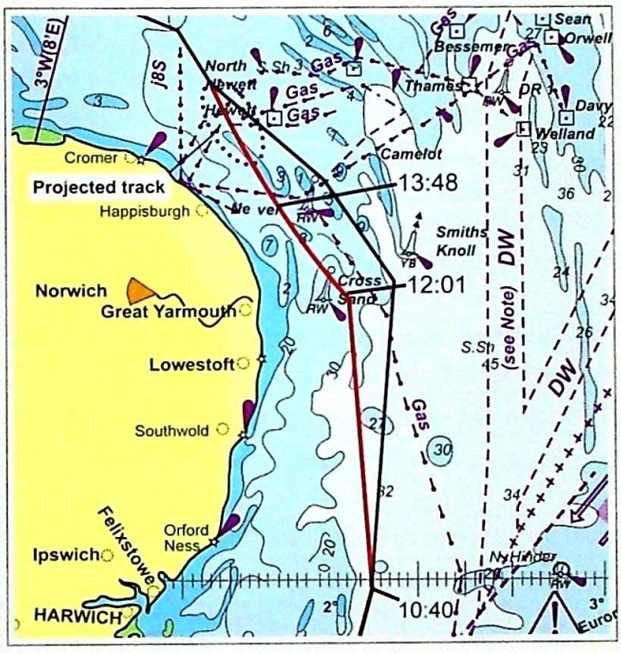


Photo and chart extract reproduced from MAIB Accident Investigation Report 21/2008 'Grounding of general cargo vessel CFL Performer'

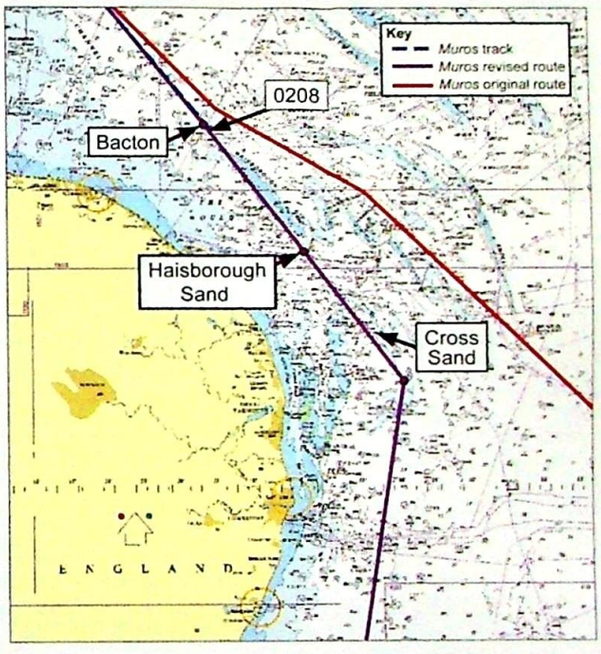


Photo and chart extract reproduced from MAIB Accident Investigation Report 22/2017 'Grounding of Bulk Carrier Muros'

Figure 2.2 – MV *'CFL Performer'* grounding on Haisborough Sand in 2008. MV *'Muros'* grounding in almost identical position almost ten years later. Both ships used ECDIS as the primary means of navigation

3 ECDIS Operator Skill Gaps and PSC Preparation

3.1 Top 20 Questions Asked at Inspection

These questions are often used at inspection to gain an appreciation of whether, regardless of certification, the ECDIS operators have a complete understanding of the critical elements of their ECDIS. The questions require an 'instinctive' answer as they are deemed safety critical, ie the ECDIS operator should be able to answer and demonstrate without consulting a user guide or taking time to work out the answer.

Administration
1. Confirm ECDIS procedures are embedded in SMS and all ECDIS operators understand and can demonstrate settings such as look-ahead limits for varying conditions, XTD on passage and appropriate layers for prevailing situation.
2. Confirm all ECDIS operators have completed generic training, Type Specific training and have an appropriate familiarisation checklist for the exact make and model.
3. Ensure a cyber security policy is in place for ECDIS and industry best practice is being followed.
4. Provide evidence of the last 90-day passage or voyage, either through the ECDIS playback facility, or written records.
5. Ensure latest software and IHO updates are installed.
6. Provide evidence that AIO (if available), T&Ps, LNMs and radio nav warnings are maintained.
Appraisal
7. Review source data diagram/lowest CATZOC of concern for next passage and discuss how UKC policy is affected.
8. Show examples of 'No Go' areas on the chart, highlighting dangerous areas that may be within Safety Contour limits.
9. Select varying layers and set up the ECDIS displays for planning a route.
10. Provide evidence of scale 5 harbour chart for next destination.
Planning
11. Produce a fictitious route over land or a shallow patch of water, conduct the automatic route check function and confirm the route check alerts the ECDIS operator to the potential dangers.
12. Show menu page that selects appropriate attributes for the automatic route check function. Ensure all potential hazards are selected.
13. Show the menu where specific date and times for automatic route check can be selected and ensure automatic route check was conducted over the duration of the intended passage to show any seasonal objects or future hazards.
14. Clarify range of cross track corridor used for route check and ensure compliance with SMS requirements for different areas, eg cross track (XTD) and size (pilotage, coastal, open ocean).
15. Demonstrate adding a manual 'chart note', for example, VHF reporting point.
16. Provide evidence of contingency planning such as abort points, emergency anchorage areas, PI planning, etc.

Execution
17. Ensure audible alarm is turned on, and at the correct level (75 db).
18. Turn on look-ahead or anti-grounding cone and confirm the understanding of safety settings as per company SMS requirements.
19. Discuss OOW handover considerations.
20. Practically demonstrate how to plot an example nav warning from NAVTEX or VHF warning of a 'No Go' area. For example, 'plot a diving operation in the following position xxx,xxx and add alarmable exclusion zone of 5 cables around the position on ECDIS'.

3.2 ECDIS Skill Gaps

Gaps in ECDIS knowledge are still encountered in all sectors of the maritime industry. Ship owners/operators are encouraged to maintain an onboard procedure for continual professional development (CPD) of ECDIS knowledge.

Many of the gaps identified in this Guide, which have been compiled from observations, ship detentions and the assessment of ECDIS operators (through competency assurance training), are considered safety critical.

This chapter focuses on ships where ECDIS is the primary means of navigation and the ECDIS operators had completed both generic and Type Specific training.

This chapter has utilised the following resources to assist in identifying ECDIS Skill Gaps:

- Results of the International Inspection Programmes
- the joint Paris/Tokyo MOU Concentrated Inspection Campaign (CIC) on Safety of Navigation, including ECDIS.

The aim of this chapter is to ensure all ships have a procedure in place for familiarisation and refresher training.

Due to the ongoing Covid-19 restrictions, no new data was gathered on ECDIS observations between the Spring of 2020 and 2021. The international inspection regime, was also paused.

However, in November 2020 an independent ECDIS survey was conducted of over 650 ships. The full report can be found here:

https://www.ocimf.org/publications/information-papers/recommendations-on-usage-of-ecdis-and-preventing-incidents

3.3 ECDIS Observations – Independent Inspections

Recent audits emphasise that an alarming number of ECDIS operators (who have completed both generic and Type Specific training) still do not understand many of the basic, yet critical, safety functions of ECDIS.

Completion of formal, mandated ECDIS training is only the first step in becoming a competent ECDIS operator. The observations shown identify a need for ship specific procedures to be developed to ensure that ECDIS operators engage in ongoing competency training based on the factors outlined in this chapter.

Key ECDIS Functions and Terms

It is clear from survey reports that, despite many years of training in ECDIS advancements, basic safety settings remain a common observation.

- The anti-grounding cone/safety frame was designed to compensate for any poor planning or lack of appraisal, it is considered the 'last chance' for the system to highlight any danger to the ECDIS operator
- the appropriate use of Safety Contour and Safety Depth is critical
- CATZOC and UKC policy – an understanding of UKC policy on ECDIS still appears to be a common issue at sea
- out of date software (PL 4.0). It is critical that the ECDIS system is up to date, both in line with manufacturers' updates and IMO/IHO updates
- evidence of familiarisation training remains important.

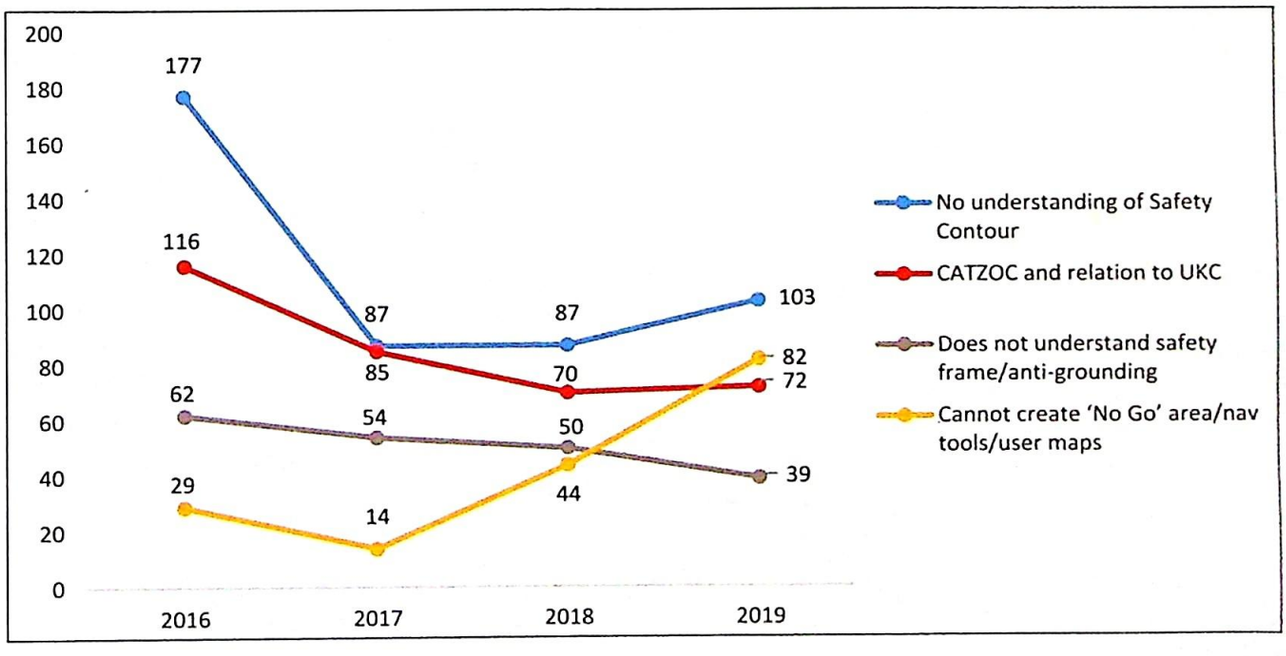


Figure 3.1 – Number of ships unable to answer key ECDIS functions and terms competence questions in 2016–2019

Basic Navigation Skills

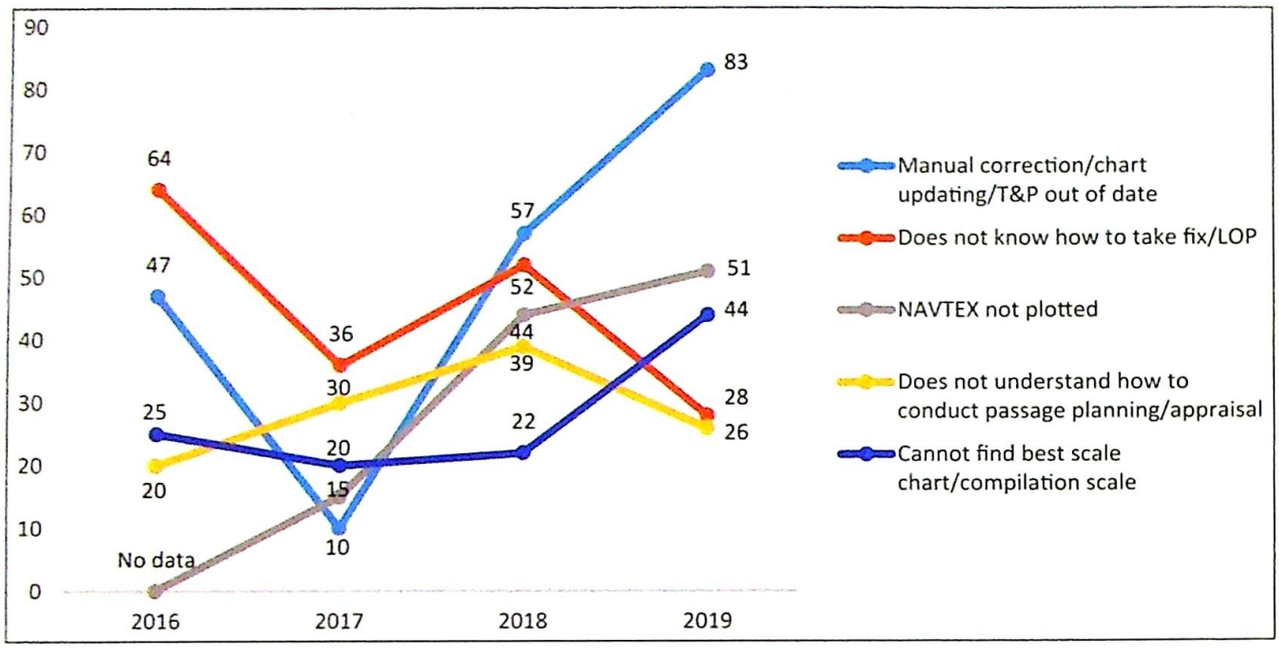


Figure 3.2 – Number of ships unable to answer basic navigation skills – ECDIS competence questions in 2016–2019

IT and Security Related

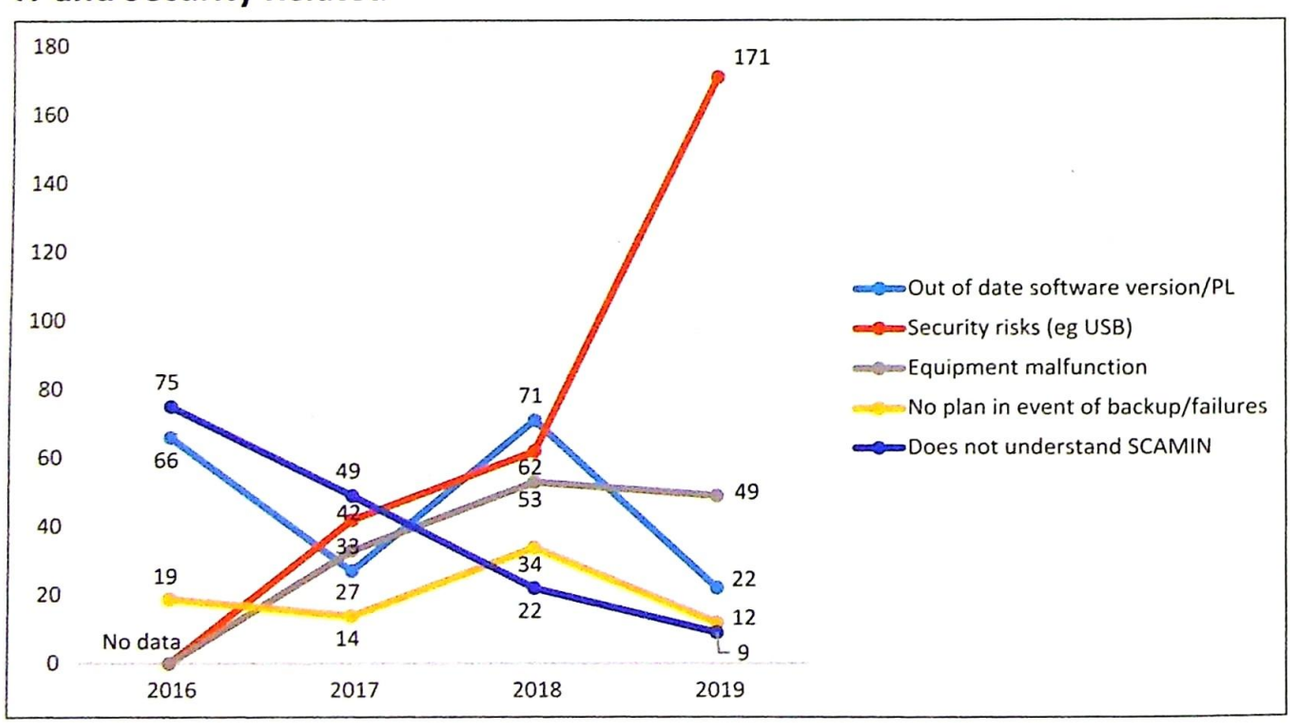


Figure 3.3 – Number of ships unable to answer IT and security related ECDIS competence questions in 2016–2019

Training and Equipment Related

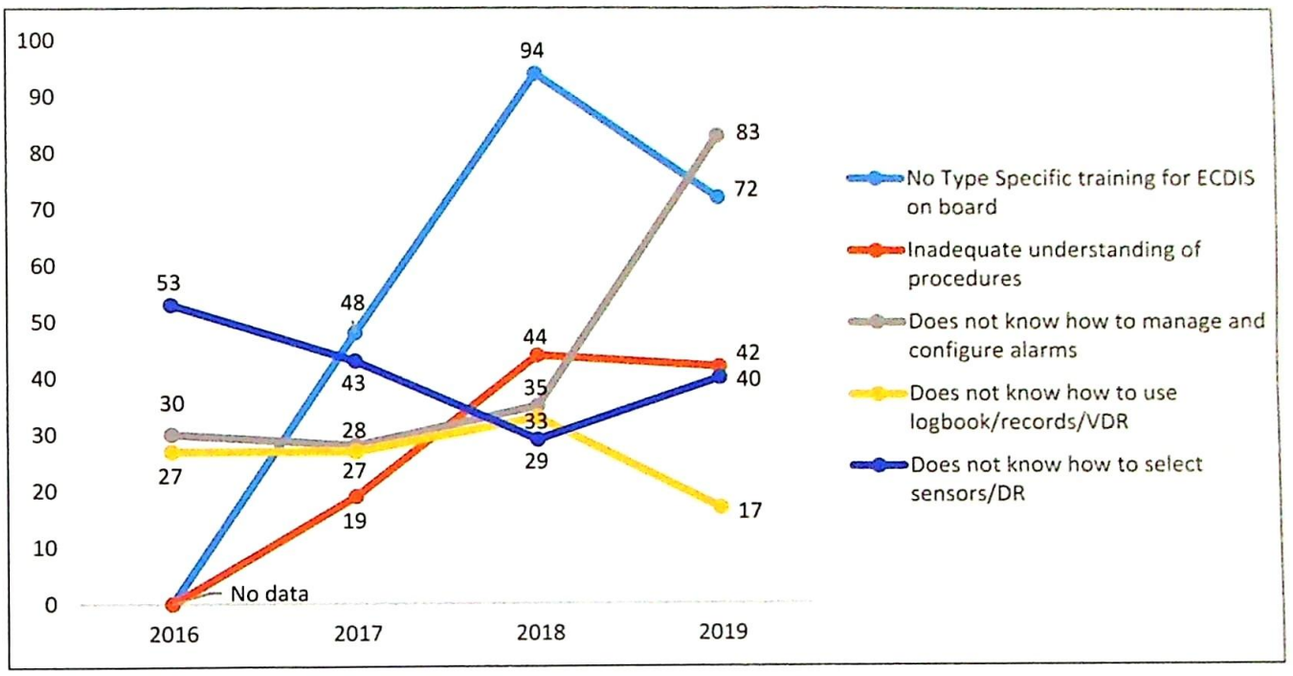


Figure 3.4 – Number of ships unable to answer training and equipment related ECDIS competence questions in 2016–2019

3.4 Comparison of Observations to Training Syllabus

Owners and Masters should ensure that all officers required to keep a watch using ECDIS have received the appropriate training.

However, it is also important for Masters and owners to understand that, even after training, onboard procedures need to be developed to address potential gaps in the training.

Common Observation	Time Spent on Model Course
Safety Depth and Safety Contour	Lesson 2.5 60 mins (L=45, D=15)
Safety Frame/Check Area	Lesson 3.5 120 mins (L=60, D=30, P=120)
CATZOC	No specific timings in model course
PL 4.0 Updates	Not covered by model course
Performance Test Procedures for ECDIS	Not covered by model course

Figure 3.5 – IMO 1.27 lesson plan number and time recommended to cover a wider subject that includes the subject matter observed to be poor. L = Lesson, D = Demonstration, P = Practical

There is a significant amount to be covered in the 40 hour course and some training providers may deliver less than the model course. Operators should consider spending further time on board concentrating on these topics.

It is vital that the ECDIS operator, Master and company understand that there may be a requirement to compensate for any shortfalls in the training and certification delivered to operators. An onboard training calendar and procedure should be developed to address any of the safety critical failings highlighted in this chapter and throughout the publication, plus all other resources available to ensure operators are competent in ECDIS navigation.

3.5 ECDIS Non-Conformities and Detentions – PSC

The first detentions due to either inadequate ECDIS equipment or poor ECDIS operator understanding were reported in 2015. Since then, PSC has increased its interaction with ECDIS operators during inspections. This has culminated in recent campaigns on safety of navigation by Port State MoUs. Inspectors were given guidelines on questions to ask to see whether post-training, safety related skill gaps still existed. This section details those questions and their results.

The CIC targeted 11 aspects of compliance provisions that are considered critical to safety of navigation. Areas included:

- ECDIS appropriate up to date charts and suitable backup arrangement
- navigation equipment in accordance with applicable safety certificate
- passage plans covering whole voyages.

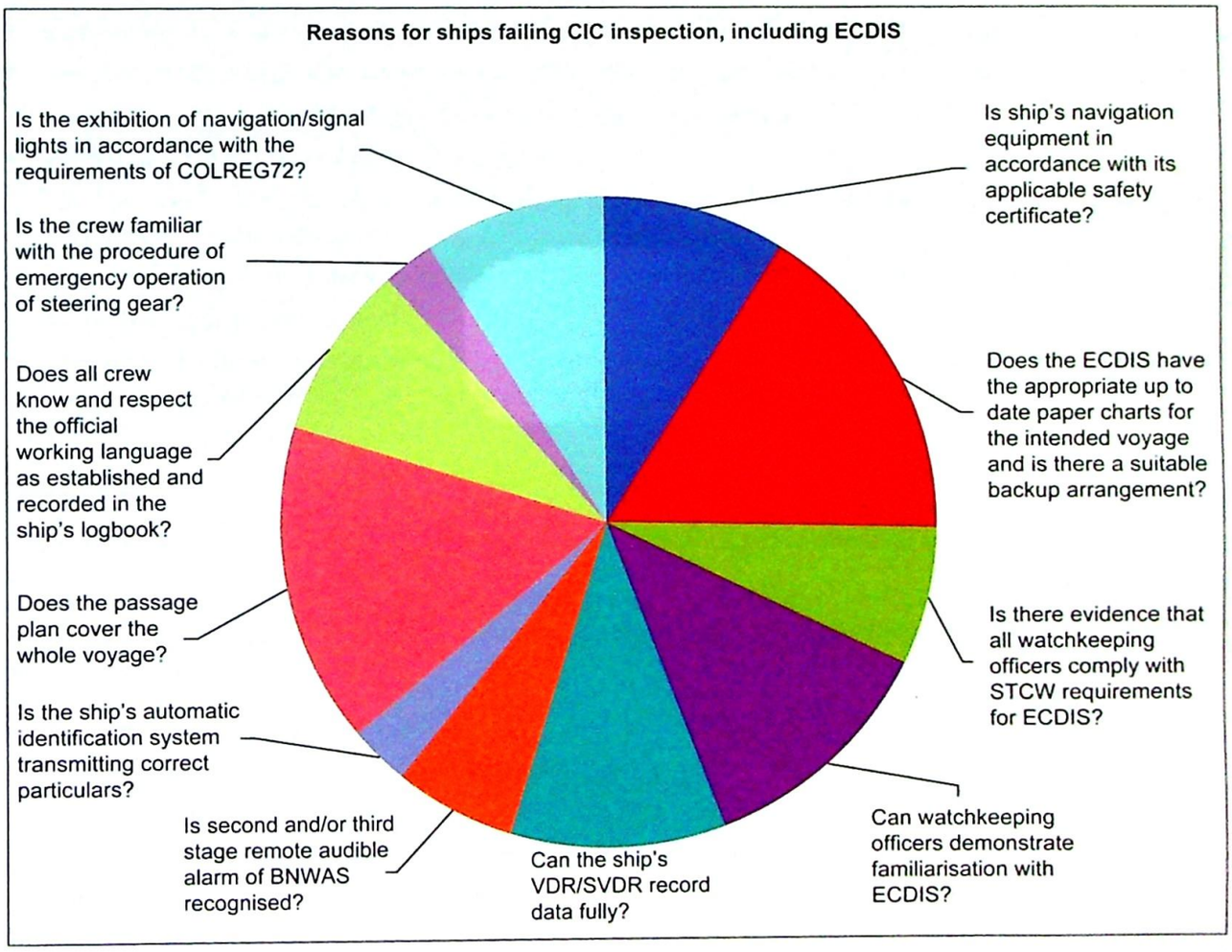


Figure 3.6 – Number of observations and detentions due to each question

Closer inspection of PSC detention results shows the main elements failing are:

- Passage planning
- ability to demonstrate familiarisation
- ability to display VDR/history
- lack of charting and suitable/up to date scale.

4 Key ECDIS Procedures for Safe Navigation

4.1 Appraisal

The following are considerations when conducting the appraisal phase (not exhaustive):

- Receive orders
- destination, location and suitability
- pilot books, sailing directions, object interrogation
- Ocean Passages for the World, Ship's Routeing, ENC and RNC Overview, digital catalogue
- parameters, tidal constraints, speed, ETA, ETD, provisions, fuel and water, cargo considerations
- chart permits (ENCs/RNCs), paper backup, order digital catalogue, email from chart agent
- navigation warnings, NTM, T&Ps, AIO, NAVAREAs, local port warnings
- tides and currents, approved digital publications
- CATZOCs, under keel clearance, Safety Depth, Safety Contour, coastal, nav danger clearances, company procedures, Master's discretion
- weather information, routeing, internet, Met Office, specific met service, routeing charts
- reporting requirements, systems, ALRS
- any other considerations such as piracy, cargo, limiting latitudes, MARPOL, contingencies, abort positions, ice, IALA buoyage systems, ECDIS licence expiry, chart permit expiry.

4.1.1 NAVTEX

NAVTEX information should be plotted in ECDIS where relevant to the likely trading areas of the ship.

Where NAVTEX is not integrated with ECDIS, operators must manually insert navigation warnings using the appropriate functions, such as user charts or mariner-added objects. On receipt of a NAVTEX message, it is recommended that the ECDIS operator:

- Deletes outdated information
- highlights the location and coordinates that the message relates to
- plots the coordinates
- assesses the effect on the route, informing the Master where required
- indicates that the message has been read and the location examined
- saves the message.

If integrated and automatically plotting on the ENC, the position of NAVTEX data may be marked with a NAVTEX icon. If the ECDIS recognises the position, the NAVTEX icon appears at that position. The ECDIS operator must ensure that, where NAVTEX is integrated with ECDIS, the following actions have been taken:

- Outdated information has been deleted
- NAVTEX data is selected for display
- area alerts are configured with regard to NAVTEX information
- the effect on the route has been assessed and the Master has been informed where appropriate.

During inspections and audits in 2018, a large number of observations were raised concerning NAVTEX, where ECDIS operators assumed that NAVTEX was automatically plotted on the ENC as it was connected to the ECDIS.

It is vital to understand that the appearance of a 'pop-up' on the ECDIS screen, regarding a new NAVTEX message or correction, does not necessarily mean that it has been plotted. It may only be highlighting that the operator needs to make a plot in accordance with the new message.

4.1.2 'No Go' Areas

There are still a significant number of groundings where ships are not familiar with the Safety Contour, and when Safety Contour needs to be supported by a manual 'No Go' areas.

The ability of an ECDIS system to highlight a given Safety Contour based on a set Safety Depth is one of the great advantages of the system. The system displays clearly in bold the contour beyond which you do not wish to proceed. Furthermore, if you have activated your look-ahead, the system will alarm when in contact with the Safety Contour, giving warning of the proximity of danger. However, the lack of contour data currently available within ENCs means the operator is not able to fully utilise Safety Contour to define safe water. It can be seen, therefore, that if the ship has to proceed over soundings shallower than the contour but deeper than the Safety Depth, safe areas cannot be defined automatically with the Safety Contour. Furthermore, the system will continuously alarm, causing alarm fatigue.

This means that ships that need to reduce the Safety Contour, in accordance with their Safety Depth in order to get into harbour safely, will be faced with two options:

1. Turn off the Danger Detection Area to reduce alarm fatigue.
2. Reduce the Safety Contour value to a shallower contour, which risks removing the automatic alarm.

Both options are inherently dangerous and must be risk assessed.

Turning off the Danger Detection Area means that the system will only alarm when the ship symbol encounters a danger, which in most cases will be too late. Reducing the Safety Contour value to below the value of Safety Depth is possible in many systems, although not recommended as the majority of systems only alarm crossing the Safety Contour, not the Safety Depth.

A solution to this problem is to draw a Limiting Danger Line 'No Go' area. This is a tried and tested technique that works on RNCs as well as ENCs. Essentially, it is a manually inserted danger line that will alarm when the look-ahead touches it, replacing the Safety Contour.

The value of the 'No Go' area is calculated as follows:
Draught + safety margin + squat – HoT (time dependent)

On most systems, when the Safety Depth value is inserted all soundings equal to or less than this value are highlighted in bold. Using the relevant function on the ECDIS system, draw a danger line around the soundings to produce the Limiting Danger Line (LDL). The safety margin is a prime consideration and must be large enough to take into account the quality of data.

As the contour is being drawn manually, the ECDIS operator must consider the inaccuracy of the data in use. Some systems can draw a 'No Go' automatically.

Figure 4.1a – Safety Contour generates too much 'blue' indicating unsafe water due to the limited contours available

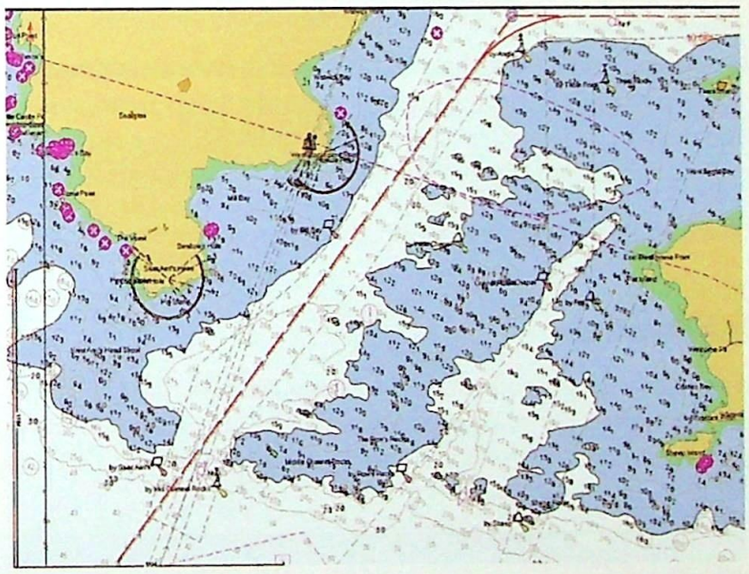


Figure 4.1b – Safety Contour dangerously reduced, however, this means some spot soundings need to be highlighted manually as dangerous

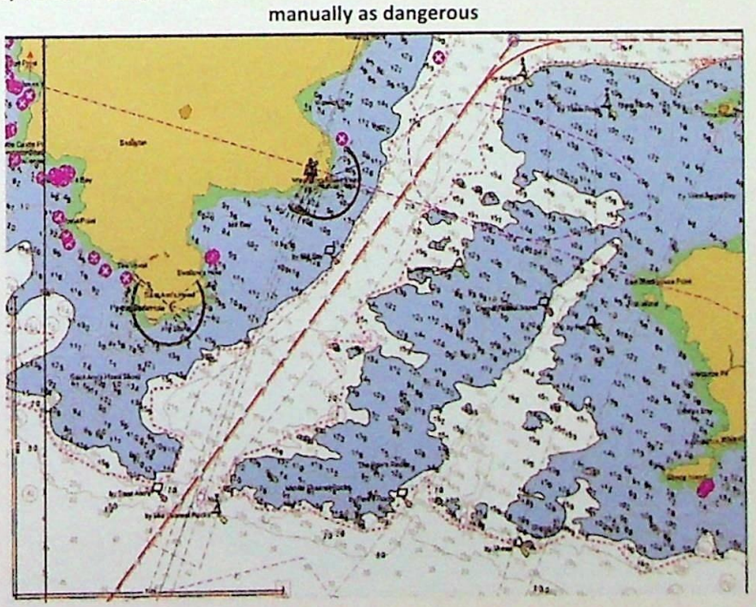
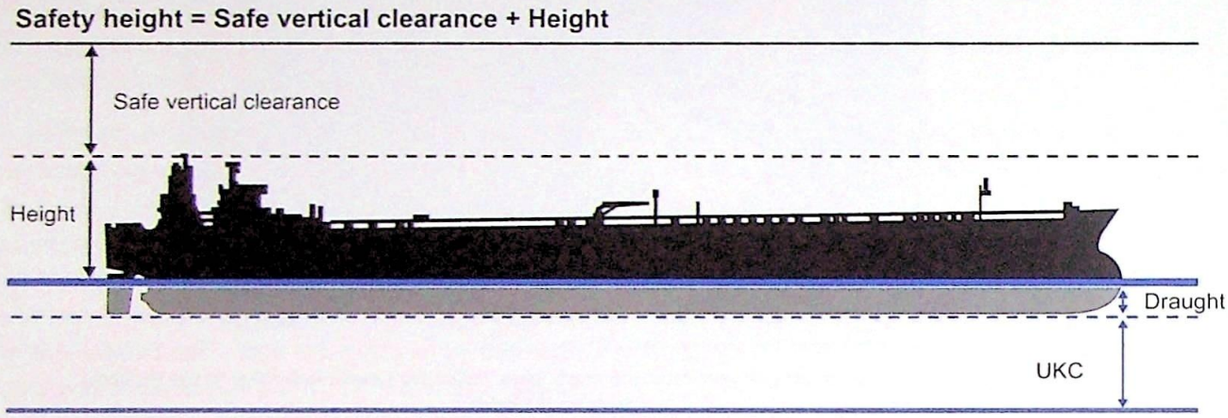


Figure 4.1c – Safety Contour dangerously reduced, however, this means some spot soundings need to be highlighted manually as dangerous

4.1.3 The Safety Depth

Safety Depth for each leg of the passage plan must be calculated by the navigator using the following formula:

Safety Depth = draught + under keel clearance (UKC) (including squat and a safety margin) – height of tide (HoT)



The ECDIS operator must always ensure that the Safety Depth remains appropriate throughout the voyage. Prior to departure, the navigator must check that the planned Safety Depth value remains appropriate. This could be affected by delays in sailing, tidal restrictions or other factors such as a change in draught. Where the Safety Depth value has changed, the route must be checked again prior to sailing.

If the ECDIS operator fails to enter a Safety Depth, the system will default to a 30 m Safety Contour.

4.1.4 Spot Sounding Depths

Soundings equal to or less than the Safety Depth selected are displayed in bold type when the display of spot sounding depths is turned on, making them slightly more conspicuous than deeper soundings. This is important because the Safety Depth value is intended as an aid when no appropriate Safety Contour is available in the ENC.

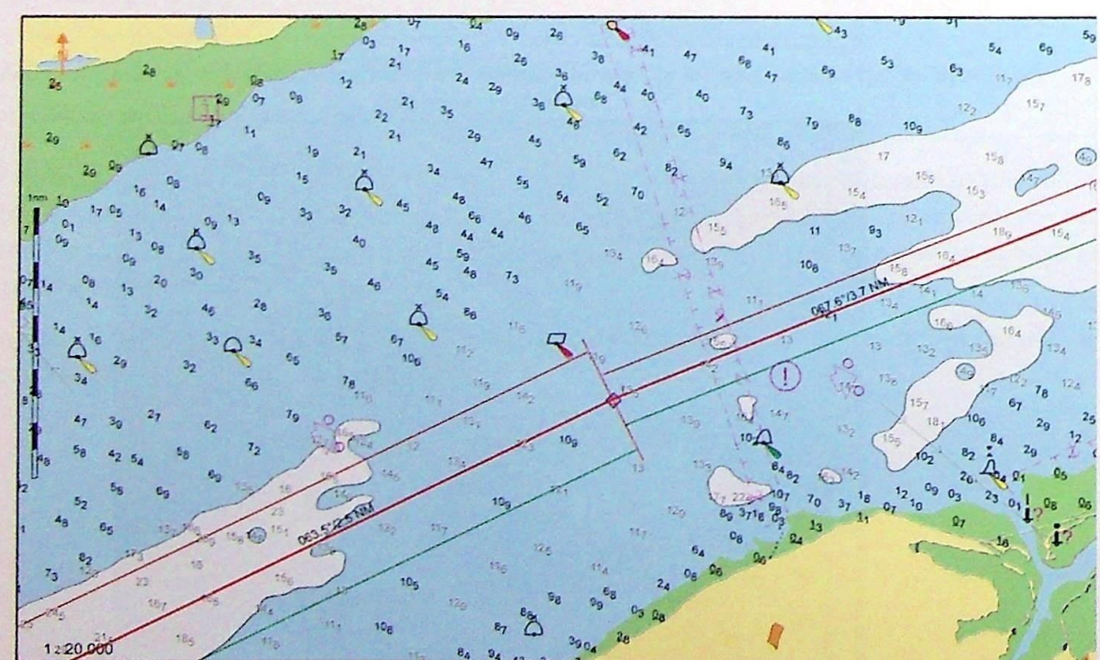


**Figure 4.2 – Safety Depth value is 11 m and the Safety Contour is 15 m.
Passage plan crosses Safety Contour, Isolated Danger switched off, bold soundings show limit of navigable water.
Bold soundings are less than the Safety Depth indicating the limit of navigable water**

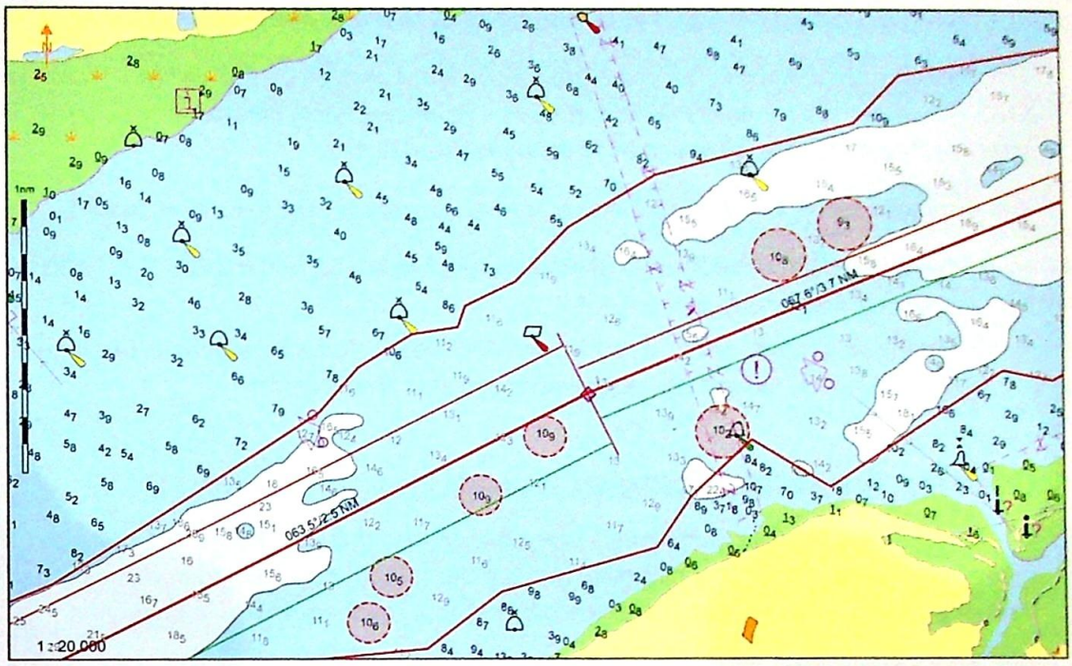


Figure 4.3 – Safety Contour value set at 11 m with additional mariner-added objects that initiate an alert

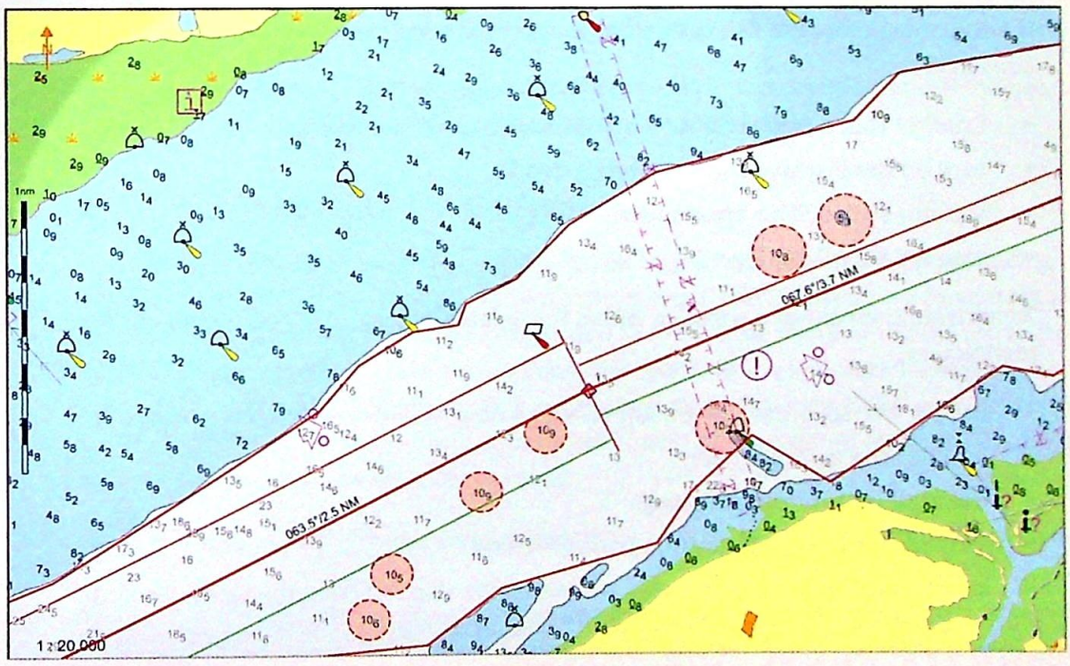


Figure 4.4 – Safety Contour value reduced to 10 m with additional mariner-added objects that can be set to alert

Be aware that ECDIS will only alert when crossing the Safety Contour and not for individual depths.

4.1.5 Safety Contours

The system Safety Contour is selected by the ECDIS user. This is an instruction to the ECDIS to use the Safety Contour value and to highlight that contour on each ENC. It is intended to represent the limit of navigable water. The ECDIS selects the contour and applies a bold grey line that defines the limit of blue water and white water areas displayed for each ENC.

However, in many cases, the desired Safety Contour value may not be available within the ENC in use. Where this occurs, the system automatically selects the next deepest contour available (eg the contour for a Safety Depth of 7.7 m may not be available, nor the 8 m or 9 m contours. In this case the next deepest contour will be used, ie the 10 m contour, if available).

The display of Isolated Dangers is also determined by the value of the system Safety Contour.

ENC contours are defined at the production stage, when each ENC is created by a Hydrographic Office. Some ENCs may have contour lines available at every 1 m interval. Most ENCs will have contour lines at less frequent intervals. Most typically, 10 m and 30 m contours are available.

The displayed Safety Contour may change during a voyage for the following reasons:

- If the Safety Contour selected by the navigator is not available in the ENC, the ECDIS will select the next deepest contour and trigger an alert
- when the ship moves onto a new ENC and the Safety Contour previously in use is no longer available, the ECDIS will select the next deepest contour and alert the navigator.

4.1.6 Crossing the Safety Contour

Where the Safety Contour defaults to a value deeper than that specified by the navigator, the Safety Contour may not represent the limit of navigable water. If the navigator is forced to navigate in these waters and the limit of navigable water will be represented by the spot sounding depths in bold type.

This decision should be thoroughly risk assessed and discussed with the Master. This will particularly affect ships navigating in restricted sea areas.

If a ship must cross the Safety Contour to continue along the planned route, the following should be considered:

- Confirm that Isolated Dangers are displayed in shallow waters
- turn on the display of spot sounding depths
- suitably scaled ENCs are available
- assess CATZOC quality.

To mitigate the risks of navigating within the Safety Contour, ECDIS operators should use the following techniques:

- Define 'No Go' areas using mariner-added objects and activate danger alerts
- monitor the echo sounder
- use additional bridge manning
- increase frequency of position cross-checking
- clearly mark in the passage plan whenever the ship will cross the Safety Contour.

When navigating within the Safety Contour, the navigator must ensure that Isolated Dangers are displayed.

When monitoring an active route, ECDIS will alert the navigator prior to crossing the Safety Contour. However, during planning ECDIS may not alert and may only give a minor indication during the route check function.

Mariners should not rely on the automatic route check function to replace detailed verification of the route conducted by the navigator and the Master.

RNCs do not contain contour vector data, so ECDIS operators should mark the limit of navigable water using mariner-added objects.

4.1.7 SCAMIN

SCAMIN can be described as the process by which the system automatically filters information from the display. When the display is underscale, and therefore not at the compilation scale, certain features are suppressed and the operator runs the risk of not seeing all relevant and possibly safety critical information.

This, therefore, requires careful management. While there are various techniques to minimise the SCAMIN effect, such as ensuring Autoload and Autoscale are on, the only foolproof measure is for the operator to select '1:1' or equivalent function, which displays the ENC at compilation scale, and then frequently check that this setting is correct.

Presentation Library (PL) 4.0 allows the ECDIS operator the ability to turn off SCAMIN. SCAMIN is not universally applied by Hydrographic Offices in the same way, so the ECDIS operator may need to see all data. However, the ECDIS operator must be aware that disabling the SCAMIN filter will add significant clutter to the display.

4.2 Planning

The following are considerations when conducting the planning phase (not exhaustive):

- Use all the information from the appraisal to create the safest appropriate route and navigation plan
- during the route planning processes, consideration must be given to the intended method of execution and monitoring, such as:
  - chart availability, ENCs and RNCs at appropriate scales, appropriate portfolio of paper charts, licensing and risk assessment
  - WGS 84 datum coverage
  - GNSS denial or inaccuracy
  - relative navigation techniques to cross-check accuracy of GNSS, such as RIO, parallel indices, visual aids to navigation, visual and radar fixing and astronomical observation.

4.2.1 Preparing ECDIS for Visual/Radar Navigation

During pilotage, or when navigating close to shore, there are still significant advantages in producing a plan that allows the OOW to 'look out of the window'. For example, a route that is based on a headmark allows the OOW to make an immediate track assessment without having to look at the chart. Similarly, the route may have 'visual references' such as the passing of a buoy down the beam, which indicates 1 cable or 36 seconds (at 10 knots) to the wheel over point. Any preparation of the chart that allows the OOW and Master more capacity to look out of the window and not down at the screen must be considered ideal, although a balance of both navigation aids and visual is always recommended.

The second advantage of preparing ECDIS for visual navigation is that there is no over-reliance should any equipment fail.

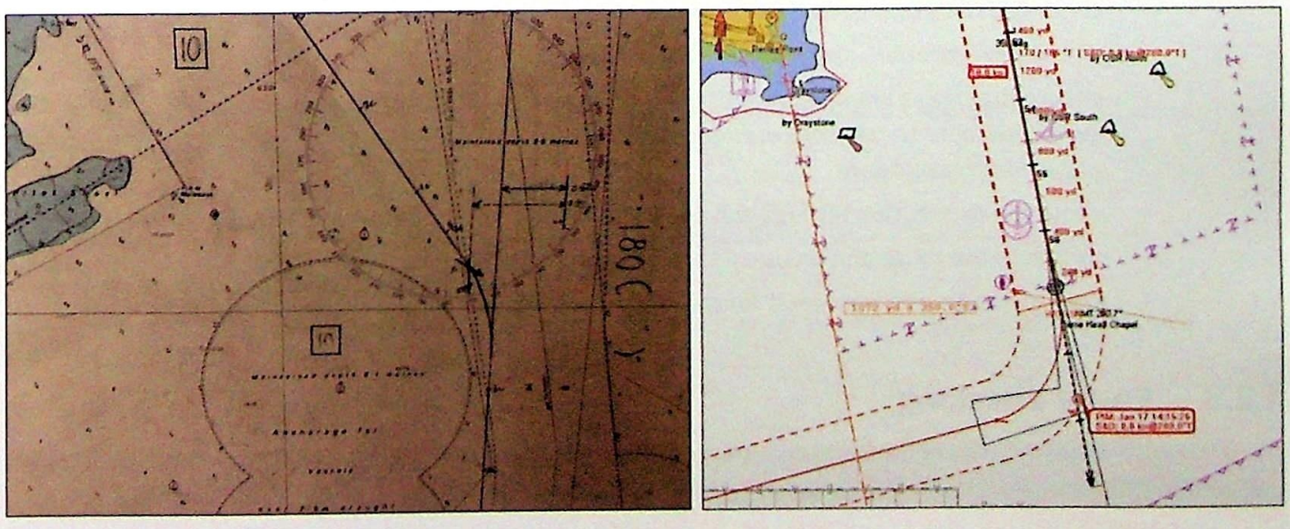


**Figure 4.5 – Left: A paper chart in preparation for visual pilotage.
Right: An ECDIS preparation for similar visual pilotage, using the same techniques**

When preparing ECDIS for visual/radar navigation, the following additions to the route should be considered:

- Accurate turning radius
- visual wheel over bearings
- identification of objects that visually indicate when the ship is 'at wheel over' position
- distance to run
- tidal stream predictions
- key information (such as conspicuous visual references to aid navigation)
- headmarks/sternmarks and their bearings
- any visual transits, in particular for headmarks
- clearing bearings to define how much further safe water to port/starboard through visual means if forced off-track
- parallel Index lines
- predicted course to steer
- expected echo sounder readings.

4.2.2 Route Creation

The following notes on creating a route using ECDIS to assist with fast, efficient and safe planning are detailed but not exhaustive:

- Create a 'blank canvas' by unloading old routes, notes and user charts
- configure screen display as required
- if available, set display to 'large' or 'planning' format at a scale that allows a view of the start and end locations, prior to detailed routeing
- use an ENC or RNC, depending upon availability
- enable route creation
- name the route appropriately
- begin with waypoint plotting in the general area of the start and end of the route
- the route may default to rhumb line, so change properties if necessary
- set Safety Depth and Safety Contour values, noting that these values may change throughout the voyage
- zoom in to a more appropriate scale, such as best scale to modify the start and finish waypoints, and 'name' waypoints to account for TSS etc, alternating between chart formats as required for quality control. It will be necessary to activate appropriate layers for this purpose
- check CATZOCs or source data diagrams and amend the route or highlight as necessary
- where ENCs overlap, check the route on each ENC
- ensure that there are adequate XTD/XTE/channel limit/corridor and safety margins (if available) for each leg of the route to take into account the availability of navigable water, expected traffic, likely deviations and collision avoidance
- check the turn radius settings and ensure that the computed turn calculations are realistic
- complete the route and ensure all schedule information is correct
- save the route and prepare it for the Master's approval.

4.2.3 Route Checking

It is critical to note that the route check function will only detect certain 'danger to navigation' parameters that have been detected within the XTD of the planned route and that they will only be detected on ENCs. This means that the system will not detect dangers on RNCs unless a mariner-added object with a danger attribute

associated with it has been detected within the XTD. The route check is, therefore, not an infallible safety check and it will be necessary to check the entire route at compilation scale as a final safety check.

Routes should be routinely checked as follows:

- During and on completion of route planning
- after a route has been modified
- after any charts used by a route have been updated
- during the Master's approval of the route.

The route is checked automatically for presence of the following groups of dangers to navigation within the zone limited by the XTD (the parameters that the ECDIS uses to identify hazards and dangers must be known by the operator):

- Safety Depth
- Safety Contour
- Isolated Dangers to navigation
- saved and loaded objects with danger attribute associated in user charts/mariner-added objects/ mariners' notes/additional information.

The following are considerations when conducting the route checking phase (not exhaustive):

- Select ENC as the chart priority, select custom display and configure the display so that all navigation dangers may be viewed
- ensure that all area alerts are configured appropriately
- ensure that there are adequate XTD/XTE/channel limit/corridor and safety margins (if available) for each leg of the route to take into account the availability of navigable water, expected traffic, likely deviations and collision avoidance
- use the route check function to automatically check the route
- cycle through the generated alarms and view each in turn, editing the route as necessary
- once all alarms have been checked and verified, check the route in its entirety on compilation scale by manually scrolling along it, taking care where ENCs overlap and where dangers lie close beside route XTD. This is necessary because the automatic scan will not look for dangers outside the XTD and may not detect dangers where ENCs overlap
- add relevant user charts and notes
- double check distance, ETD, ETA and tidal constraints
- print route information as necessary
- save the route
- obtain the Master's approval of the route. Note that the route can only be approved once all alarms have been accepted and the route saved
- record approval
- ensure both the route and schedule are uploaded into all ECDIS units
- create a bridge notebook as necessary
- if updates are installed prior to sailing or during the execution of the route, ensure that the route is checked again as updates may affect it
- activate the route prior to departure.

If the check does not result in any detected dangers, it is likely that an appropriate value has not been set for XTD and that area alerts have not been configured. In such circumstances, set the values as required and check the route again.

Voyage notes and supplementary information to aid in the execution of the route should be added using the user charts/mariner-added objects. If there is a requirement for an alarm to sound when additional information is detected by the look-ahead area during monitoring of the route, then a danger attribute must be associated with the object. To ensure that inserted data is positioned correctly, the operator must ensure that data is inserted on the same scale chart that the operator will be using to monitor the route. User chart/ mariner-added object files that are relevant to the active route should be saved with an appropriate filename and linked to the route.

Examples of the type of supplementary information that may be applicable are as follows:

- Planned changes to Safety Depth, Safety Contours, Deep and Shallow Contour values
- ship's routeing and reporting systems with instructions
- changes in IALA maritime buoyage
- weather concerns and measures to be taken (safe care of cargoes and personnel)
- information relevant to international regulations, codes and guidelines (eg MARPOL)
- abort points and contingencies
- pilotage obligations with reporting points, rendezvous (including marine declarations of health and requirements of the international health regulations)
- applications of the safety management system (SMS)
- areas of special interest or concern, such as piracy measures to be taken during day or night.

4.2.4 Importing and Exporting

Once a route has been prepared, it can be saved and used again or uploaded and used in another ECDIS. In the case of multiple systems connected by LAN, data such as routes, user chart and manual updates should be transferred between systems to keep all systems in an identical state. It is recommended that all voyage plans are backed up on external media. When transferring data between ECDIS units or external sources, ensure that cyber security policies are followed.

It is becoming common practice for ships to share route information. However, it is essential when utilising an imported route that the entire passage plan is subjected to a comprehensive check.

4.3 Execution

The following are considerations when conducting the execution phase (not exhaustive):

- When ETD is confirmed, actual ETA at each waypoint can now be determined
- ETA at each point allows tidal predictions
- latest AIO, navigation warnings and NTMs applied
- safety settings reconfirmed
- final route checks before activating passage plan
- conduct final pre-sailing checks, as recommended in Section 9.2.

4.4 Monitoring

The following are considerations when conducting the monitoring phase (not exhaustive):

- Display the most relevant panel for execution, such as route monitoring
- ensure appropriate configuration of safety alarms (look-ahead, Safety Depth, Safety Contour, etc)
- follow the route and know the XTD in case of deviation
- manually review the passage plan ahead to check for any voyage notes or dangers for the duration of the watch
- check weather forecasts and any effect on the plan
- monitor NAVTEX and navigation warnings, plotting relevant information manually as required (if not done automatically) and checking the route as necessary to see if affected
- at all times, be aware of the nearest danger to navigation
- monitor the status of all sensors and their accuracy
- determine the accuracy of the primary positioning fixing system (GNSS) using all available means, including visual references, RIO, parallel indices, visual and radar fixes and astronomical observation
- check waypoint ETAs
- frequently cross-check against all other navigation aids
- always be vigilant to any hazards or dangers not previously identified in the passage plan. It may be necessary to dynamically adapt the passage plan and anomalies should be reported to the Master immediately.

4.4.1 Cross-Checking ECDIS Position

The ECDIS operator should make full use of route information overlay (RIO) checks (if available) and should take manual ECDIS fixes when possible to check the accuracy of the primary GNSS against all other means. An assessment of the validity of the ECDIS position should be made by comparing the own ship past track display history against manual ECDIS fixes. The ECDIS operator should regularly assess, at an appropriate interval, whether a discrepancy exists. The offset EBL/VRM should be used to measure the fix's range and direction from the track time-mark. Where doubt or a discrepancy exists, it should be reported to the Master. The result of the cross-check fixes should be recorded as these are now subject to external inspection and verification. Irrespective of the method of recording, ships should keep records of cross-check fixes for as long as the flag State requires.

When applying operator fixes, the following should be understood:

- ECDIS operator fixes may not be displayed if the ship's track or position events are not displayed
- ECDIS operator fixes will not affect the ship position if GNSS is set as the primary position input
- when DR/EP mode is the primary position input, accepted operator fixes will determine the ship position. Therefore, it is important that the operator fix is checked for accuracy prior to accepting the position.

The recommended intervals for checking the accuracy of GNSS in ocean navigation and coastal navigation are:

- During ocean navigation, cross-check fixes should be conducted where available
- during coastal navigation, RIO alignment check with the coastline should be continuous where available. The frequency of further cross-check fixes will increase as appropriate for the prevailing conditions and the navigational situation.

During ocean navigation, the following methods should be used to cross-check the ECDIS position:

- Verify the primary ship track against the secondary ship track and monitor for divergence between the tracks, verifying their positions at each check fix
- the primary method of cross-check fixes should be by radar fix using RIO, if available and within range
- celestial can still be added as a manual fix.

During coastal navigation, the following methods should be used to cross-check the ECDIS position:

- Ensure the ship progresses as planned using relative navigation techniques, including but not limited to radar ranges, visual bearings, PIs and echo sounders
- the primary method of cross-checking fixes should be RIO, where available.

Methods of maintaining records of cross-check fixes include:

- ECDIS integrated playback (ECDIS operators must be aware of the length of time for which their system will store these records)
- ECDIS integrated logbook
- past track display
- deck logbook (the deck logbook entry must have sufficient information to present a faithful replica of the voyage, including evidence by means other than GNSS to verify the position)
- cross-check fixes marked on a mariner-added object layer
- ECDIS screenshots/printouts.

4.4.2 Use of Radar Information Overlay (RIO)

When using RIO during ocean or coastal navigation, the RIO should be available to check fixes and at any other times when required by the OOW. The RIO should be set at an appropriate colour and transparency to enable an assessment of correlation between the coastline and the RIO without causing excessive clutter or covering safety critical information.

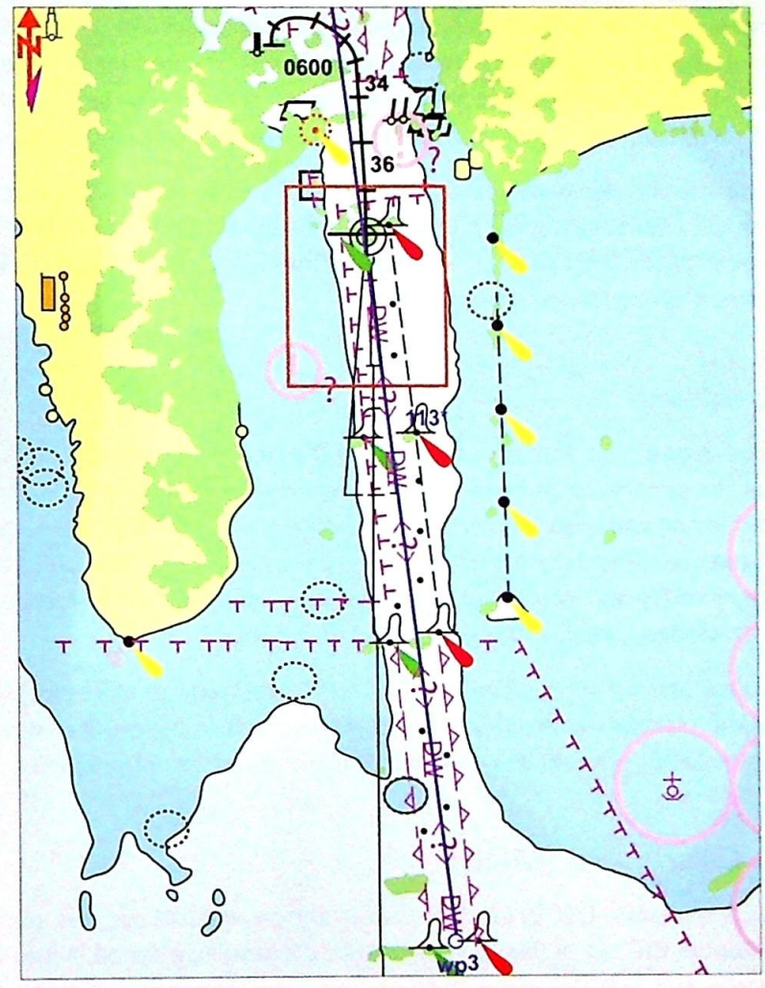
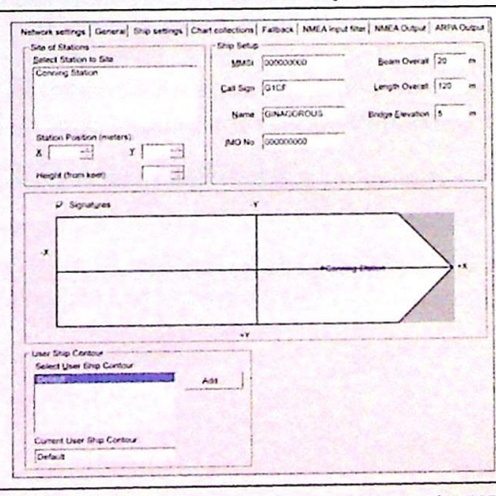
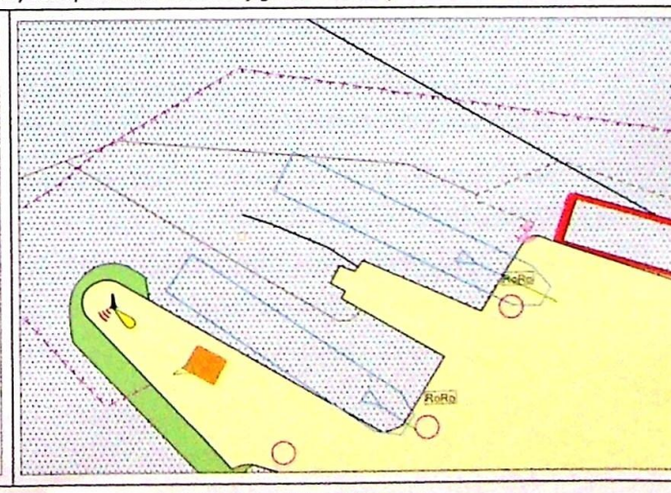


Figure 4.6 – Possible angular rotation shows incorrect alignment

While the buoys appear to be out of position, they are actually in the correct charted position. RIO misalignment may be the first indication of an error in ECDIS set-up. Further investigation is required. In this instance, the common consistent reference Point (CCRP) set-up had not been configured correctly.





Figures 4.7 and 4.8 – The ECDIS operator should be aware of the CCRP set-up page

This shows the parameters entered at the initial set-up of ECDIS. The ECDIS operator should take note of these settings when contacting manufacturers.

4.5 ECDIS Safety Functions

ECDIS safety settings must be configured correctly to ensure that charted objects are identified by the ECDIS as dangers or hazards to navigation. These parameters are referred to as chart alert parameters and are set by the ECDIS operator.

The ship Safety Depth, own ship look-ahead, chart alert parameters, navigation parameters, optimisation parameters and other safety functions in ECDIS are essential to ensure the ship's navigational safety. If configured correctly, they will alarm to warn the ECDIS operator that the ship is approaching shallow waters or other hazards to navigation so that timely action can be taken to avoid them. The ECDIS operator is required to acknowledge, interrogate and understand all alarms, warnings and cautions.

To maximise the efficiency of these safety functions, standard procedures for setting them should be developed, incorporating the guidance in this section. It must be noted that, when conducting route planning, the Safety Depth and Safety Contour values may differ at various stages of the voyage and this must be considered during the planning phase.

4.5.1 Look-Ahead

The look-ahead area is intended for setting the size of the area that will be used for the chart data analysis and for the generation of the anti-grounding alarms, alarm alerts and navigational alarms. The trigger points for alarms and warnings are defined by a look-ahead projected ahead, stern, port and starboard of the ship. When calculating and configuring the size of the look-ahead area, consideration must be given to the size, manoeuvrability and location of the vessel. The look-ahead area must be sufficient to allow the ECDIS operator to acknowledge, assess and take appropriate action.

The Master should only modify or adapt look-ahead settings after careful risk assessment. Should it be necessary to modify look-ahead settings, for example in the event of deviation from the passage plan or in an emergency, these should be made with the authorisation of the Master.

4.5.2 Man Overboard (MOB)

The man overboard (MOB) function is available on all ECDIS systems and all ECDIS operators must be competent in the use of this function on the equipment installed. Activating the MOB function creates a reference point in ECDIS and a constant range and bearing from the ship is provided. If the MOB is not being tracked visually, ECDIS should be used to direct the lookout bearing, although the position of the MOB may not take into account set and drift. Any time delay between the MOB entering the water and activation of the MOB marker should be established as quickly as possible and some systems may allow the ECDIS operator to apply this offset to the MOB marker.

If visual contact has been lost and a significant delay in activating the ship's MOB marker has occurred, the ECDIS operator should estimate the likely position of the MOB against the primary ship track history.

Note that the MOB function may not provide a prediction of set and drift and so tidal information must be known to the ECDIS operator.

When a MOB is reported after an unknown interval, the ECDIS operator should be familiar with, and may wish to utilise, the search and rescue (SAR) functionality on ECDIS.

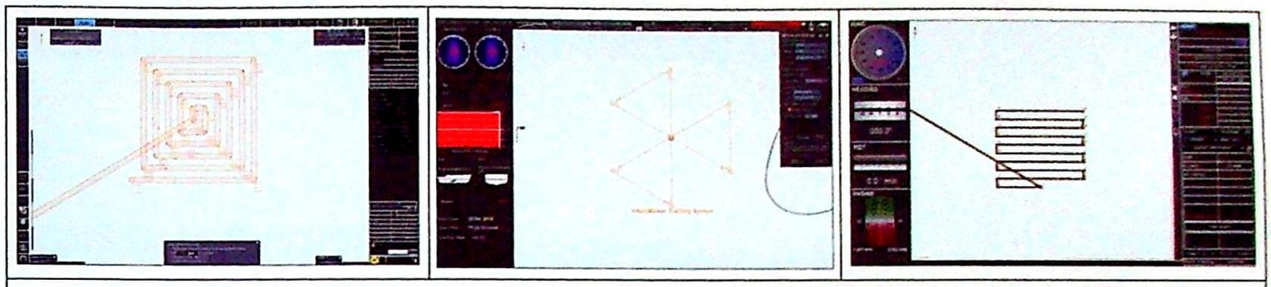


Figure 4.9 – Automatic SAR patterns displayed on FURUNO, Sperry and Transas

4.5.3 Predictor

The Path Predictor function, if available, may be used when necessary, but as it is based on speed over ground, course over ground and rate of turn, it is only a guide and does not replace the need to verify progress of turns by visual means.

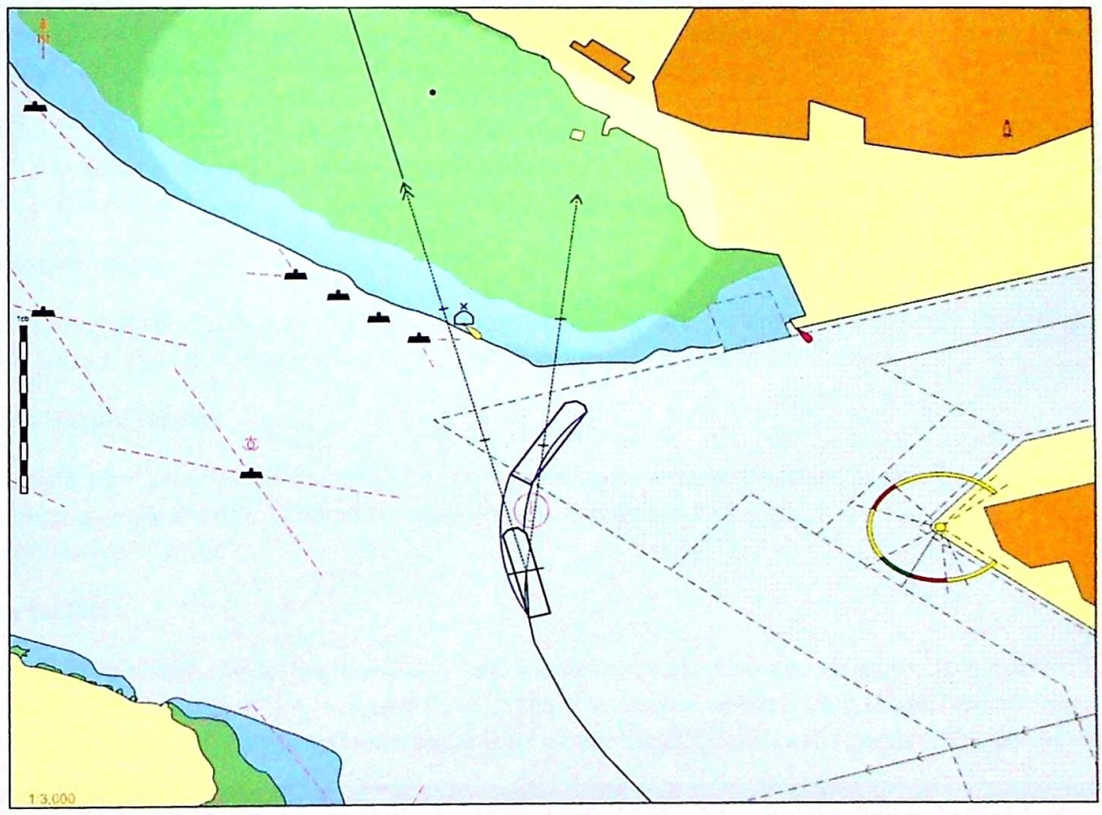


Figure 4.10 – An example of Path Predictor

4.5.4 Anchor Watch Planning

When planning anchorages, the distance between the anchor and the CCRP (stem to standard distance) should be used to establish the position of the CCRP at the moment of letting go. This let go position is also the final waypoint of the anchorage leg.

The Anchor Watch feature checks to see whether the ship is drifting when it should be at rest.

5 Administration and Records

5.1 ECDIS Data Recording

The ECDIS records voyage related items such as movement and position of own ship and dangerous radar targets (from radar). In accordance with IMO Resolution MSC.232(82), ECDIS should store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours. The IMO Resolution does not specify what these elements must be. This creates variation between manufacturers and it is, therefore, incumbent upon the ECDIS operator to understand what their particular make and model records.

ECDIS automatically records voyage data during use, the settings for which should be configured to provide as comprehensive a picture as possible of the past track of the ship. Navigational data should never be played back on an ECDIS at the same time as it is being used for route monitoring.

Since 2014, it has been a requirement that the ship's voyage data recorder (VDR) should record the ECDIS display in use at the time as the primary means of navigation. The recording method should be such that, on playback, it is possible to present a faithful replica of the entire display.

Further Explanation

It is important that the ECDIS operator can demonstrate both on-screen 'past track' (usually 12 hours) and the 'playback' (also known as replay, record or log) facility (usually a minimum of 90 days).

On-screen History Display

"ECDIS should store and be able to reproduce certain minimum elements required to reconstruct the navigation and verify the official database used during the previous 12 hours."
IMO Resolution MSC.232(82)

Playback Facility

In addition to the above, the software will also have the ability to playback the voyage. It is important to note that on several systems this is not reviewed through the main menus or even from the ECDIS software itself. On some systems, it is a separate software application where the ECDIS software needs to be closed first.

A significant number of reports have found that ECDIS operators are not able to show inspectors the history of the ship via the playback options. It is vital that ECDIS operators and Masters know the menu for their system's playback and its time limitations in order to provide this information during inspection.

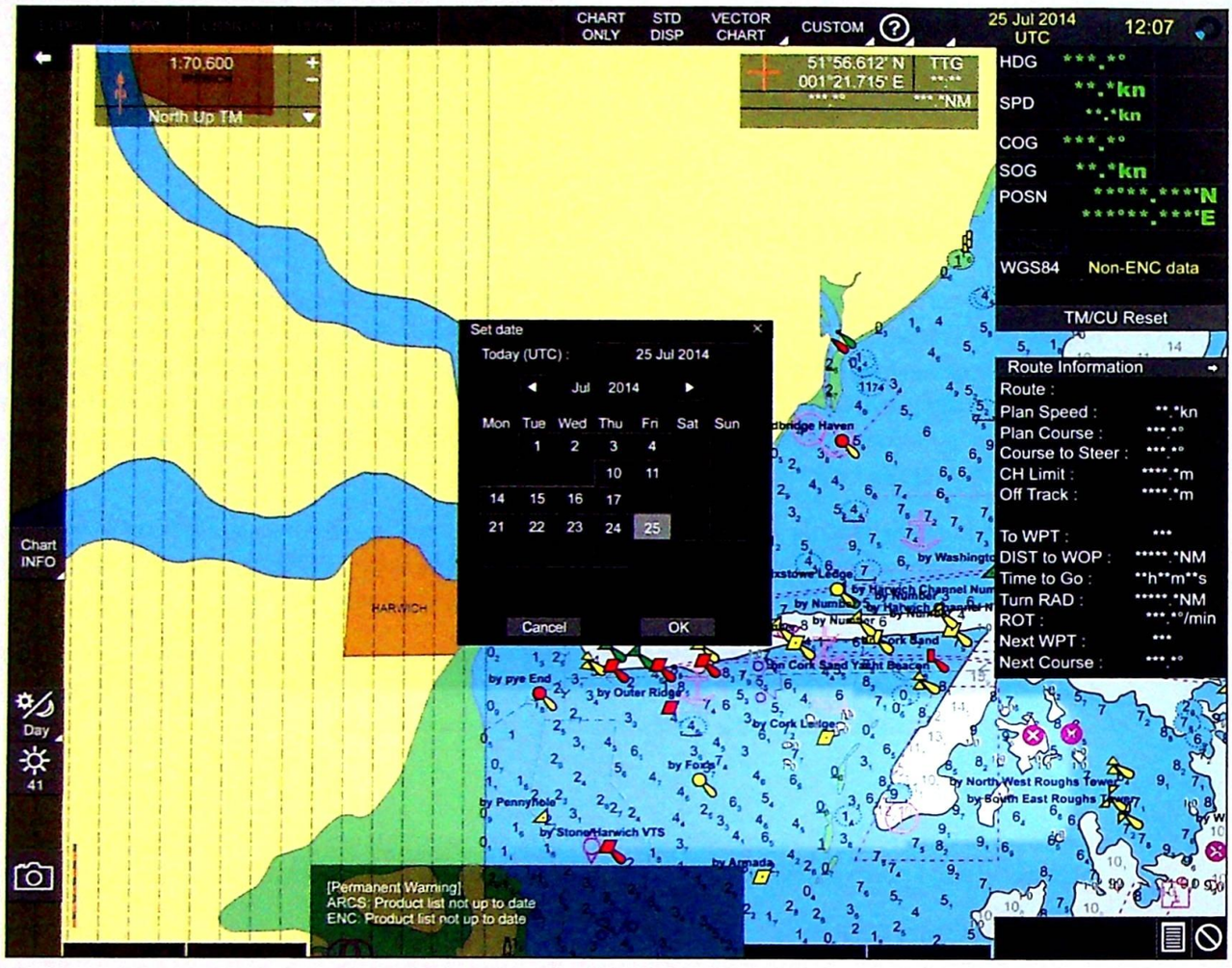


Figure 5.1 – Visual playback option on FURUNO FMD
(The playback option is where you can set a specific date or time, often with the option to play at high speed, and is usually available for 90 days and, in some cases, up to one year)

5.2 Backup Procedure

The ECDIS operator is responsible for backing up routes, user charts, mariner-added objects, manual corrections, logbook and other relevant ECDIS data. This serves to release storage space on the ECDIS and to provide a readily available record in the event of ECDIS failure, loss of data or inadvertent deletion of data. If necessary, create a backup copy of ECDIS logs on a USB memory device or external hard drive, ensuring adherence to any cyber security policies in force.

5.3 Records and Documentation

ECDIS carriage and training regulations require ships to provide evidence of compliance, particularly for Port State Control (PSC) inspections. It is likely that the following documentation must be available for inspection (this list is not exhaustive):

- Type approved documentation stating ECDIS complies with IMO performance standards
- documented evidence of 30 minutes UPS per ECDIS
- type approved documentation stating ECDIS backup complies with IMO performance standards
- generic ECDIS training certification, as per flag State requirements
- Type Specific training certification under the terms of the ISM Code and the ship's relevant flag State (method of training/approval to be determined by relevant flag State).

It must also be ensured that:

- ENC and RNC data used for the intended voyage are from the latest official editions
- the ECDIS is being updated properly and a system for updating electronic charts is in place from an official electronic chart supplier
- the onboard SMS has been updated to incorporate ECDIS training and familiarisation requirements, including ECDIS maintenance procedures.

It is recommended that the following manual records are maintained by ECDIS operators:

- Chart correction log for the APC, if required
- record of chart spot-checks on all systems (example in Annex A)
- record of manual updates (example in Annex B)
- record of chart updates installed on all systems (example in Annex C)
- receipt and installation of any new licences or permits
- receipt and loading of any new cells.

6 Known Charting Issues, Support and Solutions

6.1 ENC Scales and Known Issues

All units are to carry an outfit of up to date electronic charts that provide adequate coverage of the intended operating area at an appropriate scale. Official chart data, derived from government authorised Hydrographic Offices, is to be used for safe navigation. Official chart data is to include Electronic Navigational Charts (ENC) and may also include Raster Navigational Charts (RNC) and official paper charts. If utilising RNCs for navigation then ECDIS must be in Raster Chart Display System (RCDS) mode and an appropriate portfolio of paper charts (APC) is to be carried in line with IMO Circular 207, '*Differences between RCDS and ECDIS*', or as required by the individual flag State.

Where possible, an ENC must be used. However, when operating in areas without ENC coverage, RNCs or paper charts must be used.

It should be noted that the best scale chart available in ECDIS may be an RNC, if such data is installed, and so the ECDIS operator must be fully aware of the requirements and limitations of RCDS mode.

The requirements for an APC are stated in IMO Circular MSC.1/Circ.1503/Rev.1, '*ECDIS – Guidance for Good Practice*', which has revoked and replaced several ECDIS related circulars. However, the IMO does not define the word 'appropriate' and does not specify the size or content of the portfolio. This is the responsibility of the flag State, and the ECDIS operator must be fully aware of the requirements of their flag.

All ECDIS are to be kept fully up to date. This includes ENC updates, Notices to Mariners (NTM), Temporary and Preliminary Notices to Mariners (T&Ps), Navigation Warnings and manually applied updates in the form of manual corrections.

The scale of an ENC cell has a direct link to the object data available to the user. The appreciation of ENC scales available worldwide, and subsequent loading of them into the ship's system prior to planning, is vitally important to ensure details are not missed or running into an area without appropriate charts. In the worst case, misunderstanding could lead to navigation being attempted on a chart that is not of an appropriate scale and does not show all the dangers. To aid in the identification of scales, vector charts are labelled according to their intended use. It would be inappropriate to enter a port on a small scale chart in the same way as if it were paper. Unless operating in 'pay as you sail', with access to every chart at all times, the navigator must still pay close attention to the ship's future programme and ensure permits are obtained before planning, otherwise dangers may well be missed in an initial port assessment. Even if you are using 'pay as you sail', you must still ensure you have the best scale charts available.

The ship faces a risk of a serious incident if approaching a berth on a scale 2 ENC and simply zooming in. Scale 5 must be installed and loaded.

ENC cells are currently split into six different scale categories (each having a range of scale within them):

1. Overview
2. General
3. Coastal
4. Approach
5. Harbour
6. Berthing.

Each ENC is identified by an 8 character identifier, eg FR501050. The first two characters indicate the producer, eg FR for France, GB for Great Britain. The third character (a number from 1 to 6) indicates the navigational purpose band. The last five characters are alphanumeric and provide a unique identifier.

For example ENC cell number GB50202 M would mean:

UKHO authorised = (GB)
Harbour scale ENC = (5)
Cell or chart number = 0202 M

A complete list of producer codes is included in the IHO standard S-62.

The ECDIS operator should be able to either see the 8 character identifier on the screen or interrogate the chart to see what scale band they are navigating on, ensuring it is the 'best scale'.

Compilation Scale Issues

Navigational Purpose	Code	IHO Recommended Scale Ranges	NOAA Compilation Scales
Overview	1	< 1:1,499,999	1:5,120,000 1:2,560,000
General	2	1:350,000 – 1:1,499,999	1:1,280,000 1:640,000
Coastal	3	1:90,000 – 1:349,000	1:320,000 1:160,000
Approach	4	1:22,000 – 1:89,999	1:80,000 1:40,000
Harbour	5	1:5,001 – 1:21,999	1:20,000 1:10,000
Berthing	6	≥ 1:5,000	1:5,000 1:2,500

Table 6.1 – Usage bands, IHO recommended scale ranges and NOAA compilation scales

It is important for the ECDIS operator to understand that S-57 does not define both minimum and maximum compilation scales. Therefore, as each country produces ENC charts, they may produce different scales for coastal, general, etc. This would mean that even though the ECDIS operator has selected best scale, or compilation scale, the chart may appear to suddenly zoom in or out as the ship crosses between production boundaries.

This will also impact any ECDIS connected to an integrated bridge system keyboard (in terms of zooming in and out by range scale), as discussed in Section 6.3.

Navigational Purpose	Compilation Scales	Height (°)	Width Zone I (°)	NOAA Zone II (°)	NOAA Zone III (°)
Overview	1:5,120,000 1:2,560,000	19.2	19.2	38.4	76.8
General	1:1,280,000 1:640,000	4.8	4.8	9.6	19.2
Coastal	1:320,000 1:160,000	1.2	1.2	2.4	4.8
Approach	1:80,000 1:40,000	0.3	0.3	0.6	1.2
Harbour	1:20,000 1:10,000	0.075	0.075	0.15	0.3

Table 6.2 – The minimum and maximum compilation scales

Scale 6 Berthing Charts

Figures 6.1 and 6.2 show how the area North of the Isle of Wight and South of Southampton in the UK looks at a Scale 5 and 6 ENC. The top image of each figure shows the chart underscale, so you can see a clear outline of the 'amount of water' covered in each scale. The lower image of each figure shows the level of detail given by each scale.

It is important to understand that the 'best scale' for ENC that should be used to replace the harbour paper chart is Scale 5. Ships may face Port State Control (PSC) observations if not using best scale as described in SOLAS Chapter 5 and, therefore, should carry an adequate folio of Scale 5 for the harbours they visit. Scale 6 is beyond best scale and ideal for large harbours or a harbour with a significant number of features that need to be taken into account when passage planning or berth planning.

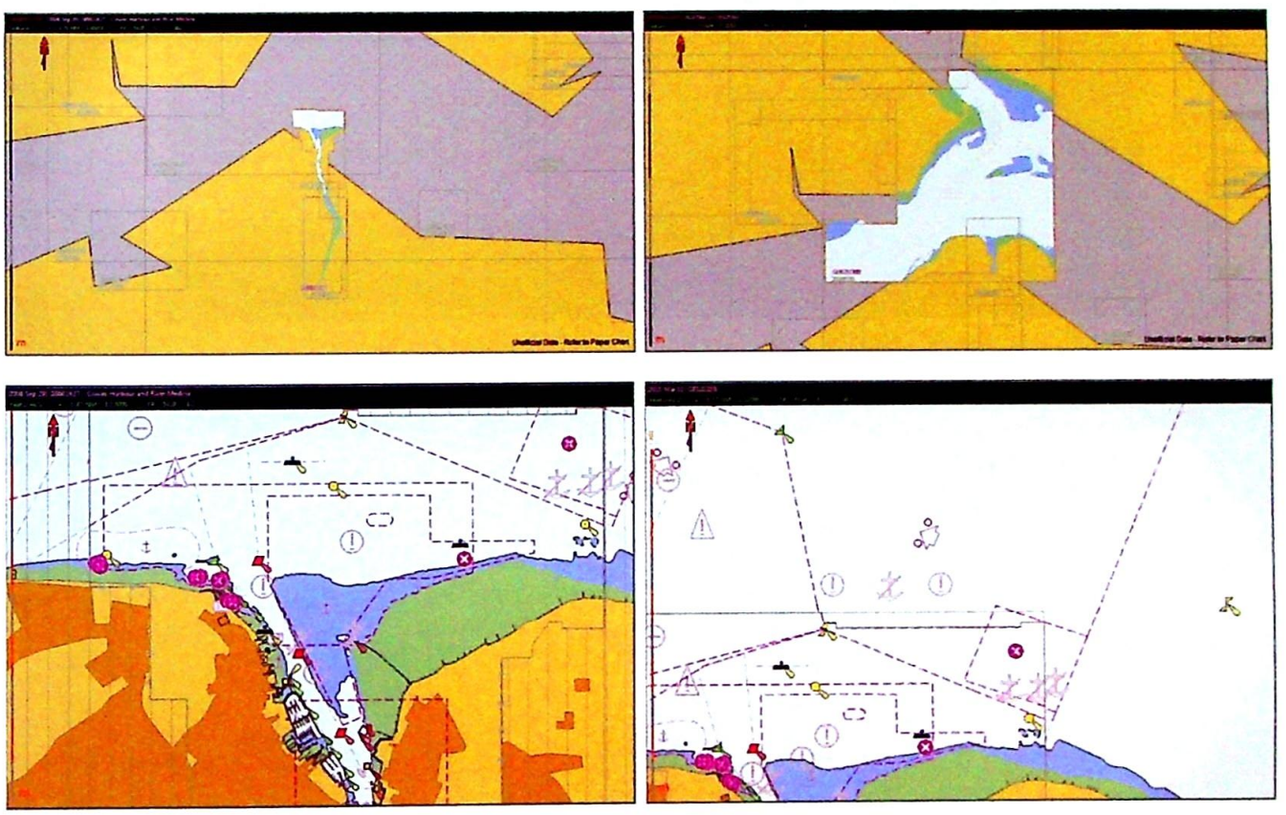


Figure 6.1 – Left images show Scale 6 ENC at underscale (above) and optimum (below)
Figure 6.2 – Shows equivalent on Scale 5 ENC

Display Accuracy

It is important to understand that most ENCs have been created using historical survey data or scanned from paper charts. The only known Hydrographic Office that will only produce ENCs if a recent survey has been conducted is Australia, while other Hydrographic Offices will use historical data. When producing the paper chart, the cartographer may have created a theoretical line of 'no real thickness'. When rendered into an ENC, the cartographer faces the issue of where to place the ENC contour.

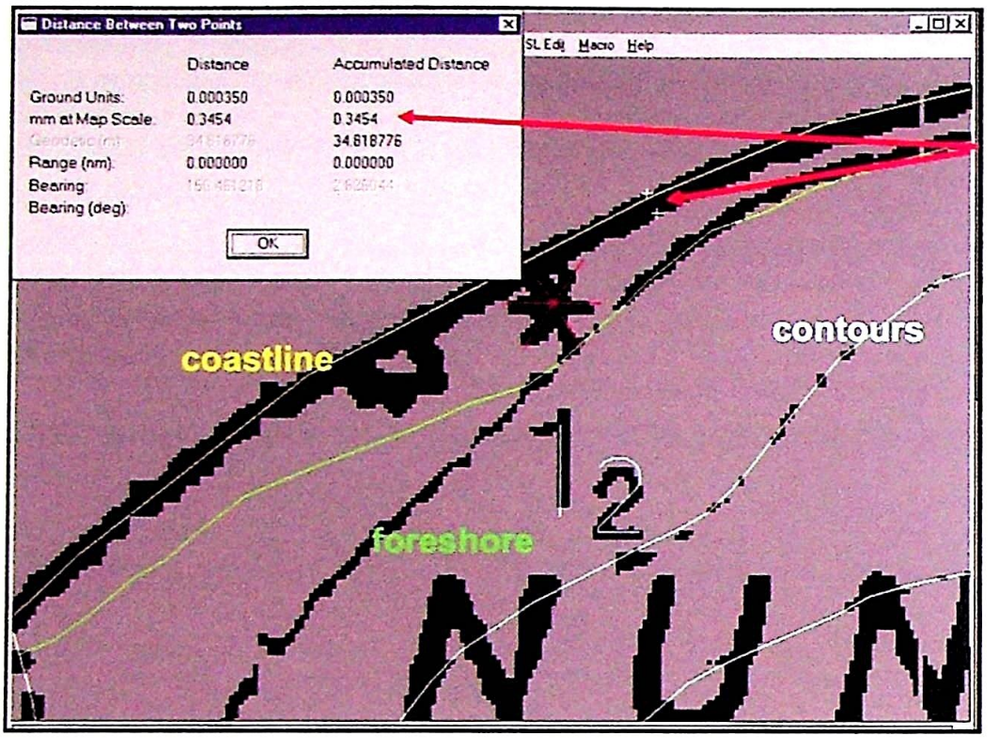


Figure 6.3 – In this example, 0.34 mm displayed at 1:100,000 = 34 m

This can create confusion on board for ships using contours to navigate, or basing anchorage areas on contoured water.

6.2 Datum

For an ENC to be authorised, it must accurately be referred to WGS 84.

"MSC.232(82) 7.3 ECDIS and added navigational information should use a common reference system. If this is not the case, an indication should be provided."

The 2017 *'Kea Trader'* grounding highlighted that the ENC chart in use stated: "this chart cannot be accurately referred to horizontal datum; see caution message".

It is also important to note that vertical datum varies by ENC producer. For example, the UK uses lowest astronomical tide (LAT), while Germany uses MLWS.

All charted depths are relative to chart datum (CD), which is usually the LAT.

Although there is no fully implemented global standard at this time, the IHO recommends that CD should be set at the depth of water when the LAT occurs. However, this is currently not the case worldwide, so operators must check the ENC in use.

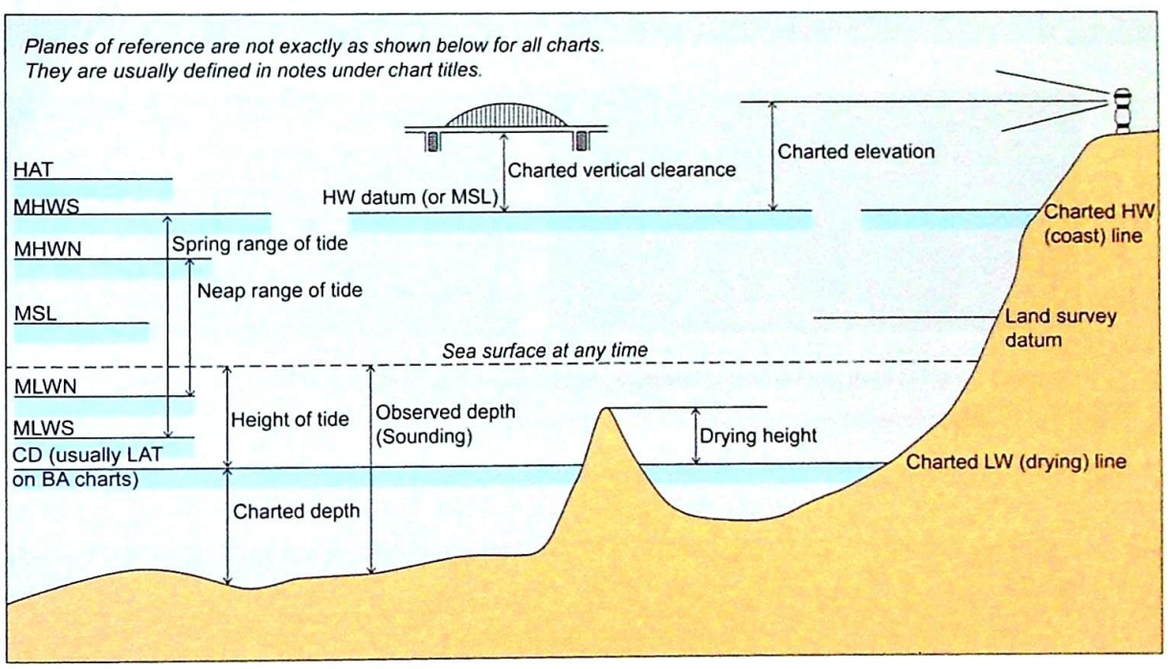


Figure 6.4 – Vertical references (UKHO Chart 5011)

In cases of differing CDs between neighbouring States, such as in the Baltic Sea where neighbouring Germany uses mean low water springs (MLWS), contour lines may not intersect where there is a slight difference in references. The only way to manage this is to be aware of the issue. If in doubt as to the source, monitor and apply greater safety margins until the situation is understood.

It is also important to appreciate that depths less than those of LAT may occur during negative storm surges and from barometric pressure effects.

It is important that the ECDIS operator understands both the horizontal and vertical datum in use.

6.3 Potential Issues with Integrated Bridge System Keyboards

When looking at both keyboards, and menus structures used in ECDIS, there may be an issue in range versus scale. Default settings are at 3 NM for ECDIS. Generally the default range for radar is 6 NM, although this is currently not an issue nor is likely to be an issue with RIO (see Section 4.4.2 of this Guide).

Figure 6.5 – ECDIS keyboards as part of integrated bridges with 'range in and out' buttons, and an example of range versus scale in a menu structure

The keyboard or menus structure actually 'ranges up and down' may become in issue and require software changes. Many ECDIS systems adjust either range or scale to suit the ECDIS operator's preference.

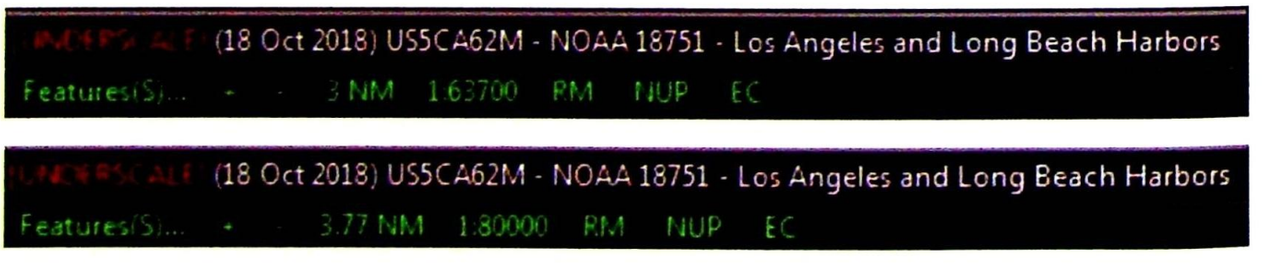


Figure 6.6 – Example of how an ECDIS operator can 'range in or out' by either range or scale with the system adjusting to suit. S-Mode will standardise integration into other bridge equipment, which may require software changes

It is important for the ECDIS operator to fully understand if they are navigating by 'range' or 'scale' as this may also affect SCAMIN settings.

6.4 SCAMIN – Known System Issues

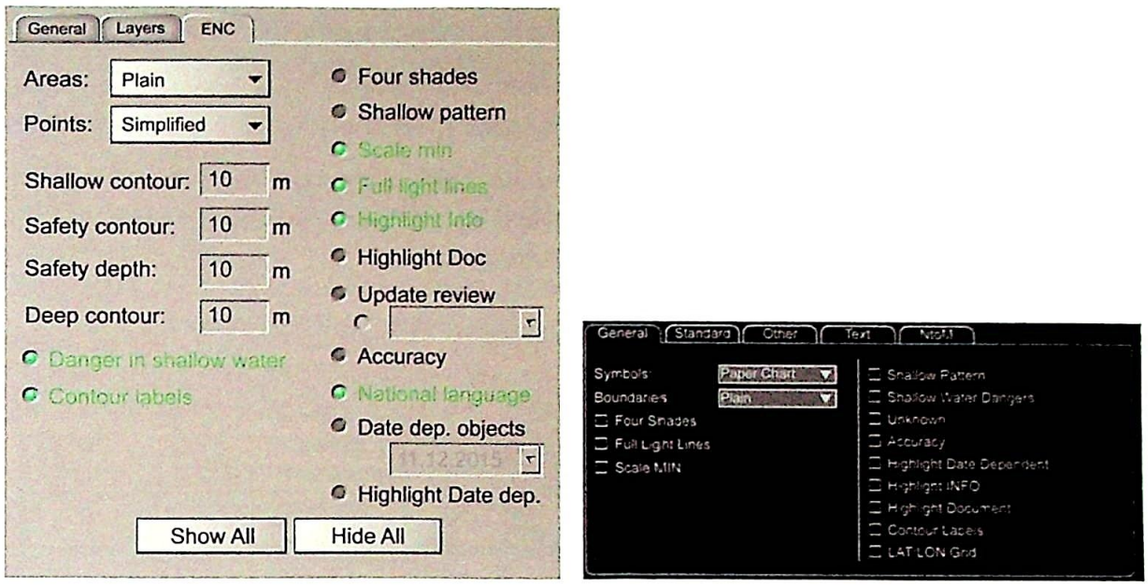


Figure 6.7 – Left: Transas
Right: FURUNO. It is important to know where the option is and the advantages/disadvantages of it being used

If the filter is disabled, information will continue to be displayed on the screen when zooming out. This has the advantage of ECDIS operators being able to view all the charted objects selected for display, but the hidden disadvantage that the system will try to process significantly more information. This may become a problem as older hardware struggles to 'process' the amount of data on the screen.

When zooming out slowly, with the filter off, the ECDIS operator can often spot that the chart is 'slowing down' in its ability to display information. The potential danger is when the ECDIS operator quickly 'zooms out' by selecting a very small scale chart in the dropdown options to 'zoom out' in several steps.

If the Master and ECDIS operators are concerned about the system slowing down, or even 'crashing', the SCAMIN filter should be routinely left on. In such situations, the option to turn it off should be reserved for where the ECDIS operator wants to see more chart than the recommended compilation scale when navigating (eg to temporarily increase spatial awareness and see more of the ENC). Significant 'zooming out' beyond the recommended compilation scale for prolonged periods, or navigating on an underscale chart, is not only dangerous, but may affect the stability of the system.

6.5 SCAMAX – Known System Issues

Significant discussion and documentation has been produced on the dangers of SCAMIN. However, the dangers or SCAMAX (scale maximum) are just as important but often overlooked.

The ECDIS operator should be aware of the dangerous effect of overscale or SCAMAX on the display near 'Isolated Dangers'.

'Zooming in' over the recommended compilation scale (1:1) affects the charted position of the object, mainly due to how the computer can process the S-52 charted objects.

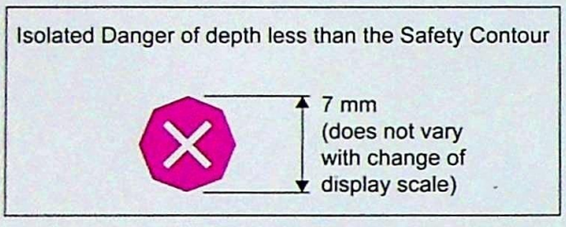


Figure 6.8 – Regardless of scale, the Isolated Danger is approximately 7 mm in size

When the ENC is displayed at the correct compilation, there is increased situational awareness and the danger presented by an Isolated Danger is more visually apparent.

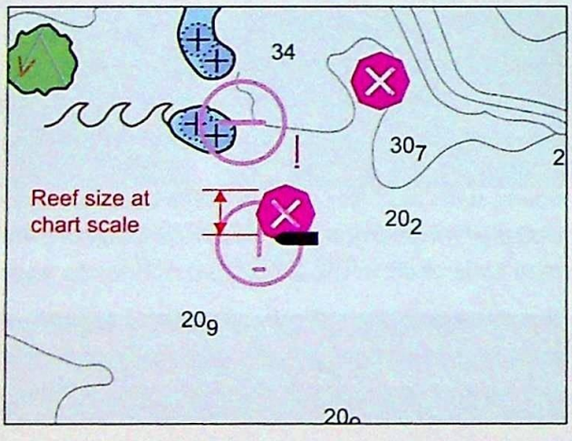


Figure 6.9 – ENC at correct compilation scale – notice no 'jail bars'

However, when zooming in, or navigating on an overscale chart, the ship appears to be away from the Isolated Danger.

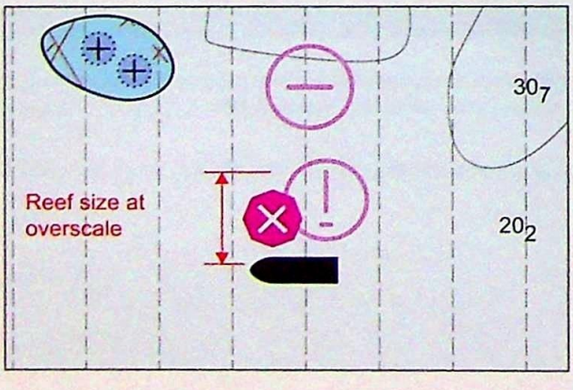


Figure 6.10 – ENC viewed beyond SCAMAX (zoomed in too far). Notice the 'jail bars' for overscale rather than the usual 'underscale' use of jail bars

6.6 CATZOC – Understanding the Importance of Both Horizontal and Vertical Reliability

The creation of CATZOC is based not just on vertical assessments of reliability, but also positional accuracy (horizontal) and seafloor coverage.

An indication of horizontal accuracy is just as important as vertical. When a ship plans a passage over areas of rated C, D or U (as shown in Table 6.3), they are accepting that Isolated Dangers and soundings may be up to 500 m horizontally from the charted sounding position and that the depth may potentially be ±2.5 m vertically from the charted depth, so potential impact on UKC must also be considered.

When navigating in an area of CATZOC C, D or U, consideration should be given to not only vertical predictions of navigable water, but also the horizontal assessment of charted data.

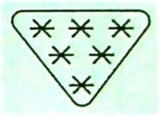
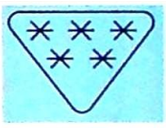
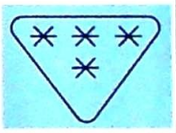
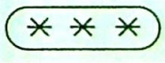
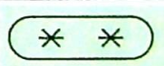
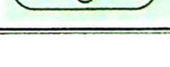
1	2	3		4	5	6
ZOC 1	Position Accuracy	Depth Accuracy		Seafloor Coverage	Typical Survey Characteristics	CATZOC Symbol
A1	± 5m	= 0.05 + 1%d		Full area search undertaken. Significant seafloor features detected and depths measured.	Controlled, systematic survey high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.	
		Depth (m)	Accuracy (m)			
		10	± 0.6			
		30	± 0.8			
		100	± 1.5			
		1000	± 10.5			
A2	± 20m	= 1.00 + 2%d		Full area search undertaken. Significant seafloor features detected and depths measured.	Controlled, systematic survey achieving position and depth accuracy less then ZOC A1 and using a modern survey echosounder and a sonar or mechanical sweep system.	
		Depth (m)	Accuracy (m)			
		10	± 1.2			
		30	± 1.6			
		100	± 3.0			
		1000	± 21.0			
B	± 50m	= 1.00 + 2%d		Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies then ZOC A2, using a modern survey echosounder but no sonar or mechanical sweep system.	
		Depth (m)	Accuracy (m)			
		10	± 1.2			
		30	± 1.6			
		100	± 3.0			
		1000	± 21.0			
C	± 500m	= 2.00 + 5%d		Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.	
		Depth (m)	Accuracy (m)			
		10	± 2.5			
		30	± 3.5			
		100	± 7.0			
		1000	± 52.0			
D	Worse Than ZOC C	Worse Than ZOC C		Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.	
U	Unassessed - The quality of the bathymetric data has yet to be assessed					

Table 6.3 – CATZOC

All ECDIS operators should be familiar with the CATZOC table when appraising the chart and the quality of the ENC. Some manufacturers may refer to this as 'M-Qual'

The allocation of a CATZOC indicates that particular data meets minimum criteria for position and depth accuracy and seafloor coverage defined in this table. CATZOC categories reflect a charting standard and not just a hydrographic survey standard. Depth and position accuracies specified for each CATZOC category refer to the errors of the final depicted soundings and include not only survey errors, but also other errors introduced in the chart production process.

It is essential that all ECDIS operators review CATZOCs for their next passage or voyage (similar to how source data diagrams are reviewed on an RNC or paper chart). If the ship is to pass over an area of low reliability, where large depth anomalies are expected, UKC and/or safe speed may need to be adjusted for that part of the passage.

Swept areas, where the clearance depth is accurately known but the actual seabed depth is not accurately known, may be accorded a 'higher' CATZOC (ie A1 or A2) provided that position and depth accuracies of the swept depth meet the criteria in the table.

Controlled, systematic surveys (CATZOC A1, A2 and B) are surveys along planned survey lines, on a geodetic datum that can be transformed to WGS 84.

Accuracy of positions may not have been rigorously calculated for CATZOCs B, C and D, but may have been estimated based on type of equipment, calibration regime, historical accuracy, etc.

It is recommended that the CATZOC table is posted near the ECDIS for ease of reference. There are three main ways of viewing and checking CATZOC values on an ENC:

1. Select All/Other SENC display, which includes CATZOC diagrams.
2. Choose to show CATZOC diagrams within the user's own customised SENC display.
3. Interrogate the area or use 'pick report' and scroll down to find source data and the CATZOC value.

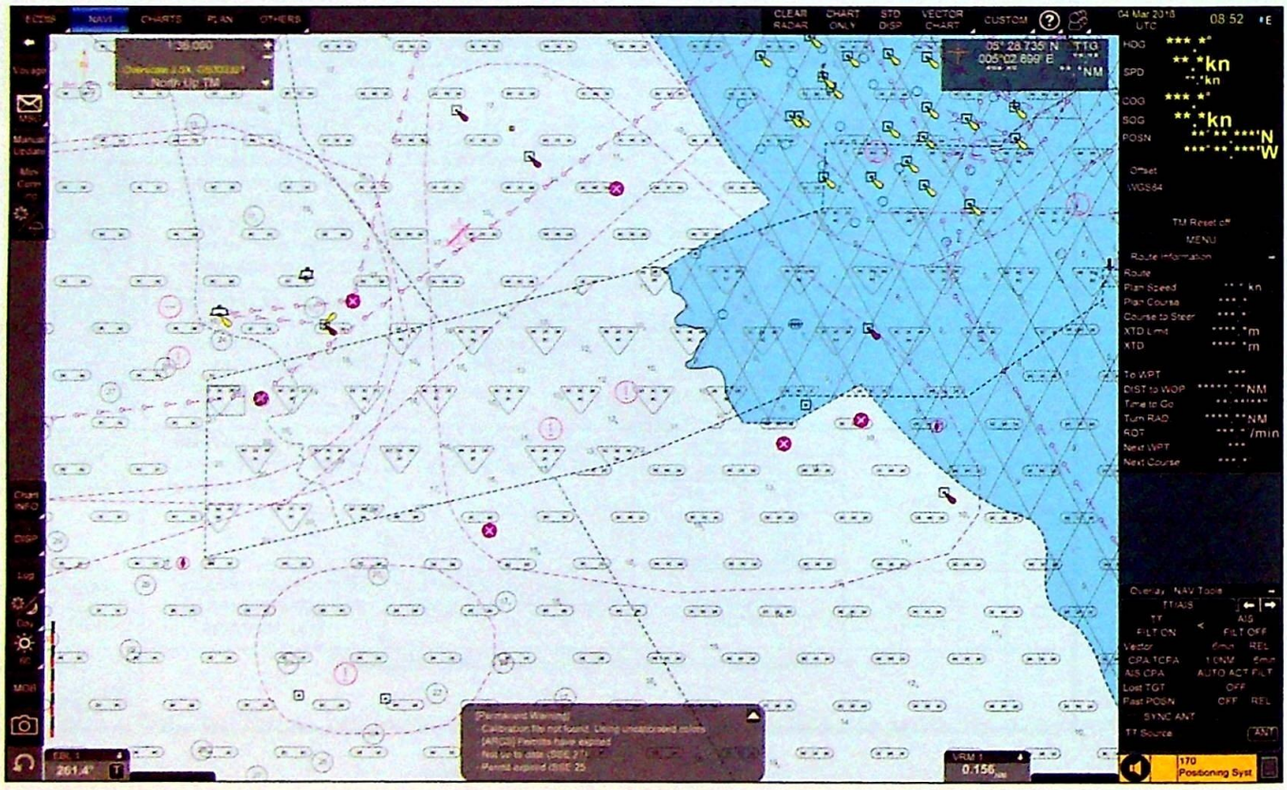


Figure 6.11 – Without the CATZOC layer displayed, the ECDIS operator may assume the quality of the ENC is uniform throughout the passage planned area

Within confined waters such as harbours or anchorage areas, the Pilot or Harbour Master may advise that higher accuracy surveys have been conducted that allow for smaller under-keel clearances. This will allow the ship to deviate from the default CATZOC advice.

Without 'local' advice, additional under keel safety margins should not be assumed.

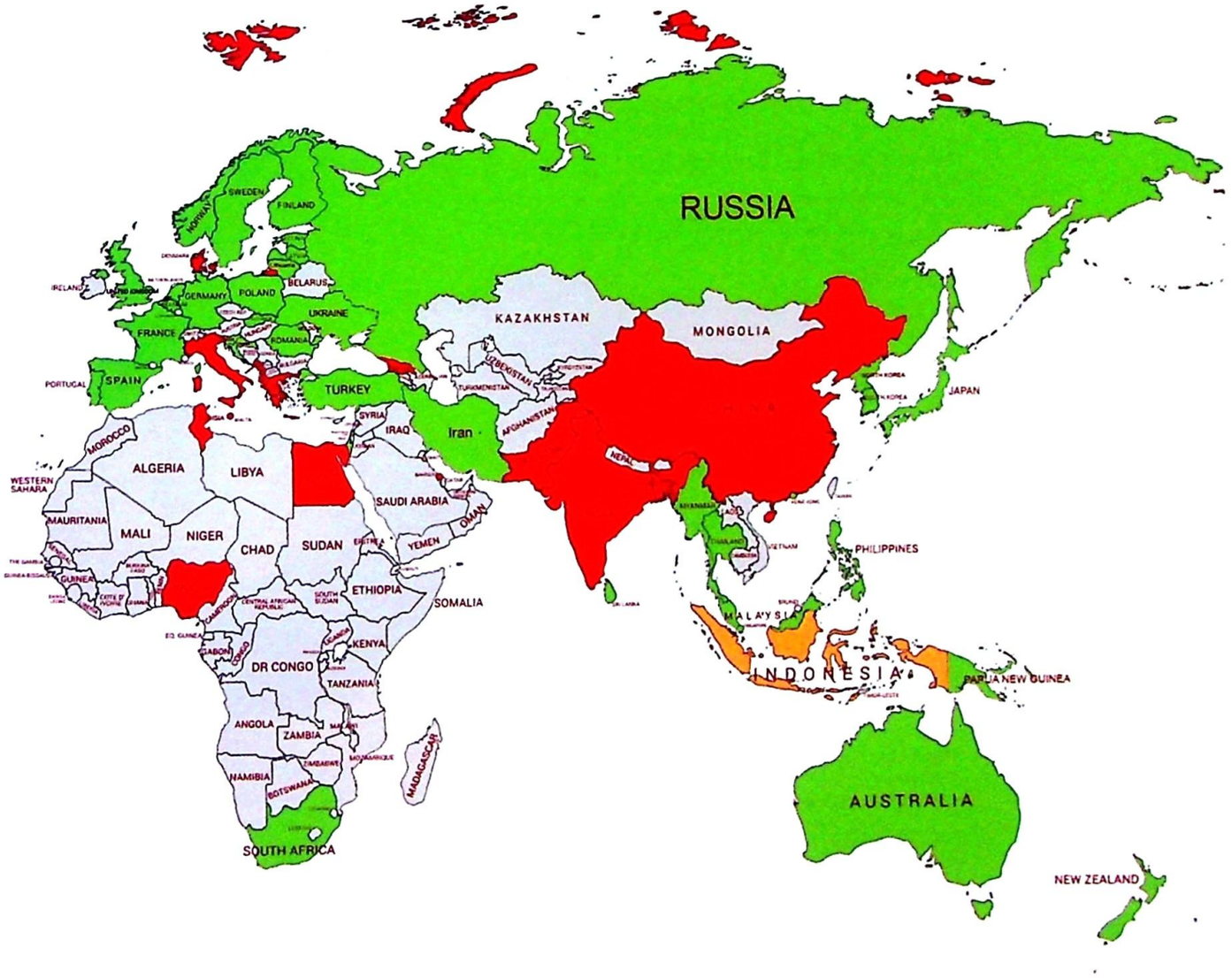
6.7 T&P Update Status by Country in 2021

Not all National Hydrographic Offices issue Temporary and Preliminary (T&P) notices with their weekly ENC updates, so they cannot be relied upon to automatically update the ENC. In such areas, local Notice to Mariners (NMs) must be plotted manually.

The map below shows countries that were not updating ENCs weekly in 2021. An up to date list can be found at the UKHO website.

Green – Yes
Red – No
Yellow – Yes to bands 6 to 3, No to bands 2 and 1
Grey – Data not available (ensure updates are completed manually by all available means)

Data Assessment Notes are attached to all ENCs where the UKHO's ENC Assessment programme has identified a navigationally significant difference between the ENC and the equivalent Admiralty paper chart. When highlighted, individually or in Folios, cells with Notes are hatched. Remember that only continuously updated data allows for safe navigation. ENC cells require updating to include details published in paper chart NMs. These are in two forms: Chart Correcting NMs and T&P NMs. Updating must be completed within a rigid timescale for ENC cells that have been issued to customers.



6.8 The Admiralty Information Overlay (AIO) Version 2

The AIO contains additional information that is considered navigationally significant and may affect a voyage. This information should be referred to when planning a passage and may also be temporarily displayed during route monitoring. When planning a passage, it is normal to review all charts (and therefore ENCs) that are expected to be used. When these charts are reviewed the Overlay should be turned on and any features that could affect the planned route should be investigated. Those features that are significant for the planned passage should be marked using Mariner's Navigation Objects, which can be displayed by the ECDIS when navigating. Sufficient information should be attached to the Mariner's Navigation Objects to inform the navigator of the action to be taken when they are encountered on passage. ENCs without AIO only have access to 40% of T&Ps.

The AIO is updated weekly and is part of the AVCS Weekly Update. A new edition of AIO is issued twice a year. Updates can either be downloaded from the UKHO website or requested via a base DVD.

According to the UKHO, the quick reference guide to compatible ECDIS systems with AIO version 2 in 2020 is:

✓	Danelec Marine ECDIS DM800 G2
✓	eGlobe G2
✓	Furuno FEA
✓	Furuno FMD
✗	iXblue Gecdis-C
✓	JRC JAN-701B/901B/2000
✗	JRC JAN-7201/9201
✗	Kelvin Hughes Manta Digital ZM ECDIS
✓	Kongsberg K-Bridge
✓	OSI
✓	PC MARITIME NAVMASTER ECDIS
✗	Raytheon Anschutz ECDIS NX
✗	Raytheon Anschutz Synapsis ECDIS
✓	SAM Electronics Chartpilot 1100
✓	SAM Platinum
✗	SIMRAD Maris ECDIS900 System
✓	Sperry VisionMaster FT
✓	TECDIS
✓	Tokyo Keiki
✓	Totem ECDIS
✓	Wärtsilä (Transas)

Live updates of compatibility are available at: **https://www.admiralty.co.uk/digital-services/digital-charts/admiralty-vector-chart-service**

The AIO is a digital dataset that is designed to be displayed over ENCs in ECDIS and other chart display systems to provide additional information to the navigator. It contains all Admiralty T&Ps and NMs and provides additional preliminary information that is specific to ENCs, such as reported navigational hazards that have been incorporated on paper charts but that have not yet been included in ENCs.

The Overlay is designed to be displayed on top of a standard ECDIS chart display and can be switched on and off without changing the underlying chart. Only those features relevant to the chart in use are displayed. As the user zooms in or out, the ECDIS will automatically select charts of a suitable scale and the Overlay features

relevant to the selected charts will be displayed. For example, a temporary NM that applies only to a large scale chart will not be displayed when smaller scale charts of the same area are being used.

All Admiralty T&P NMs that are in force are included in the Overlay. Each NM is displayed as a simple red polygon (usually rectangular) with red hatched fill which indicates the area affected by the NM. Each NM carries the same NM number that is used in the Admiralty Notices to Mariners Bulletin. The full text of the NM is included as an associated text file which can be displayed by selecting the 'Temporary Notice to Mariners' or 'Preliminary Notice to Mariners' feature in the ECDIS Pick Report. Any associated diagrams can also be viewed through the Pick Report.

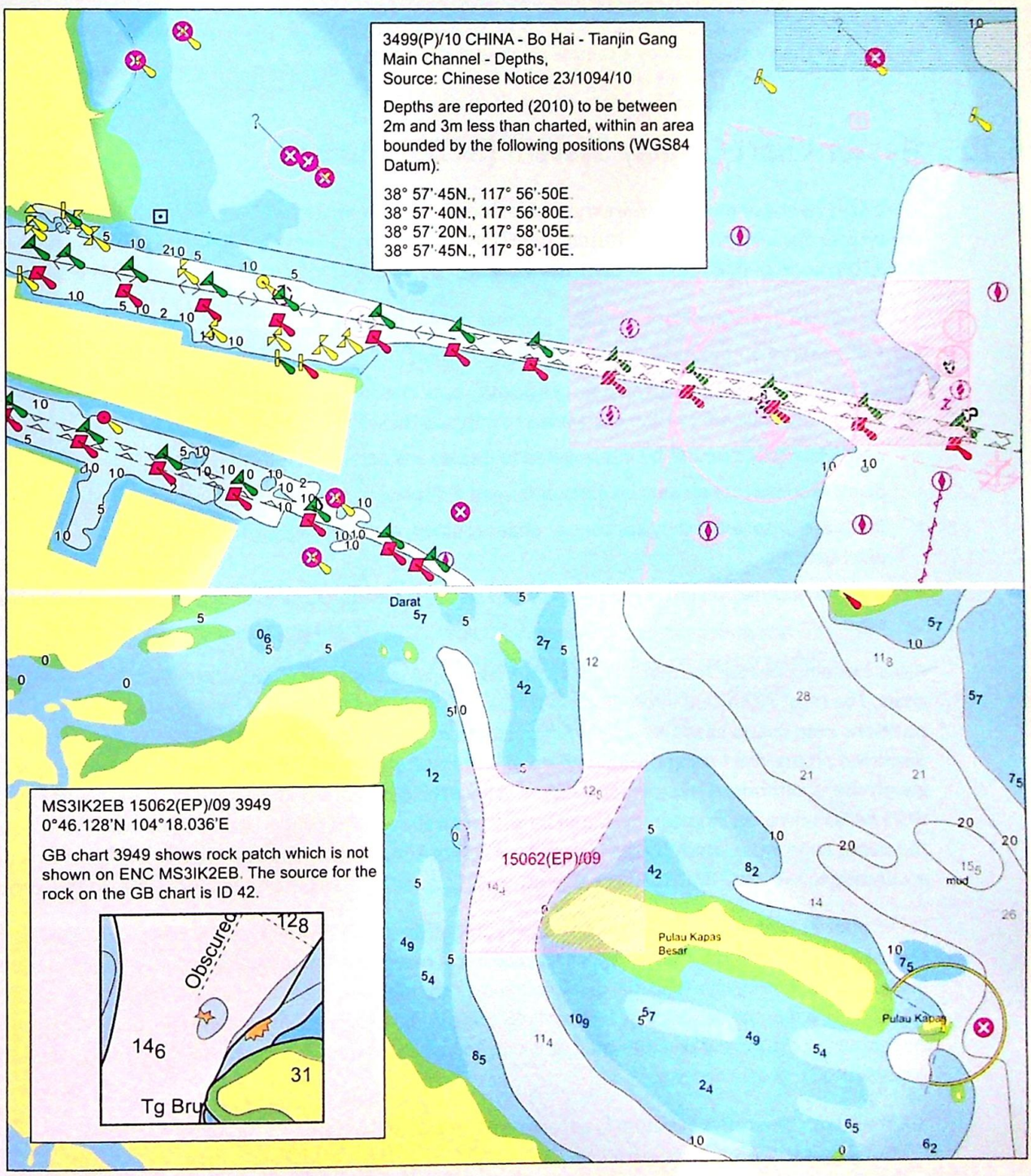


Figure 6.12 – Example of AIO V2 Overlay on an ENC

6.9 Chart Spot-Checks

Recent inspections and audits have revealed a widespread belief within the industry that all Hydrographic Offices update their ENCs weekly, which is not the case. It is, therefore, highly likely that a ship passing through multiple regions will need to manually plot some corrections and warnings received from NAVTEX or any other source.

It is recommended that Masters use spot-check (visual verification) procedures to verify that the corrections have been plotted.

Annex A of this Guide provides a sample chart spot-check log.

6.10 Raster Chart Display System (RCDS) Mode

The ECDIS operator must be aware that, when the system has RNC as well as ENC data installed, the chart data the system displays must be prioritised. The ECDIS operator must know the limitations of the system when in the RCDS mode of operation. Of particular note are the following limitations when in RCDS mode:

- Unlike ENCs, RNCs are not seamless and may display boundaries
- RNCs cannot automatically generate Safety Contours
- an RNC cannot be interrogated for automatic route checking, although mariner-added objects with a danger attribute should activate alarms to mitigate these limitations
- objects on RNCs cannot be interrogated to display any additional information
- displayed information may be difficult to read if displayed in anything other than 'North Up'
- RNCs are distorted if they are over or under zoomed, as they are designed to be displayed at a specific pixel density
- charted information displayed on RNCs may be more difficult to view unless the 'day bright' palette is used.

RNCs contain a header file that includes some additional information over and above that shown on a paper chart. The most significant information in the header file is the datum shift needed for the plotting of WGS 84 positions onto charts based on another datum. Datum shifts can be applied to WGS 84 positions and directly displayed on the chart using the shift appropriate to that area and chart, as determined by the relevant government authorised Hydrographic Office. Where the difference between the local horizontal datum and WGS 84 is known, an adjustment should be automatically applied by the ECDIS. If the horizontal datum of the paper chart from which the RNC is produced is not known, then it is not possible to relate GPS positions accurately to the RNC. IMO Safety of Navigation 1, Circular 255, was issued to alert users to this problem.

ECDIS operates in WGS 84 datum and automatically offsets charts with other horizontal datums so that they are displayed to the user in WGS 84. However, in cases where the original charted datum is uncertain or unknown, shifting charts to match correct known positions is possible by offsetting GNSS manually. Conducting a manual datum shift is potentially dangerous, is always subject to errors of unknown magnitude and should not normally be attempted. It is only to be carried out with the Master's approval and after a documented risk assessment.

If a chart with an unknown datum is encountered, consider navigating in DR mode and apply manual fixes.

6.11 Deleting Charts

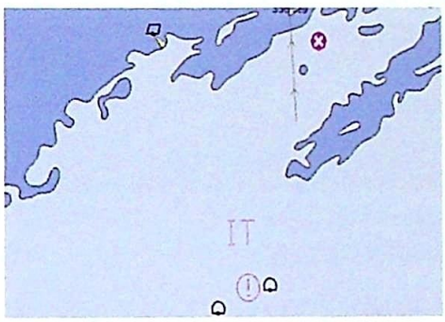
Care must be taken by ECDIS operators not to accidentally delete relevant data from the system, particularly ENC data, to ensure the continuing integrity of the ENC portfolio.

6.12 Safety Depth Concerns

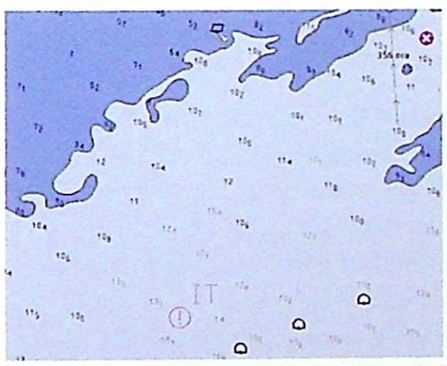
Section 1.3 of this Procedures Guide explains the changing standards from PL 3.4 to 4.0 and the impact on ECDIS operators and navigation safety. One key safety issue has been raised with regards to Isolated Dangers, which is not an 'alarm' and does not appear on the chart if settings are not correct.

Systems objects such as soundings will be shown as an Isolated Danger and will give an alert or 'alarm' status (as it used to be known) if its depth is equal to or shallower than the set Safety Contour.

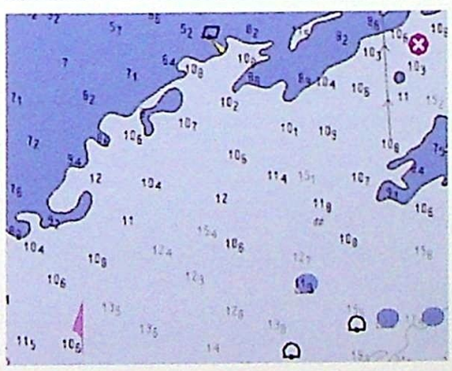
If the sounding is deeper than the set Safety Contour, it will be displayed as a regular sounding (assuming that all soundings are turned on). However, this will not produce any alerts or alarms.



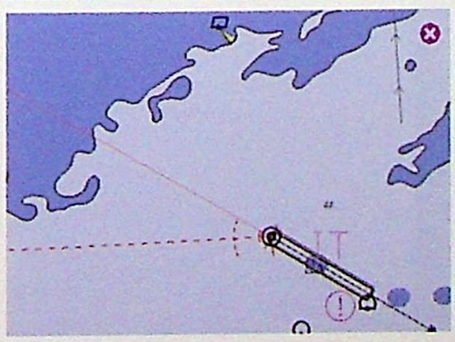
1. IMO standard presentation does not show the Isolated Danger or generate an audible alarm.



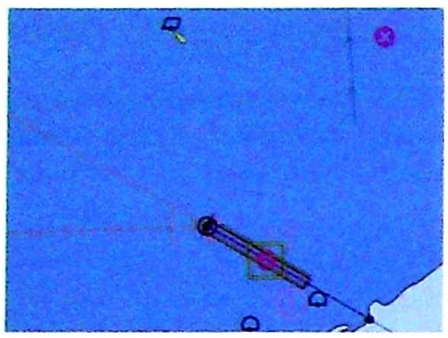
2. IMO standard with soundings turned on does not show Isolated Danger or generate an audible alarm.



3. IMO standard with both sounding and Isolated Dangers turned on but no alarm generated as Safety Contour is deeper than the isolated sounding.



4. Example of ship passing over Isolated Danger with no alarm.



5. Safety Contour is made shallower to encompass isolated sounding, which has transformed the same sounding into a magenta circle with a white cross. System now audibly alarms to alert the ECDIS operator and look-ahead turns red as seen in the image. However, alarm fatigue is now likely as the ECDIS operator is navigating within the Safety Contour.

Figure 6.13 – A worked example of the importance of both Safety Contour/Safety Depth and layer setup in trying to highlight an Isolated Danger and ensure it alarms

Alarm fatigue is a real issue with ECDIS and is discussed in Section 8.1 and Annex D. If the Safety Depth is increased to ensure a dangerous sounding becomes an Isolated Danger with associated alert parameters, then it may by default expand to the next Safety Contour. This could dramatically decrease the area of ENC 'safe navigational waters', creating unnecessary alarms.

7 ECDIS Vulnerabilities and Solutions

7.1 ECDIS Cyber Security Awareness

While an ECDIS may have a rugged case, screen and keyboard, it is fundamentally just a PC. There are exceptions where specific equipment is utilised with bespoke software and operating systems, such as Linux. However, most systems still use XP, Vista or Windows 7, all of which are operating systems that have reached 'end of life' and are no longer supported by Microsoft. As ECDIS is a computer, it requires software updates to be applied to the operating system and to the ECDIS software and charts. It is critical to ensure proper segregation from the rest of the network. While adding any operating system update carries the risk of breaching the manufacturer warranty, failing to update potentially exposes the ECDIS to cyber security vulnerabilities. ECDIS is increasingly being connected to ship networks to facilitate automatic online chart updates, integration with other bridge systems and remote maintenance. Security flaws that were not exposed in the past, because the ECDIS PC was disconnected from any network ('air-gapped'), are now potential threats.

A penetration testing exercise of multiple ECDIS brands revealed that even having dual redundant ECDIS on the bridge is no guarantee of availability. A focussed hacker will have little difficulty in compromising both ECDIS systems, particularly if they are connected to synchronise.

The ship owner/operator must ensure that ECDIS security is addressed in their SMS. The ECDIS computer should be kept in a robust locked cabinet to which only authorised ship's personnel have access. It should not be possible for other personnel (eg passengers, clients, contractors, etc) to access the system case or any of its USB or network ports. Many new ECDIS systems have USB ports on the keyboard. The ECDIS should be 'hardened' as part of the installation process. Hardening narrows the operational scope of the ECDIS so that it performs only the minimum functionality required to deliver its role as an ECDIS. This removes potential routes of entry for attackers and ensures that the ECDIS is as secure as possible. Aspects of hardening may include ensuring that administrator passwords are in place (eg not left blank) and that they are appropriately complex. Consideration should be given to either locking out (with an app blocker such as 'Microsoft AppLocker' or a physical port blocker) the use of
non-relevant applications or uninstalling them. Prior to removal or addition of any other software, it is vital to consult the manufacturer.

Ship inspectors frequently report that, despite multiple 'safe' USB charging points being made available on the bridge, crew still charge phones from the ECDIS and several security incidents have been caused by this.

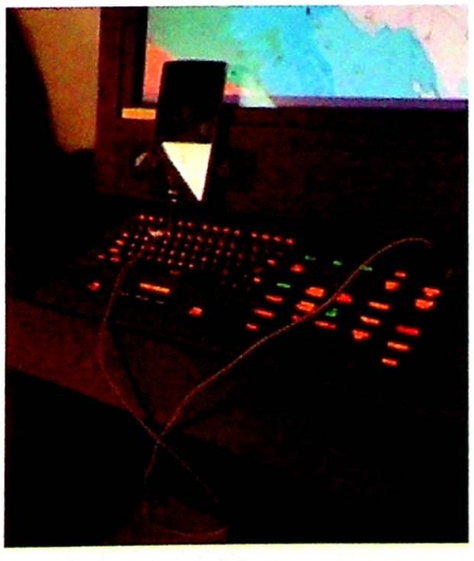


Figure 7.1 – Example of dangerous but 'common practice' by some ECDIS operators

7.2 GNSS Vulnerabilities

The risks of GNSS tampering and spoofing are well known. Numerous reports have been made regarding ships receiving incorrect position data from their GNSS receivers, often in the vicinity of military bases.

GNSS is a very weak radio signal, so jamming of the signal over an area is not difficult. It is well within the capability of an individual with some basic radio knowledge.

Spoofing of GNSS signals is somewhat more complex, requiring expensive equipment, which is why it is experienced primarily around sensitive military environments. This type of equipment is also within reach of cyber criminals.

Various studies have been carried out by maritime authorities into the practicality and detection of GNSS attacks, showing that they are a real threat. Some digital bridge systems have the capability to detect such attacks and alert the crew.

Crews should be aware of the potential for more subtle attacks. A gradually increasing error in position may be far more difficult to detect. This style of attack could be used to draw a ship into a position of danger.

GNSS data is transmitted from the above deck receiver to the various devices on the NMEA control system network that receive this input. The data is unencrypted and has the potential to be tampered with.

On most ECDIS systems there is an option to view the NMEA data via the 'COM' tab or menu. If concerned, it is worth checking the GNSS sentence is consistent.

The NMEA 0183 standard uses a simple text serial communications protocol that defines how data is transmitted in a 'sentence' from one 'talker' (transmitter) to multiple 'listeners' (receivers) at a time.

The maximum length of a sentence is 82 characters. A common NMEA sentence format is listed below:

$<talker ID><sentence ID,>parameter 1,[parameter 2],...<*checksum>

7.3 Understanding and Monitoring GNSS in ECDIS

The following NMEA GGA/GLL type sentences show how a position is plotted on your ECDIS. If concerned about the quality of the GNSS data, the ECDIS operator should review the NMEA data providing the ECDIS with a position. If the NMEA data appears to be missing a key component, or positional accuracy is of concern, the ECDIS operator should immediately inform the Master and investigate.

GGA type sentence (most common):

$GPGGA,123456,5010.001,N,00450.000,W,1,08,0.5,500,M,60,M, , ,*71

1 Talker ID ($GP)

$GP – GPS constellation
$GL – GLONASS constellation
$GN – GNSS position from both GPS and GLONASS

2 GGA – 3D fix for location, and accuracy of data (for GNSS Talker ID, letters are used):

The above example is using the following GGA data, which most ships receive:

123456 – Fix taken at 12:34:56 UTC
5010.001, N – Latitude 50 degrees 10.001' N
00450.000, W – Longitude 004 degrees 50.000' W

3 The next number shows the 'fix quality', in this case:

1 – SPS fix

This could appear as 'A' in a GNSS position. This is also very important to understand as it is referred to as the 'Fix quality'. Other numbers or letters in this part of the sentence may be:

0 or 'N' = Invalid
1 or 'A' = SPS fix – referred to as 'Standard fix' available to all GPS users
2 or 'D' = DGPS fix
3 or 'P' = PPS fix – highly accurate military position which includes velocity and timing
4 or 'R' = Real Time Kinematic (RTK) – RTK is a technique used to increase the accuracy of GPS signals by using a fixed base station which wirelessly sends out corrections to a receiver. By utilising these corrections, the position can be within 1–2 cm.
5 or 'F' = Float or Float RTK is as above, however, the algorithm used above is not considered as acceptable as fixed Base station. Using float stations could reduce any errors to 20 cm.
6 or 'E' = Estimated position ie dead reckoning (DR)
7 or 'M' = Manual input mode
8 or 'S' = Simulation mode

4 The next two digits shows the number of satellites being tracked. In this example, it is:

08 – Number of satellites being tracked

5 The next two digits show the Horizontal Dilution of Position (HDOP). In this example, it is:

**A brief table of HDOP has been added as Table 7.1 to remind ECDIS operators of its significance. For example, if the HDOP reading is over 10, the ECDIS Operator must inform the Master and consider the ECDIS position reliability as low.*

0.5 – HDOP

6 The next part of the sentence shows the altitude above mean sea level (MSL) and the height of Geoidal separation in metres, ie the difference between the earth ellipsoid surface and MSL.

Altitude above MSL. In this example:

500,M – Altitude in metres above mean sea level

7 Height of geoid in metres:

60,M – Height of geoid in metres

8 , , appears towards the end of example 7. It is two empty fields. This may show:

(empty field A) time in seconds since last DGPS update
(empty field B) DGPS station ID number

9 The last part of the sentence, as stated at the beginning of this quick reference guide, is the checksum. In this example:

***71**
Checksum (*71)

**71 – The last part of the message is undoubtably the most important. You must see the checksum. Its presence means that no errors have been introduced during the GNSS transmission. It is also a way to help verify the integrity or authenticity of the data being received.*

To verify the checksum, use an online tool such as **http://nmea.witherbydigital.co.uk**

<1 Ideal
Highest possible confidence level for precise navigation
1–2 Excellent
At this confidence level, positional measurements are considered accurate enough for standard navigation. Consideration should be taken for precise navigation (DP, automatic track control for precise berthing, etc)
2–5 Good
Represents a level that marks the minimum appropriate for plotting accurate positions
5–10 Moderate
The position provided is good as an indication, but the fix quality should still be improved. Consider reversionary fixing techniques to improve the position (LOP, contour fixing, etc)
10–20 Low
Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location
>20 Poor
At this level, measurements could be inaccurate by several hundred metres

Table 7.1 – HDOP

GLL – Only Longitude and Latitude

If receiving a GLL type sentence (instead of GGA that was shown in the previous example), the GNSS sentence will be shorter as GLL only shows latitude, longitude and time. It does not show the additional information about the satellites that a GGA sentence provides. For example, some units will not show time or HDOP in the sentence. Again, the presence of the checksum at the end is an important indication that the data is genuine.

GLL type sentence:

$GPGLL,1234.5678,N,12345.6789,W,100850.333,A,*0C

1 2 3 4

$GP | **GLL,1234.5678,N,12345.6789,W** | **,100850.333** | **,A,*0C**

1. **Talker ID ($GP)**

2. GLL –
   Much shorter than the GGA type sentence shown in the previous example, a GLL type sentence typically shows only latitude, longitude and time.

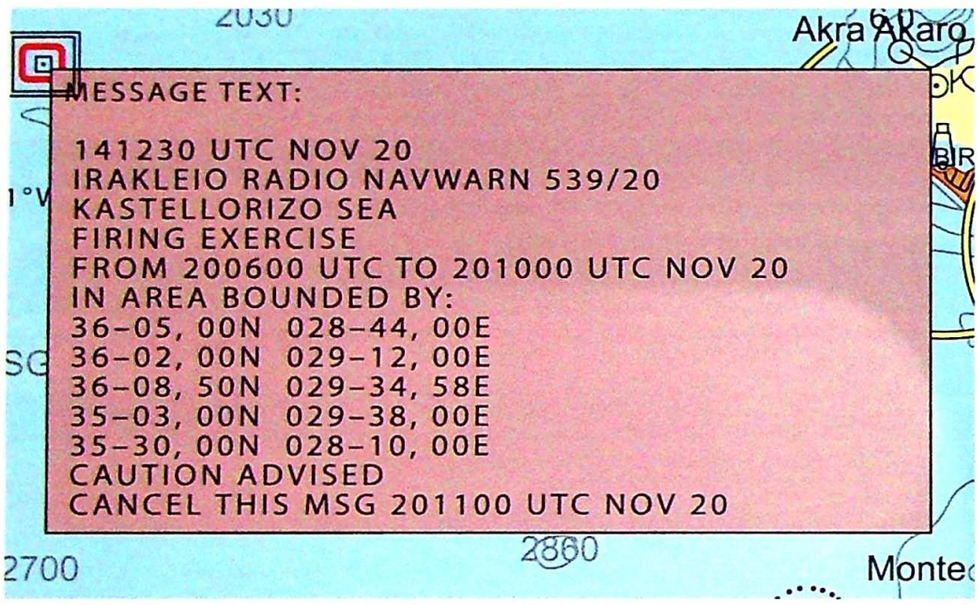
3. Time:
   '100850.333' represents the time in the form of hours, minutes, seconds and part seconds.

4. Towards the end, just before the Checksum, there is a A or V:
   A = data valid
   V = data not valid

   If using GLL, the ECDIS operator needs to see the **'A'** as well as the checksum at the end.

7.4 NAVTEX Vulnerabilities

Many ECDIS have serial inputs that can take a direct feed from the NAVTEX receiver and automatically plot the location on the electronic chart to which the message relates.



WZ 665/20	091300 UTC Jun 20	DOVER STRAIT TSS. Deep Water Route. Unexploded ordnance reported.

UK Coastal

WZ 665/20
091300 UTC Jun 20

DOVER STRAIT TSS.
Deep Water Route. Inter Bank light-buoy north-eastward.
1. Unexploded ordnance reported 51-19.31N 001-56.12E
2. Cancel WZ 523.

Figure 7.2 – NAVTEX examples

If there is any doubt as to the content and validity of a NAVTEX message, the official sender can be contacted for verification via VHF, DSC or another telecommunication method. Details of NAVTEX broadcasts are given in the ALRS Volume 3.

Sat-C NAVTEX broadcasts are also available.

In the same way as the GNSS feed should be checked, the ECDIS operator should interrogate the NAVTEX message to check the format is similar to that expected.

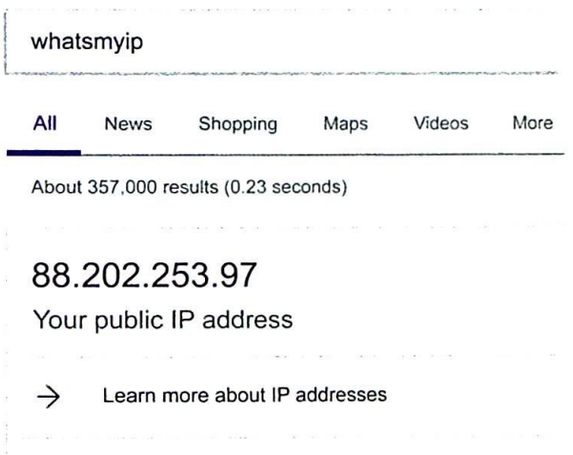
7.5 SATCOM Vulnerabilities

Some ECDIS systems are connected to the internet. If this is the case the connection must be confirmed as safe. Terminals should not be available on the public internet, which could leave them open to an attacker anywhere in the world connecting to the terminal and attempting to compromise it.

Most satellite airtime providers offer a private IP address space, so that hackers cannot reach the SATCOM system as easily over the internet. Many operators will have a VPN in place so that only the IT staff ashore can access the terminal.

There are several methods to find out if the ship's SATCOM terminals are on the public internet or not. Either connect your laptop or smartphone to the crew WiFi network or, if you have permission, use the browser installed on the ECDIS planning terminal.

Enter 'whatsmyip' on a search engine and the following will be displayed:



Then copy and paste the IP address you see into a web browser address bar, for example:

Figure 7.3 – How to find your IP address using a search engine on a web browser

If you see a page that displays a satellite terminal interface, then make a note of this. Look for the terminal vendor name (eg Cobham, KVH, Inmarsat, etc).

It is likely in this case that the terminal is available to all on the public internet. This should be reported to the Master.

If, instead, the webpage does not load or a generic error message is displayed, it is likely that the operator or airtime provider has correctly protected access to the terminal from the public internet. In this case, no further action is required.

7.6 Transferring Non-Secure Data to ECDIS and Auxiliary Equipment

ECDIS keyboards/mice/printers, etc, are likely connected via USB connectors. Most ECDIS operating systems support USBs to make the installation of the device drivers quick and easy. It is also common practice to transfer routes and ECDIS data via USB. However, there are major cyber security concerns associated with USB sticks and there are many ways that a system could be attacked via USB. Methods of attack include key loggers and USB sticks with dangerous software that is then installed onto your system.

Figure 7.4 – Key loggers are openly available for purchase online. They can be connected to the WiFi or can use their own cellular data for live 'monitoring' ashore. The first keys usually typed into any computer are its passwords

Key loggers track all use of the keyboard and store it into a log. It is worth the ECDIS operator taking time to check that none of the type approved auxiliary equipment has had key loggers attached illegally. Ships should consider installing a USB cleaning station on the bridge and limiting the number of USBs in use on navigation equipment.

7.7 Malware Passed onto ECDIS

Malware is often transferred by USB keys and there have been many reported cases of both deck and engineering systems compromised by ransomware. Smartphones are also frequent carriers of hidden malware and many inspections have reported the dangerous practice of connecting personal equipment to the ship's navigation equipment.

7.8 Virus Protection

Many ECDIS units do not have virus protection and are vulnerable to a cyber security breach. An infected ECDIS could lead to an unrecoverable failure of the system. To prevent a harmful virus infecting ECDIS, it is crucial that there is a cyber security procedure for the use of USB/CD/DVD media that is inserted into ECDIS. It is recommended that use of USBs is restricted to a single USB that is only used within the LAN. USB sticks and CDs should be virus checked prior to inserting into ECDIS. The Master is to ensure that a robust system exists and that all operators are briefed accordingly.

Only devices related to the update or backup of the ECDIS should be connected to the USB ports on the ECDIS units. No other devices should be connected.

7.9 System Updates

During ship security audits, it was discovered that many ECDIS systems are still running Windows NT, an operating system that Microsoft stopped supporting in 2004. This means that any new security flaws in the software will never be fixed.

Windows XP and Windows 7 are also commonly found on bridge systems. Even as recently as April 2018, Microsoft released 22 vulnerabilities rated as 'critical' to these operating systems. Updates to these systems must be promptly applied once notified, as otherwise hackers can quickly 'reverse engineer' the updates and work out how to exploit the security flaws.

However, not all ECDIS are based on Microsoft operating systems and a small subset use Linux based operating systems which still require updating in the same way.

It is vital that you consult the relevant ECDIS manufacturer to ascertain whether you can update the software without voiding the warranty or harming the ECDIS software itself. Amending hardware or software without first consulting the manufacturer may invalidate the system's type approval.

8 Management of Common ECDIS Operator Mistakes and Software Issues

8.1 Error and Alarm Management

PL 4.0 addresses the primary complaint of constant audible alarms. By providing clear guidance to ECDIS manufacturers on ENC objects that will raise an alarm, the IHO tackled the issue of alarm fatigue on the bridge.

Thomas Mellor, Chairman of the IHO ENC Standard Maintenance Working Group responsible for S-52 commented:

> *"One of the biggest benefits of upgrading ECDIS systems to the latest S-52 Presentation Library will be a reduction in the number of audible alarms triggered by ECDIS, helping ease the issue of alarm fatigue on the bridge, whilst still maintaining safety at sea. The introduction of an alert model, based on the requirements in the IMO ECDIS Performance Standard, will also harmonize ECDIS behaviour across different manufacturers' systems."*

It is vital that the ECDIS operator, Master and company understand that the solution to constant audible ECDIS alarms is not to simply turn the alarm off. It is also not acceptable to use the new software menus to simply reduce all alarms to warnings or indications.

An ECDIS alarms for a reason. This is either because the ECDIS operator has told it to alarm, which is called an *Operator Alarm*, or the system has detected a defect or fault, which is called a *System Alarm*. Both need careful management.

8.2 Alarm/Warning/Indicator Defect Priority Table

Annex D contains a table of possible errors and alarms that may be observed by the ECDIS operator and allows actions to be predetermined.

Column 2 lists errors and alarms and allows the ECDIS operator, the Master or the company to establish whether an alarm should be audible.

Column 4 provides an indication of the severity of an alarm.

If this table is correctly used and agreed in advance, it should allow better decision taking when a sensor failure occurs.

It is recommended that the bridge team, under the leadership of the Master, reviews the Annex table and agrees which attributes need to be alarms and which need to be indications. ECDIS must be configured appropriately for alarms and indicators.

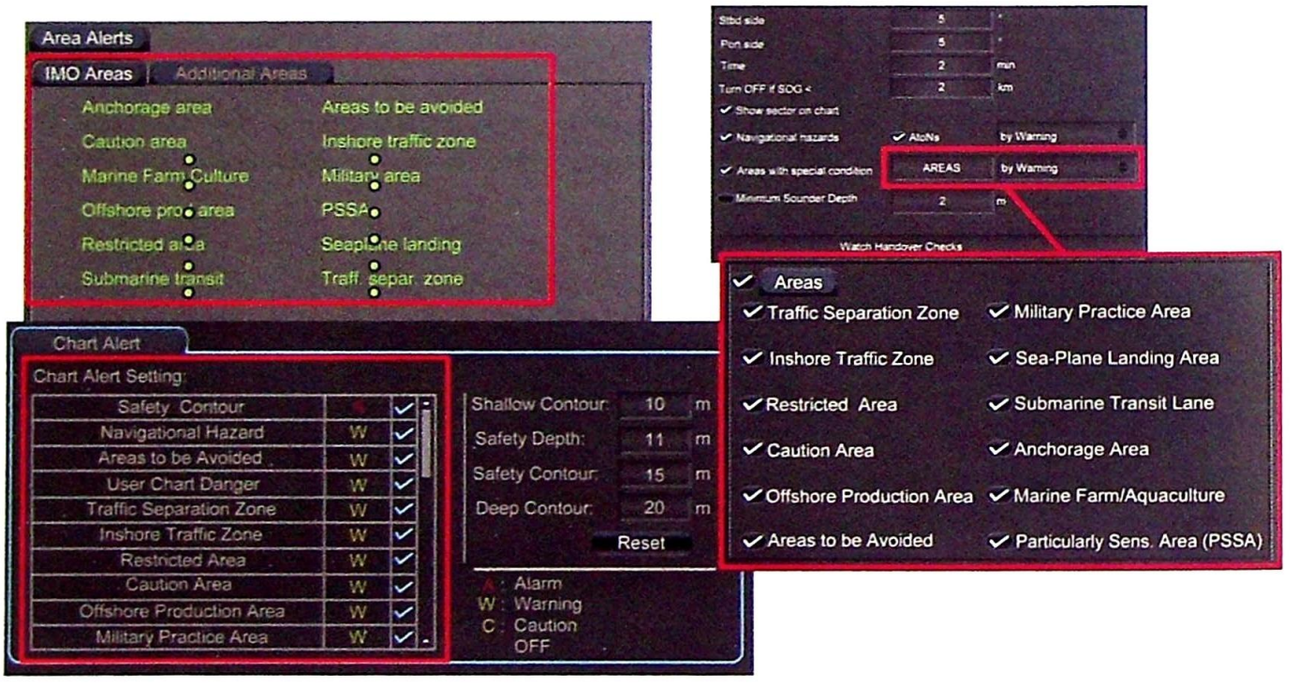


Figure 8.1 – Different ECDIS interfaces, where the ECDIS operator can change the Alert Status of each type of charted object (refer to Annex D for further details)

Definitions and guidance for alarms and indicators are provided by the IMO in Resolution A.830(19) 'Code on Alarms and Indicators', as shown below. However, ECDIS now gives the user an opportunity to 'override' when ECDIS alarms and indicates.

Requirements	Information
Alarm	Crossing safety contour
Alarm or Indication	Area with special conditions
Alarm	Deviation from route
Alarm	Positioning system failure
Alarm	Approach to critical point
Alarm	Different geodetic datum
Alarm or Indication	Malfunction of ECDIS
Indication	Default safety contour
Indication	Information overscale
Indication	Larger scale ENC available
Indication	Different reference system
Indication	No ENC available
Indication	Customised display
Indication	Route planning across safety contour
Indication	Route planning across specified area
Indication	Crossing a danger in route monitoring mode
Indication	System test failure

Table 8.1 – Extract from IMO Resolution A.830(19)

8.3 System Configuration and Maintenance

It is essential that ECDIS is configured appropriately prior to sailing and when on passage.

The ECDIS operator should ensure that the systems are configured with special regard to chart priority, sensor offsets, ship specific data and security settings.

The ECDIS operator should also ensure that all appropriate ENCs for the area of operation are installed and updated. All ENC updates are to be logged in an appropriate manner and the systems annotated with the number of the latest update installed. Following an update, a check of the intended route is to be conducted in addition to an appropriate spot-check of the entire folio of installed ENCs.

Systems configuration should be possible to reconstruct the ship's track from recorded ECDIS data.

Where ships are using both the primary and secondary ECDIS for navigation, it is recommended that each unit is configured with the same safety settings. Where two GNSS sensors are available, each ECDIS must be able to switch between the two sensors. ECDIS operators must be familiar with this function and be aware which GNSS sensor supplies which unit with position information. It is recommended that the GNSS sensor in use is changed periodically. If each ECDIS unit uses a different GNSS sensor it will allow the ECDIS operator to monitor divergence between them.

Guidance on settings and configuration of ECDIS is provided in this Guide. However, this does not affect the Master's discretion to modify safety settings as the navigational situation dictates, with suitable risk management measures and supervision in place. Deviations from standard practice are to be stated appropriately in the relevant OOW instructions or in the Master's Night Order Book.

8.4 System Sensor and Local Sensor

It is increasingly common for systems to provide an additional menu structure enabling the operator to select 'System' or 'Local' Sensors.

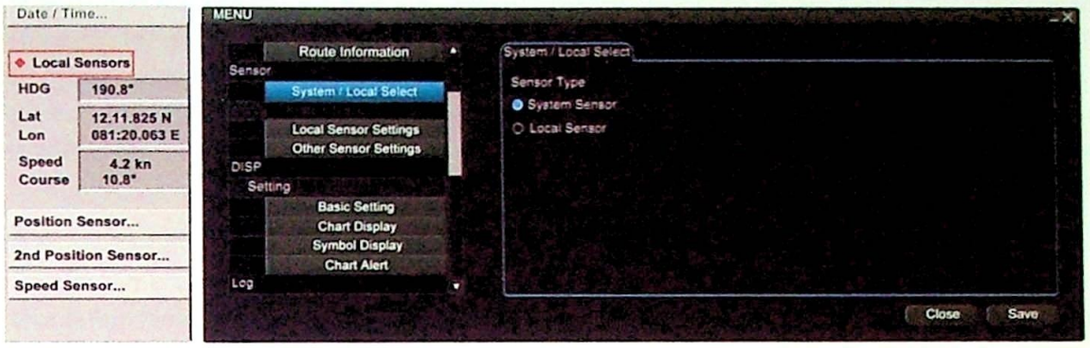


Figure 8.2 – Sensor settings screens (SAM Chartpilot on the left, FURUNO on the right)

The ECDIS operator must understand what each setting means. The SMS must reflect best practice for mode selection and for selecting and configuring the correct sensors.

The term 'System Sensors' is generally used by manufacturers where the ECDIS is connected to the bridge network of sensors. In this case, the priority sensors are selected through a separate configuration screen when the ECDIS was fitted.

The 'Local Sensors' option allows an operator to select a specific sensor connected directly to the ECDIS, although this could also be extracted from the bridge network of sensors.

An example of this would be where the master ECDIS is configured to receive from the primary GNSS, which is also configured to 'feed' the system sensors when that option is selected. The operator may believe that the backup ECDIS is configured to use a different GNSS sensor to the master ECDIS for cross-checking purposes, but if the system is in System Sensor Mode, the backup ECDIS is actually configured to repeat the master ECDIS. Therefore, the reality will be that what is being plotted on the master is actually duplicated on the backup.

ECDIS operators must familiarise themselves with the menu options (where fitted) and understand whether their systems are 'independent' or are all displaying the same information.

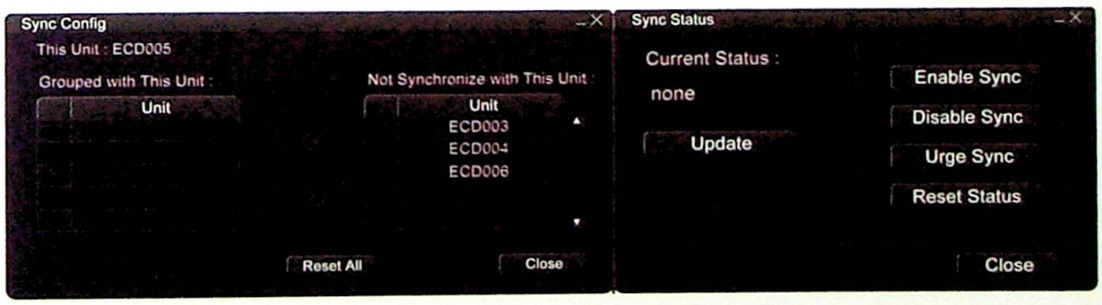


Figure 8.3 – FURUNO menu options. This menu will look different on each specific make and model

Several recent audits have revealed that operators are under the impression (in accordance with company SMS) that each unit receives its own sensor feeds from the large array available. However, the radar, in many incidents, was in fact the 'master' for selecting sensors. What is selected on the radar takes priority on what is plotted on each ECDIS, regardless of what the operator assumes to be configured.

When developing procedures, it must be ensured that guidance is provided as to which sensors are connected to each system and whether the 'Auto-Sync', 'Sensors' or 'Local' settings are selected by the ECDIS operator where available. These function names are not standardised and may be referred to differently by manufacturers.

8.5 Time Restrictions between System and Local Sensors

Another example of where selecting either System or Local Sensors might affect the display is the time zone in use. When using Local Sensor setting, the NMEA message for time will be received through an automatic synchronisation of the GPS sensor that is connected. When System Sensor settings are used, a different GPS could be generating the time NMEA sent to ECDIS. The operator needs to know which sensors and which NMEA is connected to each system for route monitoring of TTG (Time to Go) and waypoint/destination calculations. It would be unfortunate for the operator to arrive at the pilot station exactly 4 hours late after crossing the Atlantic Ocean, purely because their ECDIS passage plan was calculating waypoint target times and speed recommendations based on the wrong time zone.

This is an easy mistake to make, but difficult to spot. Often, the backup ECDIS is configured for an overview of the passage plan, eg North Up, True Motion, showing the entire Great Circle of the Atlantic crossing. While it is ideal, therefore, for an overview of the passage and for ensuring the ship is on time, it assumes the system is configured correctly. It may be showing what the operator assumes are local times for speed/ETA/distance calculations. In reality, however, the sensors could be synchronised to the master ECDIS, which is configured to show GMT or a different time zone.

9 ECDIS Safety Checklists

9.1 OOW Handover Checklist

While on watch, the OOW is responsible for the operation and management of ECDIS. Therefore, a comprehensive handover of the system is essential before taking over the watch. If the off-going or oncoming OOW is in any doubt about the state of the ECDIS system settings, the Master should be consulted immediately.

The OOW should annotate on the ECDIS unit the configuration in force, ie whether it is set up for confined waters, coastal or open ocean. The oncoming OOW should check the system to identify any changes or errors in configuration or ECDIS system settings.

When taking over the watch, the OOW should confirm the position of the ship by taking a manual fix. Wherever possible, this fix should be by means independent of the primary position source, including visual or radar and the use of RIO if available.

As a minimum, the following checks and actions are to be conducted upon watch handover:

OOW Handover Checklist	Completed
Ensure that the correct configuration is shown	
Ensure that the correct route is loaded for route monitoring	
If in True Motion, check that the TM reset setting is configured correctly	
Verify that the Safety Depth and Safety Contour settings are configured correctly	
Ensure that the look-ahead is set for the prevailing conditions	
Ensure that XTD is applied and displayed correctly	
Ensure that vectors are configured correctly	
Ensure that the chart in use is on the best scale	
Interrogate the CATZOCs and review all chart notes for the period of the upcoming watch	
Fix the ship's position on ECDIS and cross-check GNSS	
Complete any ECDIS handover checklists	
Ensure that any ECDIS management card is up to date	
Repeat the above steps for all ECDIS units	
Confirm system units (depths, distances, etc) are appropriate	
If in RCDS mode, confirm the horizontal datum in use	
If in RCDS mode, view the source data diagram and review all chart notes	
If in RCDS mode, ensure that paper backup is correct (if required)	

9.2 Pre-Sailing Checklist

As a minimum, the following checks and actions are to be conducted prior to sailing:

Pre-Sailing Checklist	Completed
Ensure that the chart in use is the most appropriate	
If in RCDS mode, ensure paper backup is correct (if required)	
Verify radar image overlay (if available)	
Ensure all relevant T&P information and mariner-added objects are displayed	
Ensure the chart is displayed at the best scale (or auto scale function enabled if available)	
Confirm system units (depths, distances, etc) are appropriate	
Verify accuracy of ECDIS sensors (gyro, log, GNSS, etc)	
Verify Safety Depth and Safety Contour settings	
Ensure correct display configuration for departure	
Ensure appropriate system settings for departure	
Ensure appropriate palette, eg day/dusk/night presentation	
Ensure correct route is loaded for route monitoring	
Ensure route has been checked and approved	
Ensure route data is selected for display	
Ensure route data is providing relevant and correct waypoint data	
Chart motion (if True Motion, consider settings for TM reset)	
Chart orientation (eg North Up)	
Chart auto load on	
Chart priority ENC	
Ensure accurate ship outline is displayed	
Ensure look-ahead is set for prevailing conditions	
Consider activating predictor (if available)	
Consider conning display when berthing/unberthing (if available)	
Determine whether true or relative vectors are being displayed	
Configure vector lengths as appropriate	
Test and ensure audible alarm is turned on	
Set AIS and ARPA targets to be displayed as required	
Configure other ECDIS units as appropriate	

9.3 ECDIS Configuration Card

Primary ECDIS			
Environmental		**System Settings**	
Port Name		Safety Depth	m
		Safety Contour	m
High Water:	Height m	Deep Contour	m
Low Water:	Height m	Depth Line	m
Springs	%	Vectors	mins
Tidal Stream	° knots Time:	Check Area	On / Off
Set and Drift	° knots Time:	Ahead	Time mins Distance NM
		Width	m
True Wind	° knots	Latest NTM Installed	Date:
		Primary ECDIS	Wk /
		Secondary ECDIS	Wk /
Time Zone		Configuration	Confined Waters Coastal Open Ocean

Secondary ECDIS			
Environmental		**System Settings**	
Port Name		Safety Depth	m
		Safety Contour	m
High Water:	Height m	Deep Contour	m
Low Water:	Height m	Depth Line	m
Springs	%	Vectors	mins
Tidal Stream	° knots Time:	Check Area	On / Off
Set and Drift	° knots Time:	Ahead	Time mins Distance NM
		Width	m
True Wind	° knots	Latest NTM Installed	Date:
		Primary ECDIS	Wk /
		Secondary ECDIS	Wk /
Time Zone		Configuration	Confined Waters Coastal Open Ocean

9.4 GNSS Failure

ECDIS can work without GNSS following a loss of signal or jamming/spoofing. In the event of such a failure, the ECDIS operator must know what actions to take. As a minimum, the following should be carried out:

GNSS Failure	Completed
Read and interrogate any alarms and identify the failed sensor	
Select the secondary position fixing sensor and assess accuracy	
If all GNSS is unavailable, select DR or EP mode	
Independently fix the ship's position using visual and radar means	
Identify other equipment that may be affected by the failed sensor	
Instigate defect rectification	
Amend the ship's route as necessary, consider contingencies, increased safety margins and reduced speed	
Call the Master and log the incident	
When the primary position fixing system is restored, correlate with RIO and other means and inform the Master	

9.5 ECDIS Failure

As a minimum, the following should be conducted on all systems in the event of ECDIS failure:

ECDIS Failure	Completed
Single ECDIS failure	
Call the Master	
Select secondary ECDIS as primary and ensure it is functioning properly	
Consider reducing speed	
Consider manoeuvring to contingency area or deeper water	
Take action to repair defective ECDIS unit, if possible	
Restart defective ECDIS unit	
Total ECDIS failure	
Call the Master	
Consider reducing speed	
Begin paper chart navigation using appropriate portfolio of paper charts (APC)	
Ensure passage plan is fully transferred to paper charts	
Ensure OOWs performing DRs and EPs look at ground ahead	
Consider manoeuvring to contingency area or deeper water	
Take action to repair defective ECDIS unit, if possible	
Restart defective ECDIS unit	

It is recommended that ship specific ECDIS failure procedures are developed taking into account the equipment on board, as well as backup power arrangements and the impact on ship operations likely to be caused by an ECDIS failure.

9.6 ECDIS Cyber Security Checklist

On many newbuilds, the ECDIS is connected to far more than navigation equipment. It is often connected to engine room systems, communication systems and planning terminals, stability calculations and even ships' alarms systems.

Many ships are often unaware of what the ECDIS is connected to, so ECDIS operators should use the below list to confirm what the ECDIS is connected to, then ensure this is in accordance with the SMS and Cyber Management policy.

ECDIS Cyber Security Checklist	Completed
Bridge systems	
Positioning (GPS, etc)	
Dynamic positioning (DP)	
Electronic navigation systems and propulsion/manoeuvring systems	
Automatic identification system (AIS)	
Global maritime distress and safety system (GMDSS)	
Radar equipment	
Voyage data recorders (VDRs)	
Other monitoring and data collection systems	
Communication systems	
Integrated communication systems	
Satellite communication equipment	
Voice over internet protocols (VOIP) equipment	
Wireless networks (WLANs)	
Public address and general alarm systems	
Systems used for reporting mandatory information to public authorities	
Engine management and power control	
Engine governor	
Power management	
Integrated control system	
Alarm system	
Emergency response system	
Control systems	
Surveillance systems such as CCTV network	
Bridge navigational watch alarm system (BNWAS)	
Shipboard security alarm systems (SSAS)	
Electronic 'personnel on board' systems	

ECDIS Cyber Security Checklist	Completed
Cargo management	
Cargo control room (CCR) and its equipment	
Onboard loading computers and computers used for exchange of loading information and load plan updates with the marine terminal and stevedoring company	
Remote cargo and container sensing systems	
Level indication system	
Valve remote control system	
Ballast water systems	
Water ingress alarm system	
Passenger management systems	
Property Management System	
Electronic health records	
Financial related systems	
Ship passenger/visitor/seafarer boarding access systems	
Infrastructure support such as domain naming system (DNS) and user authentication/authorisation systems	
Public networks	
Passenger WiFi or local area network (LAN) internet access, for example, where onboard personnel can connect their own devices	
Guest entertainment systems	
Infrastructure systems	
Security gateways	
Routers	
Switches	
Firewalls	
Virtual private network(s) (VPN)	
Virtual LAN(s) (VLAN)	
Intrusion prevention systems	
Security event logging systems	
Administrative and crew welfare systems	
Administrative systems	
Crew WiFi or LAN internet access, for example, where onboard personnel can connect their own devices	

Annexes


N UP
H UP
C UP
RM
TM
1:1
HDG
STW
COG
SOG
GPS 1
MAG 1
Sec:None
Prim
GPS 1
UTC
CHART Safety contour
Existing alarms
* SLAVE
TX X-1
ECDIS

Annex A Chart Spot-Check Log

Name	Date Check Conducted	ECDIS	Charts Checked		Discrepancies	Signature
			ENC	RNC		
2O Davies	*04/08/21*	*Primary ECDIS*	*GB250700, GB400737, GB40722E, GB500519, GB50184B*	*20, 30, 2646, 2823, 2986,*	*Nil*	*2/Off Davies*
2O Davies	*04/08/21*	*Secondary ECDIS*	*GB250700, GB400737, GB40722E, GB500519, GB50184B*	*20, 30, 2646, 2823, 2986,*	*Nil*	*2/Off Davies*

Annex B Manual Corrections Log

Name	Date Inserted	Object Inserted	Latitude and Longitude	Charts Affected	Notice	Inserted in Secondary ECDIS	Checked with Secondary ECDIS	Date Deleted	Deleted by Signature
3/Off Smith	*26/07/21*	*Submarine Cable*	*56° 07′·21N, 15° 39′·04E 56° 07′·46N, 15° 37′·81E*	*2857*	*Swedish Notice 359/7242/21*	*Yes*	*Yes*	*04/08/21*	*2/Off Davies*

Annex C Chart Update Log

Update Number	Date Received	Date Primary ECDIS Updated	Date Secondary ECDIS Updated	Update Successful Yes/No	Comments	Updated by Signature
AVCS Wk 31/21	*04/08/21*	*04/08/21*	*04/08/21*	*Yes*	*Update successful, time 21 mins*	*2/Off Robert Davies*
ARCS Wk 312/21	*04/08/21*	*04/08/21*	*04/08/21*	*Yes*	*Update successful, time 23 mins*	*2/Off Robert Davies*

Annex D ECDIS Alarms and Alerts

ECDIS Alarms, Warnings and Cautions

Users must be aware of what constitutes an alarm or a warning on their system. The definitions have been standardised, but the definitive list of the alarms and warnings that are on an ECDIS has not. Below is a list of all possible alarms and warnings.

It is important for companies to address alarm management procedures for both the user and shoreside support. This will assist the bridge in understanding the risk, severity or impact of what an alarm means to the safe passage of a ship. For example, should the ECDIS alarm that the gyro is not feeding the ECDIS, the ship would look to have this rectified immediately when next in port as it is part of the minimum sensor requirement. However, if the ECDIS was to alarm stating it was not receiving wind data, this could simply be acknowledged, silenced and even removed as a sensor as it is not part of the mandated requirement (unless, for other reasons, it is at that point deemed critical to the safe navigation of the ship). All ships operate differently. As a recommendation, the tables should be discussed and a risk assessment applied to all.

Note: With S-52, the user now has more autonomy as to what is defined as an alarm and warning. Therefore, the tables should be understood and discussed between all parties involved in the ship's procedures.

Note 1: 'Alarm' refers to the audible 75 dB alarm mandated on the bridge.

Note 2: Priority level gives an indication as to the severity and impact to the safe navigation of the ship.

Level 1 would suggest the ship requires shore support/may need a rectification period/the ship should not sail until rectified or, if alarming at sea, the Master must be informed.

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Loss of RIO	*Alarm* *Warning* *Caution*	*You have lost radar image overlay on your ECDIS system*	*1* *2* *3*
Positioning System Failure	*Alarm* *Warning* *Caution*	All position data has been lost for more than 30 seconds.	*1* *2* *3*
UKC Limit	*Alarm* *Warning* *Caution*	Measured depth from echo sounder is less than set UKC limit value.	*1* *2* *3*
Crossing Safety Contour	*Alarm* *Warning* *Caution*	When check area is set, ship entered in shallower area than check area set in Safety Contour.	*1* *2* *3*
Off Track Alarm	*Alarm* *Warning* *Caution*	Deviation is big between planning course and current heading. While monitoring route, ship position deviates from Channel Limit.	*1* *2* *3*
Gyro 1 COM Error	*Alarm* *Warning* *Caution*	Data from No. 1 gyro has been discontinued for more than set time. No. 1 gyro is turned off or there is a problem with network.	*1* *2* *3*
Gyro 2 COM Error	*Alarm* *Warning* *Caution*	Data from No. 2 gyro has been discontinued for more than set time. No. 2 gyro is turned off or there is a problem with network.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Backup Navigator	*Alarm* *Warning* *Caution*	When not acknowledging alerts related to WPT approach or track control stop alert during track control, alert is forwarded to BNWAS by this signal 30 seconds after passing WOL. This is not shown.	*1* *2* *3*
Heading Sensor Not Available	*Alarm* *Warning* *Caution*	Heading data of all available gyro has been not available for more than 2 seconds.	*1* *2* *3*
WGS 84 Not Used	*Alarm* *Warning* *Caution*	WGS 84 is not used for datum of electronic position fixing system (EPFS) or cannot be acquired. Acquisition timing: Once in 60 seconds or when position sensor is changed.	*1* *2* *3*
Datum Change	*Alarm* *Warning* *Caution*	Current datum of EPFS is changed. Acquisition timing: Once in 60 seconds or when position sensor is changed.	*1* *2* *3*
Depth Limit	*Alarm* *Warning* *Caution*	Seabed has been less than set depth for more than 3 seconds.	*1* *2* *3*
ARPA CPA/TCPA	*Alarm* *Warning* *Caution*	CPA (Closest Point of Approach) and TCPA (Time to CPA) of ARPA is within the set range.	*1* *2* *3*
ARPA Lost	*Alarm* *Warning* *Caution*	Target has been not detected 5 times successively. Tracked target is lost.	*1* *2* *3*
AIS Target Display 100%	*Alarm* *Warning* *Caution*	100% of maximum number of targets that can be displayed has been used.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
AIS CPA/TCPA	*Alarm* *Warning* *Caution*	CPA and TCPA of AIS activating target is below the value set in menu.	*1* *2* *3*
User Chart Danger Area	*Alarm* *Warning* *Caution*	When User Chart Danger Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Non-official ENC	*Alarm* *Warning* *Caution*	When No Official Data is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
No Vector Chart	*Alarm* *Warning* *Caution*	When No Vector Chart is set to Warning/Caution in chart alert.	*1* *2* *3*
Not Up to Date	*Alarm* *Warning* *Caution*	When Not Up to Date is set to Warning/Caution in chart alert.	*1* *2* *3*
Permit Expired	*Alarm* *Warning* *Caution*	When Permit Expired is set to Warning/Caution in chart alert.	*1* *2* *3*
Chart align: Over 30 min	*Alarm* *Warning* *Caution*	Own ship position has been offset for more than 30 minutes.	*1* *2* *3*
Use MAN Steering	*Alarm* *Warning* *Caution*	All GPS signals are lost during track control, and track control has continued for 10 minutes in DR. Alarm generates every 2 minutes.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
RM Stop – Exceed Max XTD	*Alarm* *Warning* *Caution*	Route monitoring is stopped because distance from route is more than set value of Max XTD.	*1* *2* *3*
RM Stop – Disconnect Sensors	*Alarm* *Warning* *Caution*	Error occurs inside of route monitoring function.	*1* *2* *3*
RM Stop – Other Causes	*Alarm* *Warning* *Caution*	Required data for route monitoring such as position, SOG/COG cannot be acquired.	*1* *2* *3*
Loss of RIO	*Alarm* *Warning* *Caution*	RIO has been lost.	*1* *2* *3*
Sensor Failure	*Alarm* *Warning* *Caution*	Sensor data related to Track Control (GYRO, GPS, LOG) is lost.	*1* *2* *3*
Course Difference	*Alarm* *Warning* *Caution*	Deviation between current heading and planned course is more than set value. Default: 30 degrees.	*1* *2* *3*
STW Not Available	*Alarm* *Warning* *Caution*	STW data of all available SDME sensors has been not available for more than 3 seconds.	*1* *2* *3*
COG/SOG Not Available	*Alarm* *Warning* *Caution*	COG/SOG data of all available GPS sensors has been not available for more than 3 seconds.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
VDR COM Error	*Alarm* *Warning* *Caution*	NMEA Sentence Information from VDR has been discontinued for more than set time. VDR is turned off, or there is a problem with network.	*1* *2* *3*
BNWAS COM Error	*Alarm* *Warning* *Caution*	Caution NMEA Sentence Information from BNWAS has been discontinued for more than set time. BNWAS is turned off or there is a problem with network.	*1* *2* *3*
AIS COM Error	*Alarm* *Warning* *Caution*	Data from AIS has been discontinued for more than set time. (Set at installation) Default: 60 seconds. AIS is turned off, or there is a problem with network.	*1* *2* *3*
NAVTEX COM Error	*Alarm* *Warning* *Caution*	Data from NAVTEX has been discontinued for more than set time. (Set at installation) Default: 180 seconds. NAVTEX is turned off, or there is a problem with network.	*1* *2* *3*
ROT Gyro 1 COM Error	*Alarm* *Warning* *Caution*	Data from No. 1 ROT gyro has been discontinued for more than set time. (Set at installation) Default: 60 seconds.	*1* *2* *3*
ROT Gyro 2 COM Error	*Alarm* *Warning* *Caution*	Data from No. 2 ROT gyro has been discontinued for more than set time.	*1* *2* *3*
Position Source Change	*Alarm* *Warning* *Caution*	Position sensor used in system (distributed by own ship's information management) is changed.	*1* *2* *3*
Heading Source Change	*Alarm* *Warning* *Caution*	Heading sensor used in system (distributed by own ship's information management) is changed.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
COG/SOG Source Change	*Alarm* *Warning* *Caution*	COG/SOG sensor used in system (distributed by own ship's information management) is changed.	*1* *2* *3*
Anchor Watch Error	*Alarm* *Warning* *Caution*	While anchor watch alert function is enabled, ship's position has been outside of alarm area centring certain position for more than 3 seconds.	*1* *2* *3*
AIS Message Transmit Error	*Alarm* *Warning* *Caution*	AIS message transmission is failed.	*1* *2* *3*
No CPA/TCPA for AIS	*Alarm* *Warning* *Caution*	Ship's SOG/COG data is not available, and L/L of own ship and AIS are not available. System cannot calculate CPA/TCPA for AIS.	*1* *2* *3*
AP Receive Error	*Alarm* *Warning* *Caution*	Communication between AP and ECDIS is discontinued.	*1* *2* *3*
EPFS 1 Sensor Banned	*Alarm* *Warning* *Caution*	Own ship position data from No. 1 GPS is determined abnormal by integrity check.	*1* *2* *3*
EPFS 2 Sensor Banned	*Alarm* *Warning* *Caution*	Own ship position data from No. 2 GPS is determined abnormal by integrity check.	*1* *2* *3*
Gyro 1 Sensor Banned	*Alarm* *Warning* *Caution*	Heading data from No. 1 Gyro is determined abnormal by integrity check.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Gyro 2 Sensor Banned	*Alarm* *Warning* *Caution*	Heading data from No. 2 Gyro is determined abnormal by integrity check.	*1* *2* *3*
ROT Gyro 1 Sensor Banned	*Alarm* *Warning* *Caution*	Heading data from No. 1 ROT Gyro is determined abnormal by integrity check.	*1* *2* *3*
ROT Gyro 2 Sensor Banned	*Alarm* *Warning* *Caution*	Heading data from No. 2 ROT Gyro is determined abnormal by integrity check.	*1* *2* *3*
No Filter Source of Position	*Alarm* *Warning* *Caution*	No valid position sensor is available for filter (banned or connection error).	*1* *2* *3*
Fan Rotation Speed Lowering	*Alarm* *Warning* *Caution*	Main Monitor. Fan rotation speed is below threshold.	*1* *2* *3*
Actual Course Change Indication	*Alarm* *Warning* *Caution*	Waypoint is now being approached. Alert is acknowledged and the ship's position is less than set time of approach alarm from WOL.	*1* *2* *3*
Wheel Over Line	*Alarm* *Warning* *Caution*	Waypoint is now being approached. When alerts are not acknowledged, ship crosses WOL.	*1* *2* *3*
Echo Sounder 1 COM Error	*Alarm* *Warning* *Caution*	Input of depth data from No. 1 echo sounder has been discontinued for more than set time. No. 1 echo sounder is turned off, or there is a problem with network.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Echo Sounder 2 COM Error	*Alarm* *Warning* *Caution*	Input of depth data from No. 2 echo sounder has been discontinued for more than set time. No. 2 echo sounder is turned off, or there is a problem with network.	*1* *2* *3*
UTC Time Not Available	*Alarm* *Warning* *Caution*	Time data of all available GPS sensors has been not available for more than 3 seconds.	*1* *2* *3*
Depth (Bow) Not Available	*Alarm* *Warning* *Caution*	Depth data of all available depth sensors (bow) has been not available for more than 3 seconds.	*1* *2* *3*
Depth (Midship) Not Available	*Alarm* *Warning* *Caution*	Depth data of all available depth sensors (Midship) has been not available for more than 3 seconds.	*1* *2* *3*
Depth (Stern) Not Available	*Alarm* *Warning* *Caution*	Depth data of all available depth sensors (stern) has been not available for more than 3 seconds.	*1* *2* *3*
Wind Speed/ Direction Not Available	*Alarm* *Warning* *Caution*	Wind speed/direction data of all available wind sensors has been not available for more than 3 seconds.	*1* *2* *3*
Rudder 1 COM Error	*Alarm* *Warning* *Caution*	Rudder data from No. 1 rudder sensor has been discontinued for more than set time. No. 1 rudder is turned off or there is a problem with network.	*1* *2* *3*
Rudder 2 COM Error	*Alarm* *Warning* *Caution*	Rudder data from No. 2 rudder sensor has been discontinued for more than set time. No. 2 rudder is turned off or there is a problem with network.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Wind Sensor 1 COM Error	*Alarm* *Warning* *Caution*	Data from No. 1 wind sensor has been discontinued for more than set time. No. 1 wind sensor is turned off or there is a problem with network.	*1* *2* *3*
Water Current COM Error	*Alarm* *Warning* *Caution*	Data from water current has been discontinued for more than set time. Water current sensor is turned off or there is a problem with network. Check the connection with water current and network.	*1* *2* *3*
Water Temp COM Error	*Alarm* *Warning* *Caution*	Data from water temp has been discontinued for more than set time. Water temp sensor is turned off or there is a problem with network.	*1* *2* *3*
Network Printer Not Available	*Alarm* *Warning* *Caution*	When executing printout, network printer is not recognised, network printer connection is interrupted, or printer error such as paper shortage, paper jam or run out of ink occurs.	*1* *2* *3*
Local Printer Not Available	*Alarm* *Warning* *Caution*	When executing printout, local printer is not recognised, local printer connection is interrupted, or printer error such as paper shortage, paper jam or run out of ink occurs.	*1* *2* *3*
AIS New Target	*Alarm* *Warning* *Caution*	System detected the new AIS target.	*1* *2* *3*
AIS Message Received	*Alarm* *Warning* *Caution*	AIS message is received.	*1* *2* *3*
Traffic Separation Zone	*Alarm* *Warning* *Caution*	When Traffic Separation Zone is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Inshore Traffic Zone	*Alarm* *Warning* *Caution*	When Inshore Traffic Zone is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Restricted Area	*Alarm* *Warning* *Caution*	When Restricted Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Caution Area	*Alarm* *Warning* *Caution*	When Caution Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Offshore Production Area	*Alarm* *Warning* *Caution*	When Offshore Production Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Military Practice Area	*Alarm* *Warning* *Caution*	When Military Protection Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Seaplane Landing Area	*Alarm* *Warning* *Caution*	When Seaplane Landing Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Submarine Transit Lane	*Alarm* *Warning* *Caution*	When Submarine Transit Lane is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
Anchorage Area	*Alarm* *Warning* *Caution*	When Anchorage Area is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
Marine Farm/ Aquaculture	*Alarm* *Warning* *Caution*	When Marine Farm/Aquaculture is set to Warning/Caution in chart alert, ship entered in check area.	*1* *2* *3*
PSSA Area	*Alarm* *Warning* *Caution*	When PSSA Area is set to Warning/ Caution in chart alert, ship entered in check area.	*1* *2* *3*
Areas to be Avoided	*Alarm* *Warning* *Caution*	When Areas to be Avoided is set to Alarm in chart alert, ship entered in check area.	*1* *2* *3*
Buoy	*Alarm* *Warning* *Caution*	When Buoy is set to Alarm in chart alert, ship entered in check area.	*1* *2* *3*
Last WPT Approach	*Alarm* *Warning* *Caution*	Ship will reach last waypoint in 30 seconds.	*1* *2* *3*
Autopilot Mode Conflict	*Alarm* *Warning* *Caution*	In communication between AP, TCS mode of ECDIS and AP are different.	*1* *2* *3*
NAVTEX Message Received	*Alarm* *Warning* *Caution*	NAVTEX message is received.	*1* *2* *3*
Water Current Sensor Banned	*Alarm* *Warning* *Caution*	Data from water current is determined abnormal by integrity check. *Currently not generated because integrity check is not performed for current.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
No Filter Source of COG/SOG	*Alarm* *Warning* *Caution*	No valid COG/SOG sensor is available for filter (banned or connection error).	*1* *2* *3*
No Filter Source of Heading	*Alarm* *Warning* *Caution*	No valid heading sensor is available for filter (banned or connection error).	*1* *2* *3*
No Filter Source of ROT	*Alarm* *Warning* *Caution*	No valid position sensor is available for filter (banned or connection error).	*1* *2* *3*
LCD Unit Lifetime Over	*Alarm* *Warning* *Caution*	For unit connected to LCD unit operating time exceeds 50,000 hours.	*1* *2* *3*
CPU Temp High	*Alarm* *Warning* *Caution*	CPU temperature in processor unit exceeds threshold.	*1* *2* *3*
CPU Board Temp High	*Alarm* *Warning* *Caution*	CPU temperature in processor unit exceeds threshold.	*1* *2* *3*
CPU Board 5 V Power Error	*Alarm* *Warning* *Caution*	5 V power voltage of CPU board in processor unit is out of threshold.	*1* *2* *3*
CPU Board 3.3 V Power Error	*Alarm* *Warning* *Caution*	3.3 V power voltage of CPU board in processor unit is out of threshold.	*1* *2* *3*

Message on Screen	If Option Available to Change, Select:	Alert Description	Priority Level 1 = Severe 2 = Moderate 3 = Low
CPU Board 12 V Power Error	*Alarm* *Warning* *Caution*	12 V power voltage of CPU board in processor unit is out of threshold.	*1* *2* *3*
Early Course Change Indication	*Alarm* *Warning* *Caution*	Waypoint is soon being approached. Ship's position is less than set time of prewarning from WOL.	*1* *2* *3*
Track Control Stop	*Alarm* *Warning* *Caution*	Track Control is discontinued because sensors such as GYRO, GPS, LOG and Autopilot stop input during Track Control.	*1* *2* *3*
Position Monitor	*Alarm* *Warning* *Caution*	When inputting position data from two or more GPS, there is a difference between position data from each GPS.	*1* *2* *3*
Low Speed Alarm	*Alarm* *Warning* *Caution*	While carrying out TCS, ship's speed becomes less than set value.	*1* *2* *3*
AIS Transmitting	*Alarm* *Warning* *Caution*	AIS transponder is transmitting.	*1* *2* *3*

Annex E Pre-Port Arrival – PSC ECDIS Preparation Activities (120 mins)

This Annex covers the most common recurring issues experienced with ECDIS.

There are 14 Pre-Inspection Activities in this Annex and all ECDIS operators, including Masters, should ensure they can complete them prior to inspection. These checks should not only be conducted immediately prior to a PSC (or any) inspection, the Master should know how to spot-check each of these activities at any time.

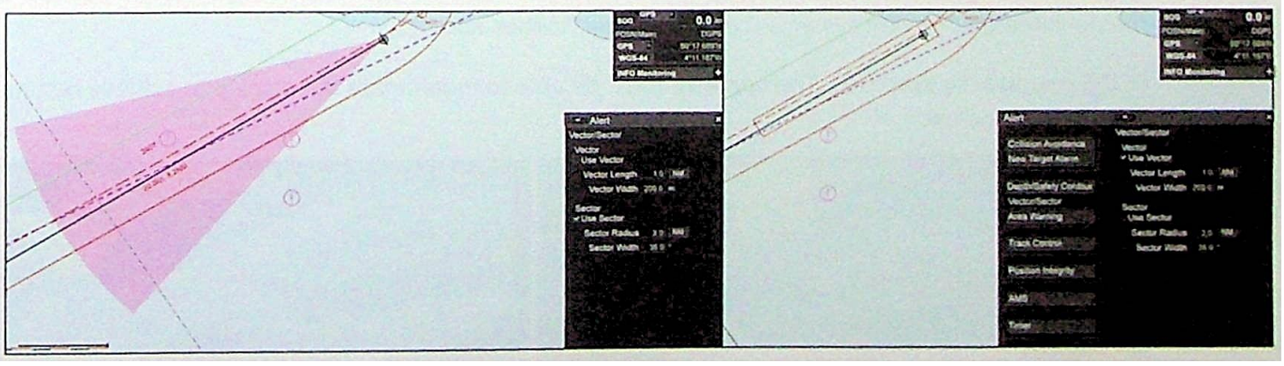
Pre-Inspection Activity 1 – Anti-Grounding Cone/Safety Frame/ Look-Ahead (05 mins)

This observation occurred at an average of 56 times per year across 2016–2018, accounting for 5.6% of total observations.

The Check Area sector is intended for setting the size of the area that will be used for the chart data analysis and for the generation of the anti-grounding alarms, area alerts and navigational alarms. The trigger points for alarms and warnings are defined by a Check Area projected ahead, astern, to port and to starboard of the ship. The size of the Check Area will depend on the size and manoeuvrability of the ship. Once a danger has been picked up in the Check Area, it will be necessary for the ship to avoid it and this delay and time to manoeuvre must be considered during configuration.

These recommendations do not alter the Master's right to modify or augment Check Area settings. The Check Area setting should be agreed when the route is presented by the OOW for approval. Authorisation to modify, augment or, by exception, turn off the Check Area to best support the execution of navigation is to be recorded in the navigation plan or standing orders book.

ECDIS operator to practise – The following image shows that on certain systems the look-ahead can be an angle or linear, true (distance) or relative (time). ECDIS operators must know where and how to use this function.



Pre-Inspection Activity 2 – Safety Contour and Safety Depth (05 mins)

This is a recurring observation, averaging 11% across 2016–2018.

Navigation in areas crowded with dangers to navigation requires permanent monitoring. To assist, the ECDIS implements functions for setting and monitoring safe navigation parameters on vector charts. Chart objects are identified by the ECDIS as dangers to navigation by certain parameters. These parameters are referred to as Chart Alert Parameters and are set by the operator.

Safety Depth

The Safety Depth is a value set by the operator that serves to detect depths that are a danger to navigation. A depth equal to or less than the Safety Depth is highlighted on the chart in bold type when the display of spot soundings is turned on (ENCs only). It is recommended that Safety Depth is likened to a critical depth and set as follows in all environments:

Safety Depth = draught + under keel clearance (UKC) (including squat and a safety margin) – height of tide (HoT)

Safety Contour

This set value distinguishes between safe and unsafe water and generates alarms and warnings against your planned and monitored route. The Safety Contour is highlighted on the chart with a bold line (ENCs only).

When transiting through areas of differing ENC scales, the previously selected Safety Contour may become unavailable. The Safety Contour is automatically set as equal to the next available depth contour.

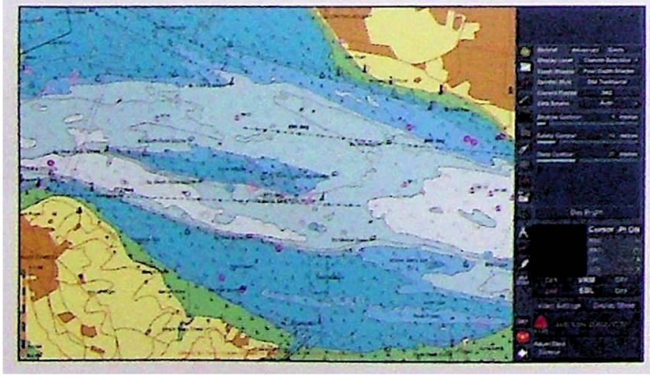
Subject to the draught and specifications of the individual ship and the Master's approval, a standard Safety Contour may normally be applied for ocean/coastal navigation as follows:

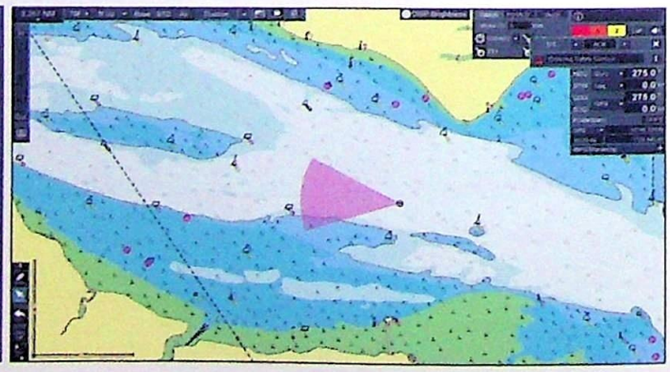
- Ships with draughts of 6 m to 10 m – A standard Safety Contour of 20 m may be sufficient
- ships with draughts of 10 m to 20 m – A standard Safety Contour of 30 m may be sufficient.

In the case of a coastline with gently shoaling depths, the recommendations above would restrict a ship's safe water significantly. Therefore, this is area dependent and needs consideration appropriate to the intended route.

The following images show how the Safety Contour and the viewing of Sounding and Safety Depth can be manipulated on different systems (below is Kelvin Hughes and JRC).

ECDIS operator to practise – The operator must be able to manipulate the display to achieve results similar to those shown below.



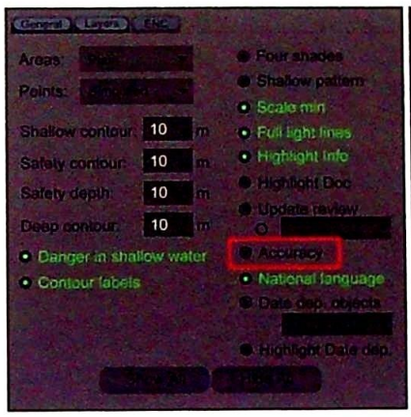


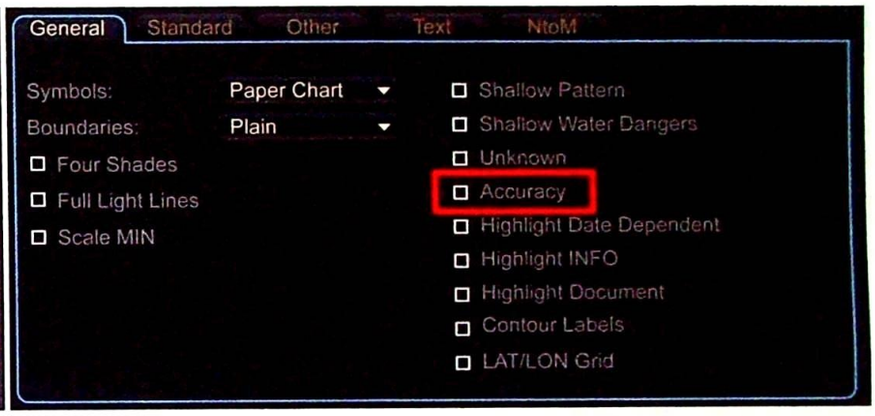
Pre-Inspection Activity 3 – CATZOC (05 mins)

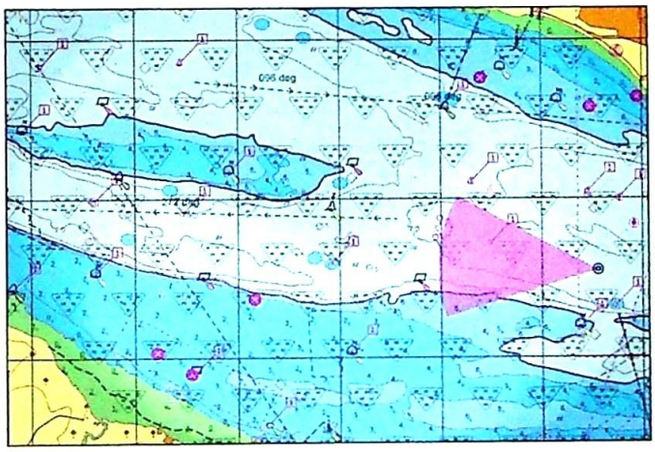
CATZOC represents an average of 9% of the observations made across 2016–2018.

It is possible that on certain ECDIS models CATZOC is given a different term.

ECDIS operator to practise – Ensure you know how to turn on the CATZOC, what CATZOC means (example below) and how that affects the UKC. Be aware that JRC and FURUNO use the term 'Accuracy' rather than CATZOC.







1	2	3	4	5	6
ZOC 1	Position Accuracy	Depth Accuracy	Seafloor Coverage	Typical Survey Characteristics	CATZOC Symbol
A1	± 5m	± 0.5 + 1%d Depth (m) / Accuracy (m) 10 / ± 0.6 30 / ± 0.8 100 / ± 1.5 1000 / ± 10.5	Full area search undertaken. Significant seafloor features detected and depths measured.	Controlled, systematic survey, high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.	
A2	± 20m	± 1.00 + 2%d Depth (m) / Accuracy (m) 10 / ± 1.2 30 / ± 1.6 100 / ± 3.0 1000 / ± 21.0	Full area search undertaken. Significant seafloor features detected and depths measured.	Controlled, systematic survey achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder and a sonar or mechanical sweep system.	
B	± 50m	± 1.00 + 2%d Depth (m) / Accuracy (m) 10 / ± 1.2 30 / ± 1.6 100 / ± 3.0 1000 / ± 21.0	Full area search not achieved; unsurveyed features hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOC A2, using a modern survey echosounder but no sonar or mechanical sweep system.	
C	± 500m	± 2.00 + 5%d Depth (m) / Accuracy (m) 10 / ± 2.5 30 / ± 3.5 100 / ± 7.0 1000 / ± 52.0	Full area search not achieved; depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.	
D	Worse than ZOC C	Worse than ZOC C	Full area search not achieved; large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.	
U	Unassessed - The quality of the bathymetric data has yet to be assessed.				U

Pre-Inspection Activity 4 – Type Specific and Familiarisation Training (15 mins)

This resulted in 8.3% of 2018 observations, which was a rise in observations over 2016.

It should be ensured that all personnel are adequately trained in the use of the ECDIS system by undertaking a flag State approved generic IMO 1.27 Model ECDIS Course and Type Specific training on the ship specific equipment.

ECDIS operator to practise – Ensure that the ECDIS manufacturer's operator's manual and a list of alarms and warnings for the specific system are available on the bridge. It should be noted that system user guides are generally poor and are not a substitute for adequate training.

Generic

All OOWs are to have undertaken a 5 day flag State approved generic ECDIS course in accordance with the IMO 1.27 Model ECDIS Course in order to be in line with current STCW requirements.

Type Specific Training

All OOWs having completed generic training are required to undertake Type Specific ECDIS training in order to be familiar with the equipment in use on their ship. This is in line with ISM and flag State requirements.

All OOWs should be familiar with the specific equipment in use on board their ship, having completed an appropriate Type Specific training course. At present, there are no IMO guidelines for Type Specific training.

Familiarisation

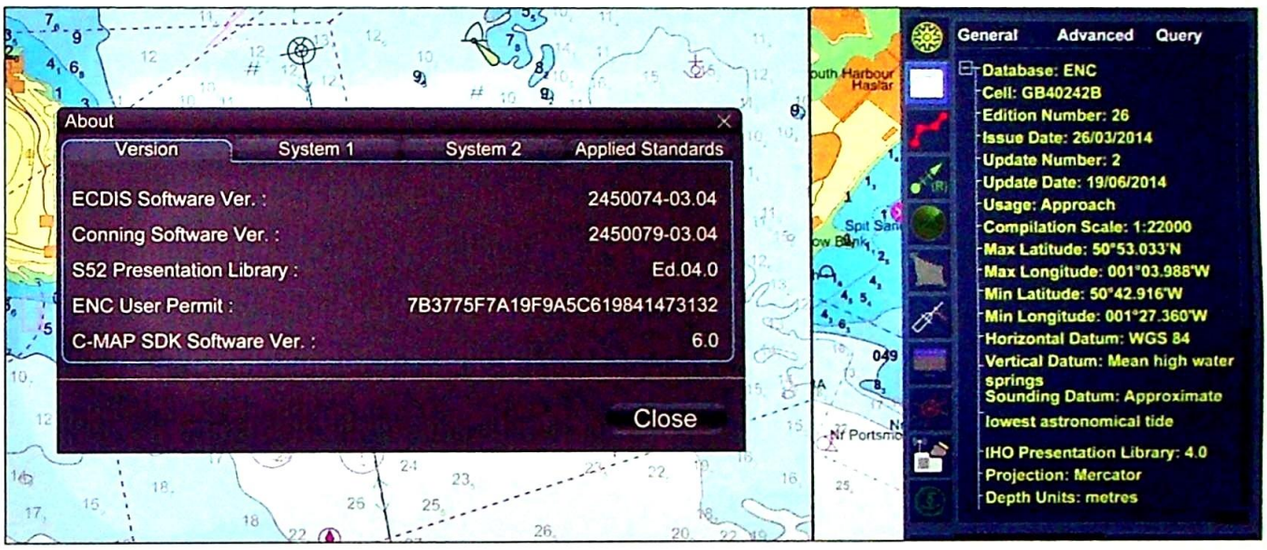
ECDIS operator to practise – The familiarisation checklist in Volume 2 of this publication must be completed and understood to prove familiarisation with the system.

Pre-Inspection Activity 5 – Out of Date (not PL 4.0) (05 mins)

In 2018, there were 71 observations (6.2%) relating to ships having not complied with the IMO implementation date of 31st August 2017 for the PL 4.0 update to software.

The navigator is to ensure that any software updates, including updates to the S-52 Presentation Library provided by the manufacturer, are installed, tested on all ECDIS and recorded.

ECDIS operator to practise – Locate the appropriate screen and ensure you are on 'PL 4.0'. It may state 'Presentation Library' rather than 'PL', as shown below on the Kelvin Hughes system.



Pre-Inspection Activity 6 – Security/Cyber Risk (USB) (05 mins)

This resulted in 62 observations in 2018, which was the first year that such observations have been made.

ECDIS units typically (2019) do not have virus protection and are, therefore, vulnerable to attack.

An infected ECDIS could lead to catastrophic failure of the system. To prevent a harmful virus infecting ECDIS, it is crucial that there is a procedure in place regarding the use of USBs and CD/DVD media inserted into ECDIS. It is recommended that the use of USB sticks is restricted to a single USB stick that is only used within the LAN. USB sticks and CD/DVDs should be virus checked prior to insertion into ECDIS. The navigator must ensure that a robust system exists and that all operators are briefed accordingly.

ECDIS operator to practise – Ensure all non-essential USB sticks are removed from the bridge, and only 'clean' media is utilised for chart updates.

Pre-Inspection Activity 7 – Route Appraisal and Scan Route (10 mins)

While observations dipped in 2017, these were 24 route checking observations in both 2016 and 2018.

It is critical to note that the Route Check function will only detect certain categories of danger to navigation that have been detected within the cross track limit of the planned route. Moreover, they will only be detected on ENCs, ie the system will not detect dangers on RNCs unless user charts with Danger Attributes have been set up. The Route Check is, therefore, not an infallible safety check and it will be necessary to check the entire route at 1:1 scale as a final check.

ECDIS operator to practise – Locate the Route Check function and check that the scan route automatically looks for the presence of the following groups of dangers to navigation within the zone limited by the channel limit (the parameters that the ECDIS in use utilises to highlight potential hazards and dangers is to be known and tested by the ECDIS operator):

- Safety Contour
- Isolated Dangers to navigation
- saved and loaded objects with danger attribute associated in user charts.

Pre-Inspection Activity 8 – Route Planning (10 mins)

In 2018, 39 ships received an observation that ECDIS operators (including Masters) did not know how to passage plan on the ECDIS and add appropriate safety parameters.

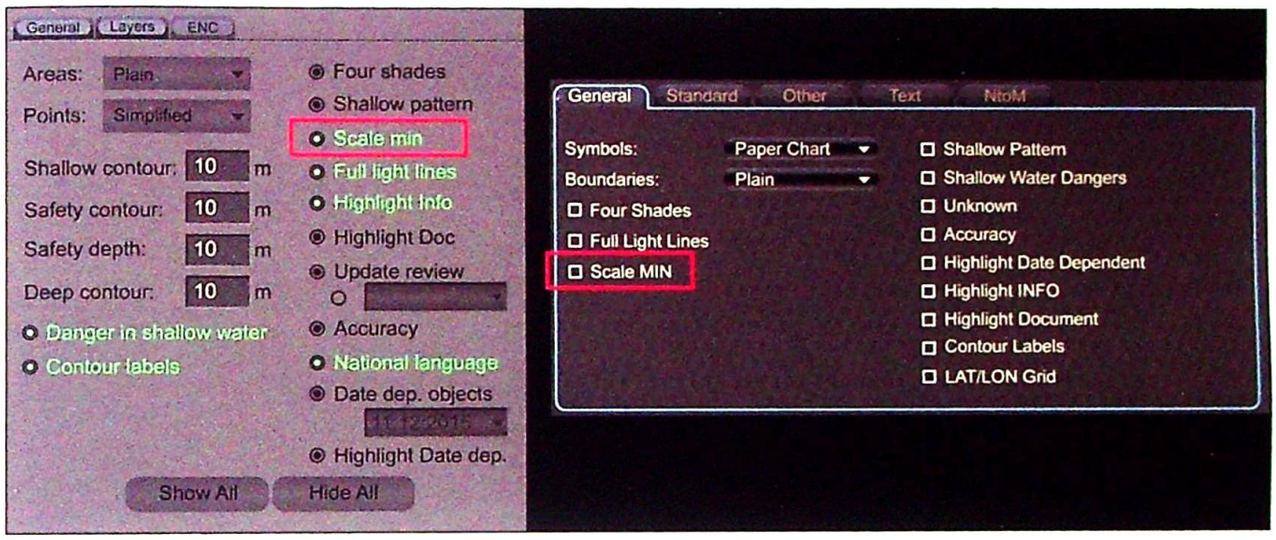
ECDIS operator to practise – Locate the menu to create a route (examples below based on FURUNO and Transas) and identify how to:

- Adjust turning radius
- XTD
- name waypoints.

Pre-Inspection Activity 9 – SCAMIN (05 mins)

While SCAMIN observations reduced across 2016–2018, it is essential that ECDIS operators understand that simply turning off the SCAMIN filter is not acceptable. The ECDIS system may crash or 'hang' when trying to process too much charted information.

ECDIS operator to practise – Locate the menu to turn on or off the SCAMIN filter. It may be labelled differently on certain models, which is demonstrated in the following examples for JRC and FURUNO systems.



Pre-Inspection Activity 10 – Berth to Berth Planning (15 mins)

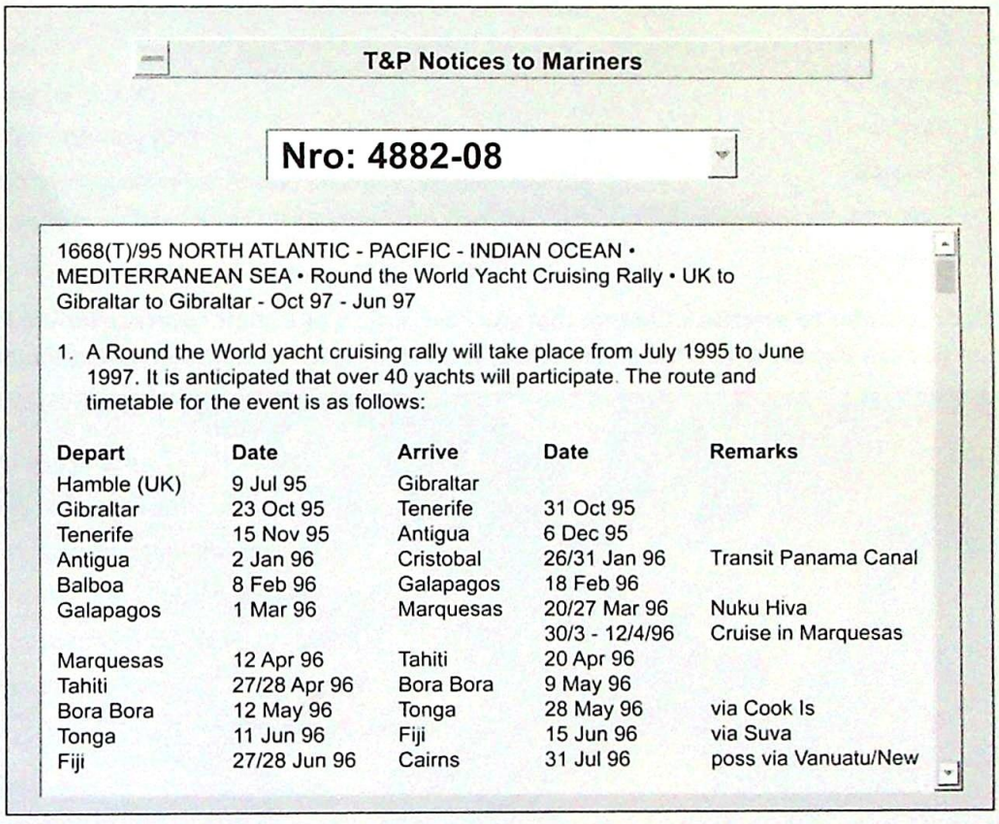
ECDIS operator to practise – Ensure you can:

- Plan berth to berth
- plot 'No Go' areas, safety limits/warning areas or PIs/clearing bearings (example below)
- set correct advance and transfer or turning circles.

Pre-Inspection Activity 11 – Misunderstanding T&P and NAVTEX Integration (05 mins)

ECDIS operator to practise – Conduct a spot-check on the following and ensure they are plotted:

- ENC updates
- nav warnings
- T&Ps.



Pre-Inspection Activity 12 – Not Maintaining Suitable Chart Coverage (05 mins)

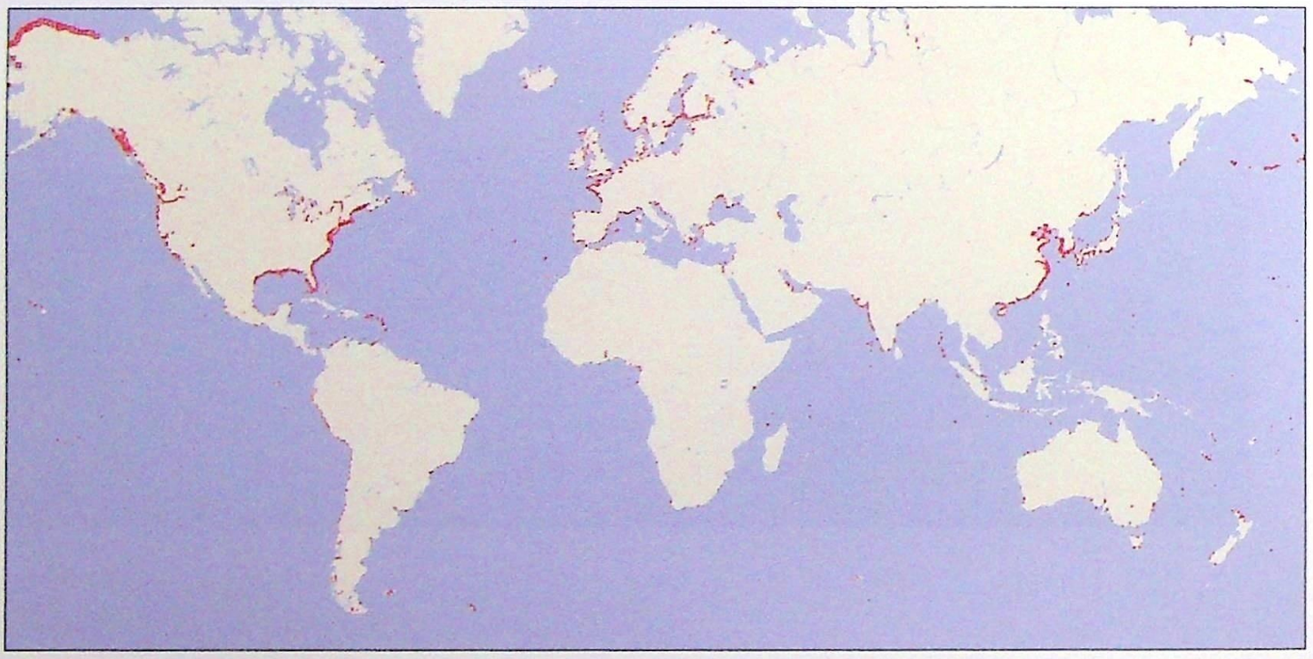
Observations reveal that inappropriate scale charts that do not conform with SOLAS have been used and that ECDIS operators demonstrate a lack of understanding of chart scale numbers.

For example GB50202 is a harbour chart, the '5' indicates harbour scale.

The other scales in use are:

- 6 berthing
- 5 harbour
- 4 approach
- 3 coastal
- 2 general
- 1 overview.

ECDIS operator to practise – Confirm that you have scale 5 or 6 chart coverage for the last and next port and that you can identify where the scale number is located either on the screen or in the menu system.



Global Scale 5 ENC coverage – 2019 (www.iho.int)

Pre-Inspection Activity 13 – Cyber Security Awareness of Integrated ECDIS Equipment (15 mins)

On many newbuilds, the ECDIS is connected to far more than simply navigation equipment. It is often connected to Engine Room systems, communication systems and planning terminals, stability calculations and even ships' alarms systems.

ECDIS operator to practise – Add/Cross through the below list to confirm what the ECDIS is connected to, then ensure this is in accordance with your SMS and Cyber Management policy.

Bridge systems

- Positioning (GPS, etc)
- dynamic positioning (DP)
- electronic navigation systems and propulsion/manoeuvring systems
- automatic identification system (AIS)
- global maritime distress and safety system (GMDSS)
- radar equipment
- voyage data recorders (VDRs)
- other monitoring and data collection systems.

Communication systems

- Integrated communication systems
- satellite communication equipment
- voice over internet protocols (VOIP) equipment
- wireless networks (WLANs)
- public address and general alarm systems
- systems used for reporting mandatory information to public authorities.

Engine management and power control

- Engine governor
- power management
- integrated control system
- alarm system
- emergency response system.

Control systems

- Surveillance systems such as CCTV network
- bridge navigational watch system (BNWAS)
- shipboard security alarm systems (SSAS)
- electronic 'personnel-on-board' systems.

Cargo management

- Cargo control room (CCR) and its equipment
- onboard loading computers and computers used for exchange of loading information and load plan updates with the marine terminal and stevedoring company
- remote cargo and container sensing systems
- level indication system
- valve remote control system
- ballast water systems
- water ingress alarm system.

Passenger management systems

- Property management system
- electronic health records
- financial related systems
- ship passenger/visitor/seafarer boarding access systems
- infrastructure support such as domain naming system (DNS) and user authentication/authorisation systems.

Public networks

- Passenger WiFi or local area network (LAN) internet access, for example, where onboard personnel can connect their own devices
- guest entertainment systems.

Infrastructure systems

- Security gateways
- routers
- switches
- firewalls
- virtual private network(s) (VPN)
- virtual LAN(s) (VLAN)
- intrusion prevention systems
- security event logging systems.

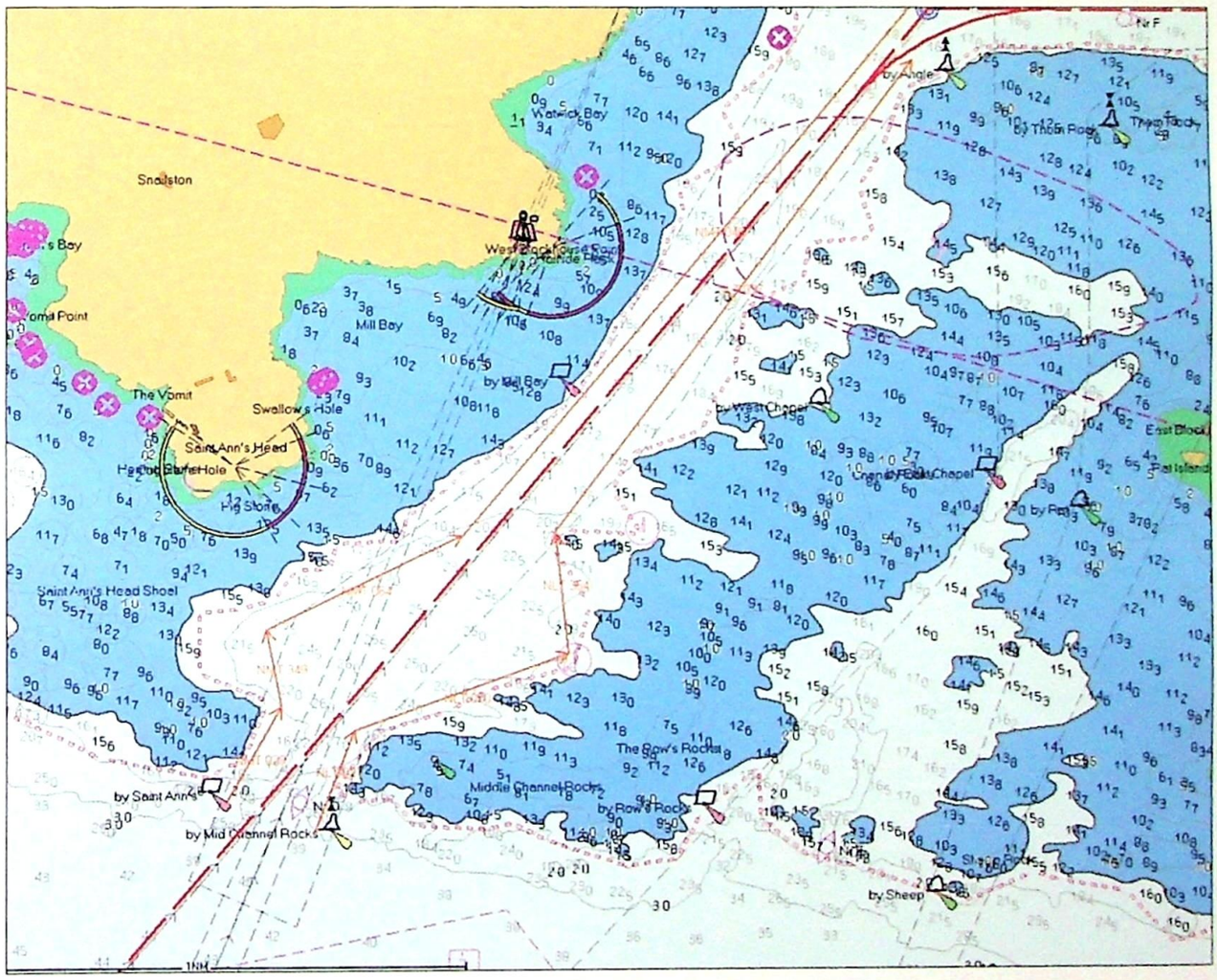
Administrative and crew welfare systems

- Administrative systems
- crew WiFi or LAN internet access, for example, where onboard personnel can connect their own devices.

Pre-Inspection Activity 14 – Production of 'No Go' Areas (15 mins)

Due to the lack of contour data currently available within ENCs, the operator is not able to fully utilise the Safety Contour as a means of defining safe water. It can be seen therefore, that if the ship by necessity has to proceed over soundings of less than the contour but greater than the Safety Depth, safe areas cannot be defined automatically with the Safety Contour and it is therefore dangerous.

A solution to this problem is the drawing of 'No Go' areas. This is a tried and tested technique that works on RNCs as well as ENCs. It is a manually inserted danger line that will alarm when the look-ahead touches it, replacing the Safety Contour when the Danger Detection Area crosses it. By doing this, a bespoke Safety Contour is effectively created by the ECDIS operator.



ECDIS operator to practise – Go to your next port and practise adding manual 'No Go' areas to highlight safe water.