INTERTANKO

Guide to Safe Navigation (including ECDIS)

TWENTY 17

Guide to Safe Navigation (Including ECDIS)

1st Edition 2017

(Rev. 1)

1. Introduction

During the INTERTANKO Safety and Technical Committee (ISTEC) meeting in London (9-10 March 2016) it was decided that the "Navigation, Safety, Ports and terminals working group" should become a Sub-Committee of ISTEC. Formal approval of this change was taken by the INTERTANKO Council in May 2016.

In the Terms of Reference (TOR) it is stated that the Nautical Sub-Committee (NSC) should meet twice a year intersessional to ISTEC's meetings.

INTERTANKO Nautical Sub-Committee

Main aims:

- Promote safe navigation and enhance navigational standard, safe loading/discharging operation and INTERTANKO's viewpoint on ports and terminals through communication and experience sharing.
- Support the INTERTANKO representation in IMO and other industry meetings so as to ensure proper representation.
- Advise and develop industry best practice in order to promote efficient and professional operation in matters pertaining to the Sub-Committee to keep INTERTANKO as a leader in the industry.
- Take active part in developing resource materials, BMP, Guides etc. for the wider membership.
- Foster co-operation with bodies such as OCIMF, Nautical Institute, International Hydrographic Organization (IHO), International Association of Ports and Harbors (IAPH), European Sea Ports Organisation (ESPO), International Harbour Masters Association (IHMA), International Maritime Pilots' Association (IMPA), Federation of European Tank Storage Associations (FETSA) and other recognised bodies involved with tanker navigation, loading/discharging and ports and terminals.
- Support and exchange knowledge with academy and research activities in the areas concerned for the Sub-Committee, enabling INTERTANKO to take the lead in developing best practices.

One of the main issues for the NSC has been to create Guidelines for our Members when it comes to safe use of ECDIS during navigation, such as this document.

Companies are encouraged to prepare their own specific procedures while considering their operational profile, company policies, fleet diversity and existing safety requirements.

Once a company has created their specific procedures, a thorough validation process, including the need for proper familiarisation, on-board training and compliance with other industry guidelines such as ICS's *Bridge Procedures Guide* should be considered.

The only way to ECDIS performance excellence is through continuous training and establishment of an open forum where issues encountered with ECDIS operations are brought forward.

The NSC encourages all its members and all concerned industry stakeholders to send in ideas and issues regarding ECDIS operation and navigation in order that these Guidelines may be updated and, as such, always be the aid to safe navigation they are intended to be.

Please send ideas and issues to: **marine@INTERTANKO.com**

Capt. Pär Brandholm, Chairman of the Nautical Sub-Committee

2. Zone of Confidence (ZOC)

1) Definition

Source diagrams have been used on paper charts for well over 100 years to indicate the survey method and the date it was conducted. The direct link between the date of a survey and its dependability is based partly on the assumption that, as surveyors have always been limited by the capabilities of their instruments and equipment, it has been possible gradually to increase the accuracy and completeness of the work as, over the years, the instruments and surveying techniques have evolved and improved. The mariner weighs up these factors, usually in light of his own personal knowledge of the area, and makes prudent allowance for possible unreported or incompletely charted dangers to calculate an Under Keel Clearance (UKC).

The 'Quality of Data' (M_QUAL) object in an ENC is included to assist the Mariner in determining a safe value for their UKC. By having an understanding of the positional and depth accuracy of the information contained in the ENC the Mariner can make an informed decision as to the amount of UKC that will be necessary for their vessel while conducting a passage.

ENC Category Zone of Confidence (CATZOC):

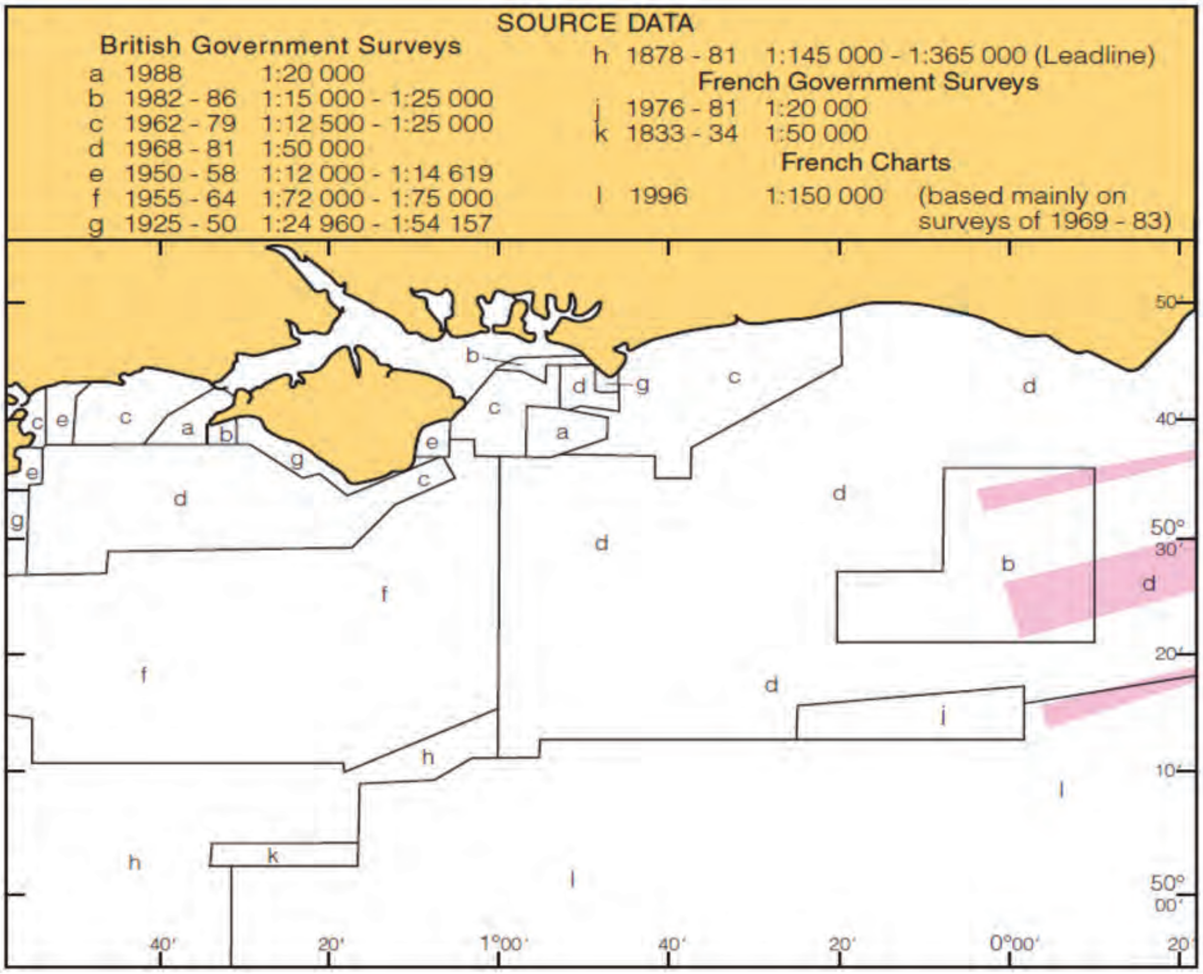
ECDIS present the Quality of Data object within the ENC as a repeating symbol across areas with the same value. The pattern of stars in the symbol is directly linked to the attribute value contained in 'Category Zone of Confidence' (CATZOC). A CATZOC attribute value of A1 will result in a triangular symbol containing six stars, this indicates the data is of a high quality and has been collected by modern survey.

A very recent development is the use of CATZOC on paper charts.

Consequently the ZOC is a system used to portray the quality of bathymetric data contained in Navigational Charts. A ZOC system allows a hydrographic authority to encode depth position data against five categories (ZOC A1, A2, B, C, D) with a sixth category (U) for data that has not been assessed. The assignment of category is based on three factors (position accuracy, depth accuracy and sea floor coverage) the details of each factor are given in Table 1.

The existing system of portraying bathymetric data in Navigational Charts is given as an example in (Fig 1).

Fig 1: Bathymetric data in navigational charts



The ZOC portrayal system of bathymetric data is currently being used in both paper charts (Fig 2) and Electronic Navigational Charts (Fig 3), both displayed overleaf, although the previous system (Fig 1) is still the prevalent portrayal system for paper charts. With this data in hand, the Mariner can easily identify at a glance which parts of the chart are based on good, or which are based on poor information, and accordingly where and when he/she should navigate with caution.

Fig 2: ZOC in Paper Charts

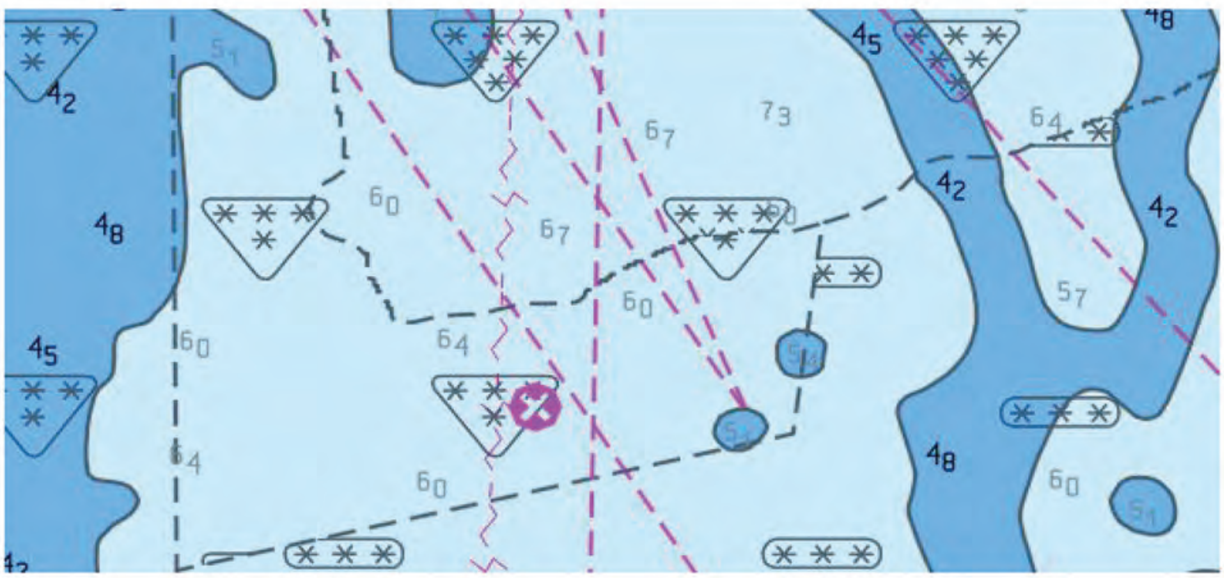


Fig 3: ZOC in ENCs

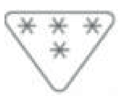
1	2	3	4	5
ZOC[1]	Position Accuracy[2]	Depth Accuracy[3]	Seafloor Coverage	Typical Survey Characteristics[5]
 A1	± 5 m + 5% depth	=0.50 + 1%d Depth (m) Accuracy (m) 10 ± 0.6 30 ± 0.8 100 ± 1.5 1000 ± 10.5	Full area search undertaken. Significant seafloor features detected[4] and depths measured.	Controlled, systematic survey[6]. 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	± 20 m	= 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[4] and depths measured.	Controlled, systematic[6] survey achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder[7] and a sonar or mechanical sweep system.
 B	± 50 m	= 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; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder, but no sonar or mechanical sweep system.
 C	± 500 m	= 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			

Table 1: ZOC table (source Admiralty publication NP100)

Explanatory notes quoted in the table:

1. The allocation of a ZOC indicates that that particular data meets the minimum criteria for position and depth accuracy and seafloor coverage defined in this Table. ZOC categories reflect a charting standard and not just a hydrographic survey standard. Depth and position accuracies specified for each ZOC 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. Data may be further qualified by Object Class 'Quality of Data' (M_QUAL) sub-attributes as follows:

a. Positional Accuracy (POSACC) and Sounding Accuracy (SOUACC) may be used to indicate that a higher position or depth accuracy has been achieved than defined in this Table (e.g. a survey where full seafloor coverage was not achieved could not be classified higher than ZOC B; however, if the position accuracy was, for instance, ± 15 metres, the sub-attribute POSACC could be used to indicate this).

b. Swept areas where the clearance depth is accurately known but the actual seabed depth is not may be granted a 'higher' ZOC (i.e. A1 or A2) providing positional and depth accuracies of the swept depth meets the criteria in this Table. In this instance, Depth Range Value 1 (DRVAL1) may be used to specify the swept depth. The position accuracy criteria apply to the boundaries of swept areas.

c. SURSTA (the start date of the survey), SUREND (the end date of the survey) and TECSOU (the method or equipment used to obtain the object's depth) may be used to indicate the start and end dates of the survey and the technique of sounding measurement.

2. Position Accuracy of depicted soundings at 95% CI (2.45 sigma) with respect to the given datum. It is the cumulative error and includes survey, transformation and digitising errors, etc. Position accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on the type of equipment used, calibration regime, historical accuracy, etc.

3. Depth accuracy of depicted soundings = a + (b*d)/100 at 95% CI (2.00 sigma), where d = depth in metres at the critical depth. Depth accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on type of equipment, calibration regime, historical accuracy etc.

4. Significant seafloor features are defined as those rising above depicted depths by more than:

	Depth	Significant Feature
a.	<40m	2m
b.	>40m	10% depth

A full seafloor search indicates that a systematic survey was conducted using detection systems, depth measurement systems, procedures, and trained personnel designed to detect and measure depths on significant seafloor features. Significant features are included on the chart as scale allows. It is impossible to guarantee that no significant feature could remain undetected, and significant features may have become present in the area since the time of the survey.

5. Typical Survey Characteristics – these descriptions should be seen as indicative examples only.

6. Controlled, systematic surveys (ZOC A1, A2 and B) – surveys comprising planned survey lines, on a geodetic datum that can be transformed to WGS 84.

7. Modern survey echosounder – high-precision single beam depth measuring equipment, generally including all survey echosounders designed post 1970.

8. The depth accuracy guidance found in NP100 does not require the accuracy values to be deducted from the charted depth but for the mariner to be aware of the likelihood of a different depth within the accuracy values.

2) ZOC and Passage Planning

With the advent of ZOCs (the assessment of depth accuracy of the charts) the issue of accounting for charted depth accuracy during passage planning has started to gain momentum.

ZOC depth uncertainty should be addressed during passage planning. Taking into account the Under Keel Clearance (UKC) policy of the Company and the ZOC data of the Chart, the Mariner eventually reaches either of the following outcomes (for each leg of the passage planned):

- The UKC required (the Safe Margin/Bottom Clearance) is greater (or equal) than the ZOC depth uncertainty
- The UKC required (the Safe Margin/Bottom Clearance) is less than the ZOC depth uncertainty.

When the UKC required (the Safe Margin/Bottom Clearance) is greater (or equal) than the ZOC depth uncertainty, there is no need for additional measures. Accordingly, it is recorded in the passage plan and no additional measures are taken.

When the ZOC depth uncertainty is greater (or equal) than UKC allowance required or, when ZOC category is "D" or "U" and the UKC is less than 50% of the ship's static draft, the Master illustrates these hazards at a dedicated Risk Assessment and sets the necessary mitigating measures in order to minimise the risks to tolerable levels basis the company's guidelines. Accordingly, the shipmaster, if so decided, in consultation with the head office, determines if the vessel can proceed through a sea leg of the passage plan where the ZOC depth uncertainty is greater (or equal) than the required UKC allowance.

Consideration should be given to the possible applicability of the below given controls in reaching such a decision:

- Up-to-date Navigational Charts Scale for the inland / port waters
- Other relevant Nautical Publications
- Caution Notes such as (Navarea messages, Navtex warnings, etc.)
- Bottom quality / nature of the sea bottom
- State of the water (calm or rough)
- Control of transit speed (to minimise squat)
- Accuracy of the ship's draught
- Channel transit during high water
- Manoeuvrability of the vessel
- Any other operational constraints that may be applicable due to vessel's UKC
- General and expected movement of traffic in the area.

Additional measures could include information obtained by Local Authorities such as the Harbour Master, Port Agent and Pilot regarding:

- Date of the most recent dredging
- Maximum allowed arrival/departure draft
- Most recent deepest arrival / departure draft (arrival and safe berthing of vessels of similar size and draft establishes a degree of safety for the transit under prevailing environmental conditions)
- Please note this is <u>not</u> an exhaustive list and other information may be requested.

When the pilot boards the vessel, the Master should present the passage plan to the pilot along with the UKC calculation of the transit. The Master should bring to the attention of the pilot the parts of the transit through shallow waters and discuss in detail the following points:

- the ship's dynamic UKC
- the uncertainties derived by the ZOC category of the Navigational chart covering the transit.

Masters should maintain a record of the exchange of information in the relevant SMS form (Master/Pilot exchange of information checklist).

3. Under Keel Clearance (UKC)

Each shipping company issues instructions on their own particular Under Keel Clearance (UKC) policy.

Below is an example of a generic, acceptable UKC policy. Members should produce their own policy. The generic policy here is for demonstration purposes only.

(a) Open/Deep Sea[1]

1. When the water depths are more than twice the vessel's static draft then no UKC calculations are required.

2. When the water depths are less than or equal to twice the vessel's static draft, the minimum UKC should be 50% of the static draft.

(b) Coastal Passage/Shallow waters passage[2] 20% of ship's static draft.

(c) Port approaches, channels, fairways 10% of the static draft.

(d) Alongside 1.5% of the vessel beam or 0.3m whichever is the greater.

(e) SBM/CBM should not be less than 20% of ship's static draft.

(f) At anchor

1. Unprotected waters should not be less than 20% of ship's static draft.

2. Protected/Sheltered waters should not be less than 10% of ship's static draft.

If Charterers[3], Port and Canal Authorities have rules that are stricter than the above criteria then such stricter UKC allowance should be adhered to. It is essential that information is made available to the vessel prior to fixing the vessel in order for the vessel to safely load.

The UKC applies to the dynamic condition of the vessel where variables as listed below are applied to the static draft.

(a) The effect of squat based on the vessel's speed through the water.
(b) The location of the vessel: open waters or confined waters.
(c) Environmental conditions such as: water density, prevailing weather, height of swell, tidal height and range, atmospheric pressure, local anomalies, current.
(d) The nature and stability of the bottom (e.g. sand wave phenomena, silting).
(e) Reduced depths over pipelines or any other obstructions.
(f) The vessel's size and handling characteristics and how the vessel squats, whether by head or stern.
(g) The reliability of the ship's draft observations and calculations, including estimates of hogging or sagging.
(h) Increase in draft due to heel when turning/rolling.
(i) Wave response allowance, which is the vertical displacement of the hull due to heave, roll and pitch motions.
(j) The accuracy/reliability of hydrographic data and tidal predictions. This is generally found described on tabulated source diagrams or as Zones of Confidence and takes into account how the depths were obtained originally, i.e. via hand leads or sophisticated survey methods (see chapter on CATZOC).

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[1] A vessel is considered to perform Open/Deep Sea passage when transiting at a distance more than 12 nm from the coastline.

[2] A vessel is considered to perform coastal passage/shallow waters passage when transiting at a distance equal to or less than 12 nm from the coastline.

[3] Please note that it might not be within the Charterers' contractual rights to ask Owners to adhere to a higher UKC allowance.

The dynamic draft is the draft of the vessel when it is subject to squat, sea and swell influences and increase of draft due to heel when turning / rolling or trim when pitching.

The static draft is the deepest draft when the vessel is not making way and is not subject to squat, sea and swell influences.

There may be occasions when the Master is unable to meet company UKC policy requirements, for instance he may have advice from the pilot on the basis of a maximum safe draft for the port. If this is the case, it is important that the Master consults with his technical operations department immediately and does not proceed until a full appraisal and risk assessment have been made to determine if passage may be carried out safely. The decision to proceed is ultimately at the Master's discretion. Local rules and practice should not be neglected in the assessment. In order to ensure these occasions are avoided, Charterers and Terminals should provide accurate and robust information at time of fixtures.

Masters should continue to seek the latest and most accurate data, utilising the latest editions of properly corrected charts, bearing in mind that locally validated data may be the most accurate. Hydrographic Offices rely on validated **local survey information** to ensure charts are up to date. When receiving data through Agents and Shippers, great care needs to be taken to cross check and to verify to the furthest extent possible that the data is **valid**. Port Authorities can often be a good source. This includes tidal data which can be quite different due to local anomalies. Best use of tides should always be made and with contingencies in place for unexpected events, e.g. if the berth becomes unavailable in a tidal waterway.

It is good practice in ports which are subject to silting or shoaling to sound round the vessel shortly after arrival when conditions permit. Silting/shoaling can frequently be noted on berths. It is also good practice and good seamanship to check the water density of the port upon arrival and, if the port is subject to water density changes due to tidal factors, then also check the water density at the high and low water phases.

Lastly it is also necessary for the Master to discuss with the pilot(s) the anticipated UKC. Accordingly, it is strongly suggested Master to present to the pilot the passage plan along with the UKC calculation of the transit. Master should bring to attention of the pilot the transits through shallow waters and discuss in detail the ship's dynamic UKC. It is also advised that Masters maintain a record of information exchanged in the relevant SMS form (Master/Pilot exchange of information checklist).

4. Area Settings

Sufficient information should be available on the electronic charts in use to safely navigate the vessel. On the top of the 'BASE' and 'STANDARD' display categories (by default selected), some additional information should also be displayed from the 'OTHER' display category, depending on the needs of the mariner. In order to optimise the information received from the bridge watch keeper, for each leg of the passage the following information from the 'STANDARD' and 'OTHER' display category are recommended to be selected:

Standard display				
Viewing Group Layer	Name of viewing group layer in the ECDIS	Open/Deep Sea	Coastal Passage	Approaches[1]
1	Display Base	X	X	X
2	Drying line	X	X	X
3	Buoys, beacons, aids to navigation	X	X	X
3.1	Buoys, beacons, structures	X	X	X
3.2	Lights	X	X	X
4	Boundaries and limits			
5	Prohibited and restricted areas		X	X
6	Chart scale boundaries			
7	Cautionary notes			
8	Ships' routeing systems and ferry routes		X	X
9	Archipelagic sea lanes	X		
10	Miscellaneous			
11	Spot soundings	X	X	X
12	Submarine cables and pipelines		X	X
13	All isolated dangers	X	X	X
14	Magnetic variation			
15	Depth contours	X	X	X
16	Seabed			X
17	Tidal			X
18	Miscellaneous			
Other display				
11	Spot soundings	X	X	X
12	Submarine cables and pipelines		X	X
13	All isolated dangers	X	X	X
14	Magnetic variation			
15	Depth contours	X	X	X
16	Seabed			X
17	Tidal			X
18	Miscellaneous			

[1] Including Anchoring and Berthing/Unberthing

5. Frequency of Position Fixing in Paper Charts and Frequency of Position Verification in ECDIS/ Chartradars

When paper charts were used, the frequency was heavily dependent on the hazards around the area of sailing. As a matter of fact, the frequency was such that the vessel could not run into danger during the interval between two fixes. At that time, without a position fixing, it is true, the Master was not aware of the vessel's position. Nowadays, the GNSS units constantly feed the ECDIS with position information and therefore the Master witnesses the vessel's position in real time. This is actually one of the main strong points of the ECDIS. Since the ship's position is "live" on a chart, spatial awareness is improved, making the decision making process simple and robust.

Taking into account the fact that the ship's position can be seen in real time, we should stop talking about position fixing. It should be called "position verification" since the position of the vessel is well known. In other words, the bridge watch keeper verifies that the vessel is indeed on the position appeared on the screen. Since the ECDIS consists of many parts, their harmonious interaction is verified. The bridge watch keeper has to verify that all of the following function harmoniously:

- the hardware (ECDIS unit)
- the software (the operating system, and ECDIS presentation software)
- and the data (ENCs, their corrections and GNSS signal).

To date there are no reports in the market for frequent ECDIS failures. In addition, as a piece of equipment its good working condition should be verified periodically, not constantly. Bearing in mind these two facts, it is not necessary for the position verification to be frequent. The following example will better illustrate the above statement. The steering gear is very important to safely navigate the vessel in confined waters. Yet, it is not tested every few minutes to verify its working condition. We rely on the pre-arrival test which is conducted many hours before the arrival at the port. The same applies to the main engine. It is tested ahead and astern before the arrival at the port and we rely on the test to safely enter a port.

The same should be applied on the ECDIS, particularly when the vessel is sailing in coastal waters/port approaches and the Master needs all the bridge team members to safely navigate his vessel. The accuracy of the system and its components should be tested periodically, not frequently. We should also take into account one more fact. In the era of the paper chart, the junior officers were only plotting position fixes on the chart and were unable to offer any other assistance to the Master. The position fixes were so frequent that in some instances they actually were not able to visually observe where the vessel was sailing, they were solely relying on the position plotted on the paper chart. If the same frequent intervals for position fixing are applied to the ECDIS, we will end up with the same bad practice, i.e., during the approach to a port, a junior deck officer solely takes the duty of position fixing and thus he minimises his input to the bridge team. In addition, the value of his duty is meaningless since the position of the vessel, as a piece of information, is already available to the Master.

Therefore, we recommend the following position verification intervals:

- Open/Deep Sea:
  While the vessel is at open sea, the accuracy of position verification is checked once every watch.
- Coastal Passage/Approaching, Anchoring and Berthing /Unberthing:
  In these cases, ship's position on the ECDIS is compared with other means at least every one hour.

Position verification methods include, but are not limited to, any or combination of the following methods:

- Visual observations
- Radar observations
- Parallel Index
- Radar Overlay[4]/ENC Underlay[5]
- Dilution of Precision (DOP) checking[6]
- Signal or Carrier to Noise Ratio (SNR or CNR).[6]

Whichever of the above methods the OOW may choose to verify the ship's position, it is necessary to mark the verification on the ENC. The methods available for plotting the verification on the ENCs vary depending on the options provided by each ECDIS maker. Options such as "Entering Position", "Event Mark", "User Map Editor" are just a few.

[4] An additional method that can be used by the Officer on Watch (OOW) to verify the ship's position is the Radar Overlay. Radar Overlay can be activated in order to determine the proper function of the unit. Should the coastal features described on the ENCs coincide with the radar echoes, the unit is functioning properly and no further action is deemed necessary.

[5] For vessels equipped with approved Chart Radars (IEC 62388 Chapter 11) the function of Chart Underlay on the radar(s) may instead be used by the OOW to verify the ships position in a similar way as for the above described Radar Overlay to ECDIS. A Chart Radar is an approved system that is intended to improve the position verification method for the OOW.

[6] These two methods should be used only for Open/Deep Sea. In coastal waters navigator will have other methods to verify GPS position.

6. Depth Contours in ENCs in Relation to Safety Contour and Safety Depth Function

1) Introduction

In the era of paper charts the colours defining different depth areas were permanently set. The mariner's only option to clearly distinguish between areas where he could safely navigate and areas he could not (No Go Areas) was to manually draw the outline of the No Go Areas and clearly mark them. By doing that the OOW had a clear picture which waters were safe to navigate through when monitoring the passage of the vessel.

The arrival of ECDIS has changed that. ENCs give the Navigator the option to change the colours of the various depth areas. He can effect this change by simply inputting in metres the safety contour ***(safety contour=depth boundary between 'safe' and 'unsafe' waters).***[7]

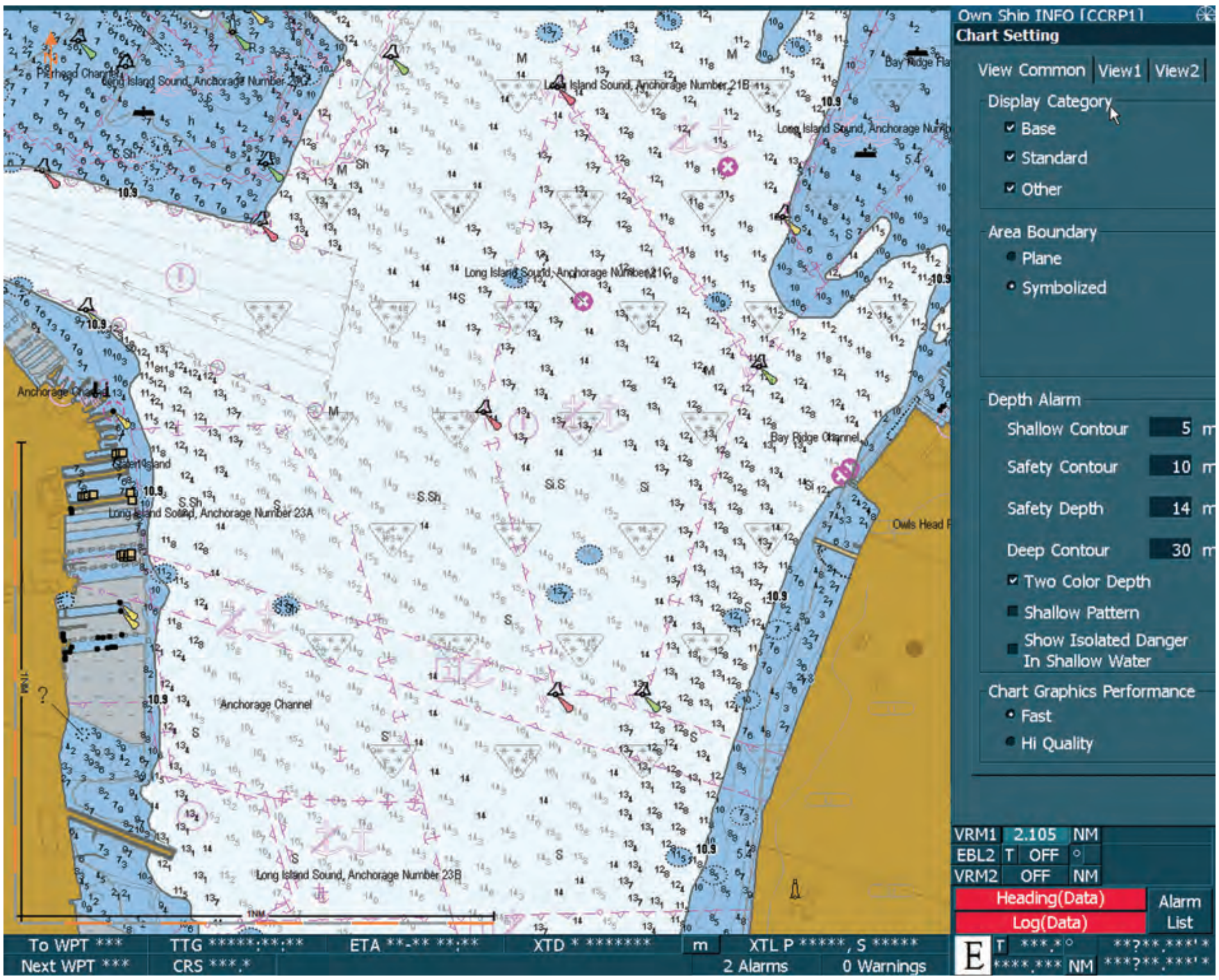

Fig 4: Safety Depth 14 metres, Safety contour 10 metres, Isolated dangers with a depth equal to or below 10m shown

[7] The safety contour as explained above intends to provide a visible boundary between 'safe' and 'unsafe' water with respect to depth, and is highlighted on the display to enable easy identification, however, to date and because of the limitation of available depth contours, the safety contour usually cannot perform this function. This is described at length in para 2) of this chapter.

The Navigator can further change how soundings are depicted by entering a safety depth in metres (all soundings with a shallower depth than the safety depth entered are shown in a bold font). This can be clearly seen in Fig 4 and 5 where the safety depth has been set to 14 metres.

The choice of safety contour is of great importance as it is used to trigger alarms and is also used to decide how and where on the chart isolated dangers (small shoals, rocks, wrecks, obstructions) are shown. This is in accordance with IMO ECDIS Performance Standards and IHO S52 Ed 6.1.1, where it is defined that isolated dangers of depth equal to or less than the own-ship safety contour must always be displayed in 'safe waters' (waters deeper than the safety contour). Systems must also provide the navigators with the option to decide if they want the isolated dangers displayed within 'unsafe waters' (waters between the safety contour and the zero metres contour). This can be seen in Fig 4 and 5. The latter option is given because, as we will see further on in the chapter, the mariner might be forced to navigate in such 'unsafe' waters.

In Fig 4 the safety contour is set to 10 metres and isolated dangers which result in depths of less than 10 metres are shown within the 'safe' waters area but not in the 'unsafe' waters area as the function "show isolated danger in shallow area" is not activated.

In Fig 5 the safety contour has been set to 20 metres so the isolated dangers which were visible with the previous setting of 10 metres are not visible anymore since the area enclosed by the safety contour is considered an 'unsafe' area as a whole and the "show isolated danger in shallow area" is not activated.

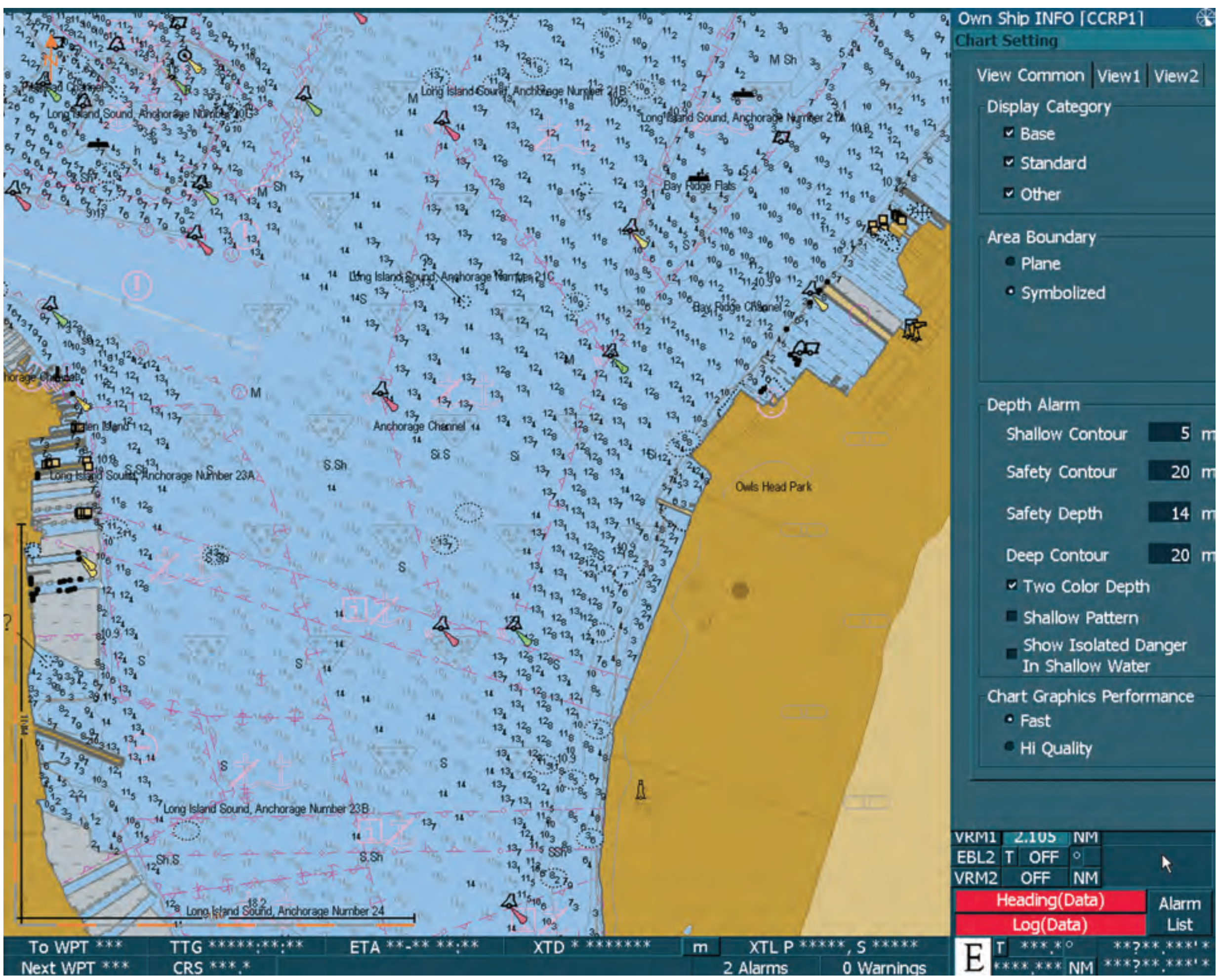

Fig 5: Safety Depth 14 metres, Safety contour 20 metres, Isolated dangers with a depth equal to or below 20m not shown, compare with Fig 4

The mariner finally has the option to choose between a two colour depth area pattern (shown in Fig 6 below and explained in table 2) and a four colour depth area pattern (shown in Fig 7 overleaf and explained in Table 3).

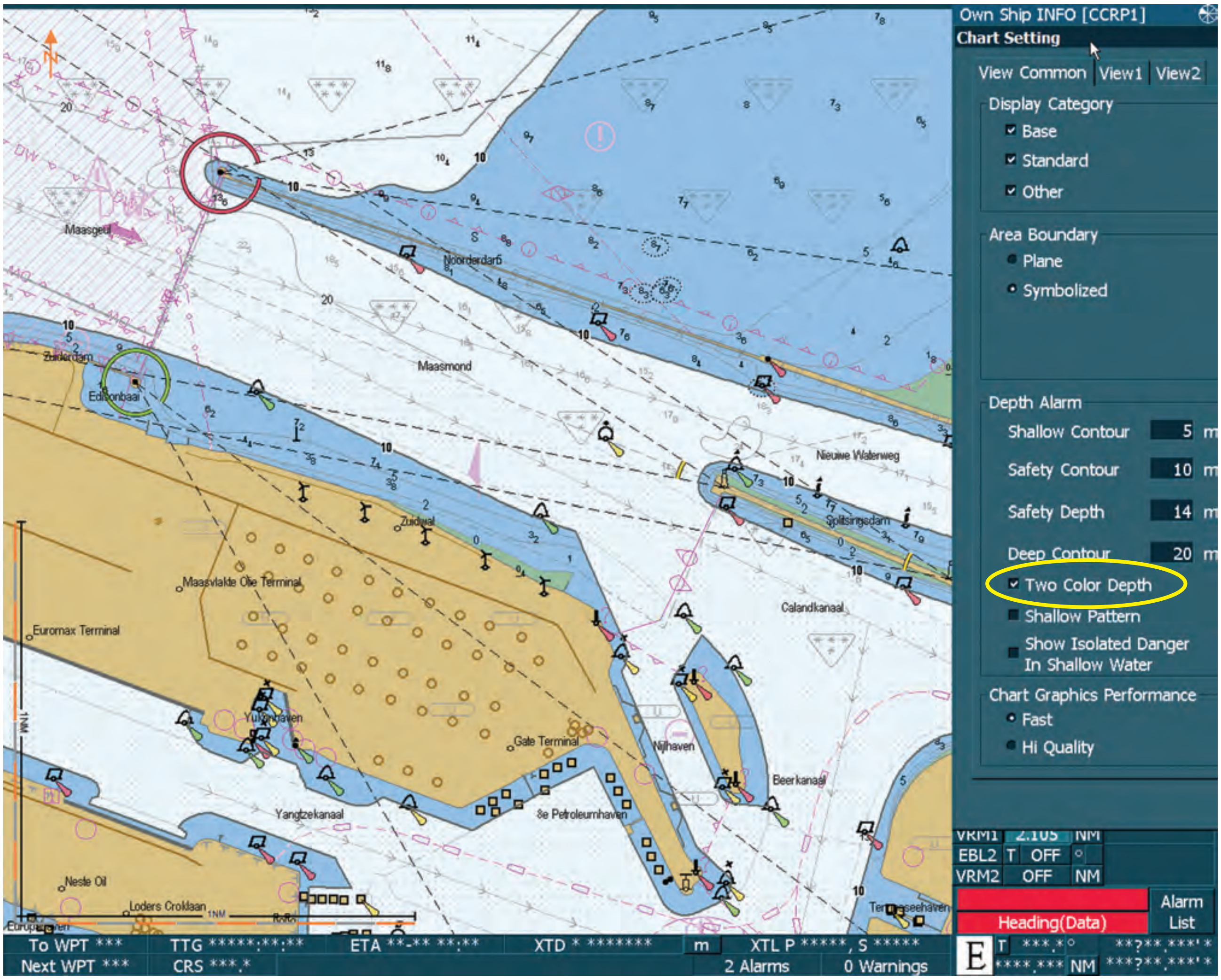

Fig 6: A sea area with "Two Colour Depth" display

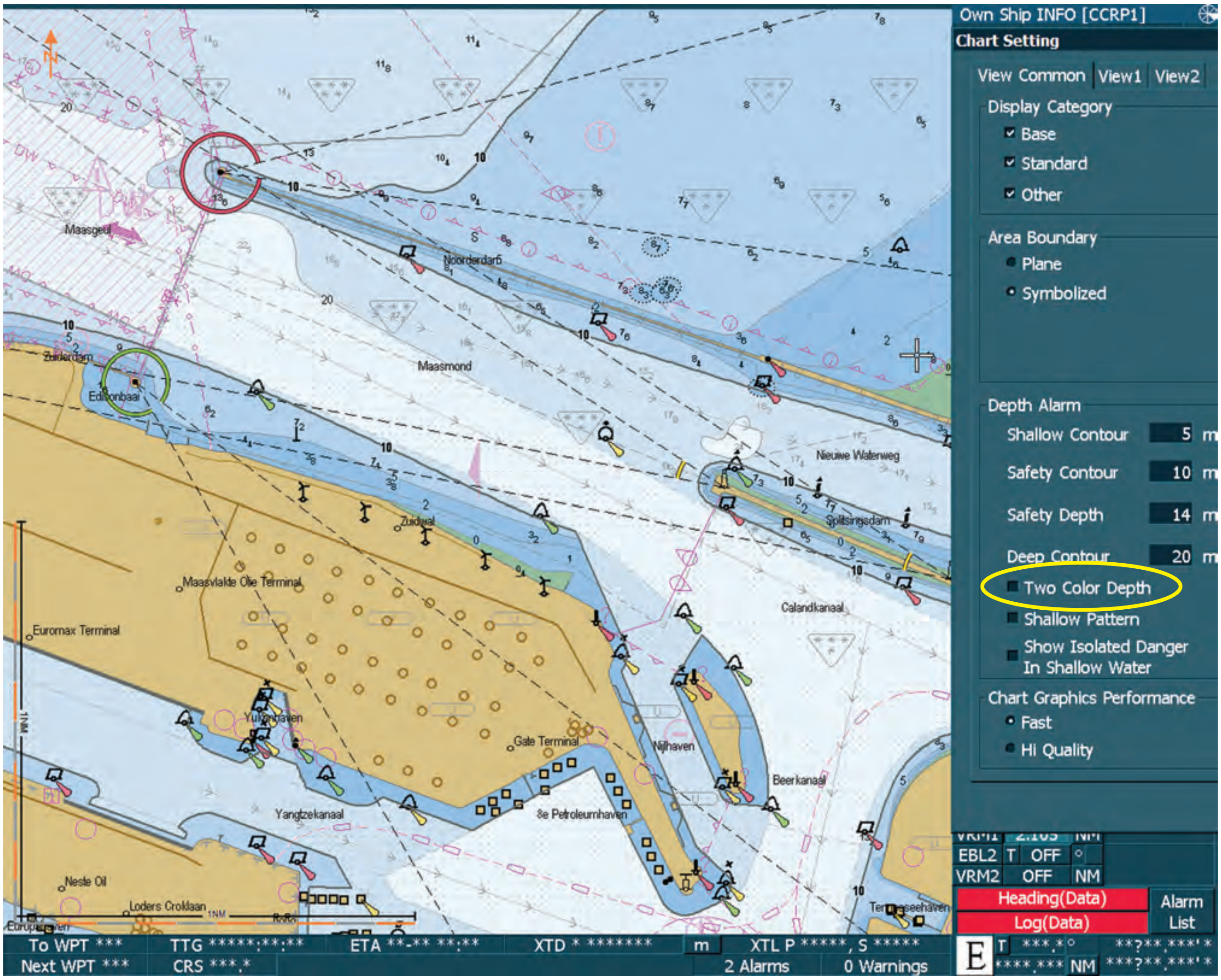

Fig 7: The same sea area as Fig 6 with “Four Colour Depth” display

TWO COLOUR DEPTH						
Area	***Colour***	***Navigational Information***	***Next deeper depth Area colour***	***Next Swallower depth area colour***	***Setting Defining deep border of area***	***Setting Defining swallow border of area***
Navigable Waters	White	Water deeper than the safety contour	N/A (deepest area for two colour setting)	Medium blue	N/A	Safety contour setting
Non Navigable Waters	Deep Blue	Water swallower than the safety contour	White	N/A (shallowest area for two colour setting)	Safety contour setting	N/A

Table 2

FOUR COLOUR DEPTH						
Area	***Colour***	***Navigational Information***	***Next deeper depth Area colour***	***Next Swallower depth area colour***	***Setting Defining deep border of area***	***Setting Defining swallow border of area***
Deep Waters	White	Waters deeper than the deep contour	N/A (deepest area for four colour setting)	Light Blue/Grey	N/A (area has no deep border)	Deep contour setting
Navigable Waters	(Light Blue) Grey	Waters deeper than the safety contour	White	Medium Blue	Deep contour setting	Safety contour setting
Non-Navigable Waters	Medium Blue	Water shallower than the safety contour	Light Blue/Grey	Deep Blue	Safety contour setting	Shallow contour setting
Shallow waters	Deep blue	Waters shallower than the shallow	Medium Blue	N/A (shallowest area for two colour	Swallow contour setting	N/A

Table 3

2) The Problem

In the best ENCs you get 5-10-15-20[8] metres depth contours but the safe draft (safe draft=dynamic draft+UKC requirement as per company policy) of ocean going vessels varies considerably and can be anywhere from 4 metres for a small gas carriers to 25 metres for a ULCC. As one can imagine it is a very rare occurrence that the safe draft of a vessel coincides exactly with the currently available depth contour.

Depending on the safe draft of the vessel and the available depth contours there are the two possible scenarios.

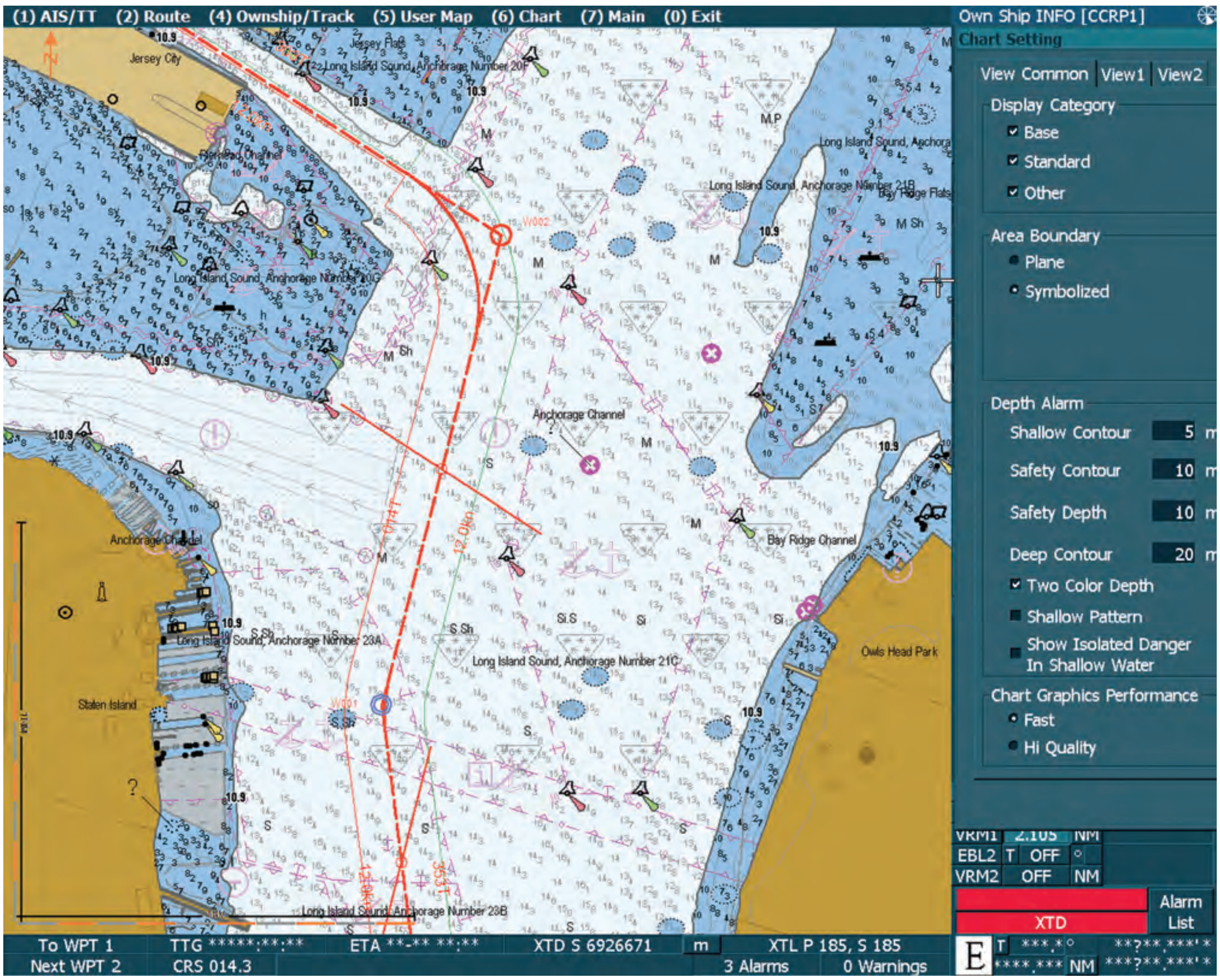

Fig 8 Safe draft equal with one of the available depth contours

Scenario one: The safe draft of the vessel is equal with one of the available depth contours for example, the safe draft of the vessel is 10.9 metres and the depth contours available in the ENC are 5.4-9.1-10.9-18.26 metres.

[8] Please note that there might be variations of the 5-10-15-20 metres contour pattern when the charts are based on fathoms soundings. In those situations we usually have 5.4-9.1-10.9-18.2 metres depth contours available.

Scenario two: The safe draft of the vessel is not equal with any of the available depth contours for example the safe draft of the vessel is 13 metres and the depth contours available in the ENC are 5.4-9.1-10.9-18.26 metres.

For scenario one the situation is clear (Fig 8, p22). The mariner will set the safety contour and safety depth equal to the safe draft. The safety contour will become the boundary that distinguishes between 'safe' and 'unsafe' waters and the depiction of this boundary will be clear to the OOW.

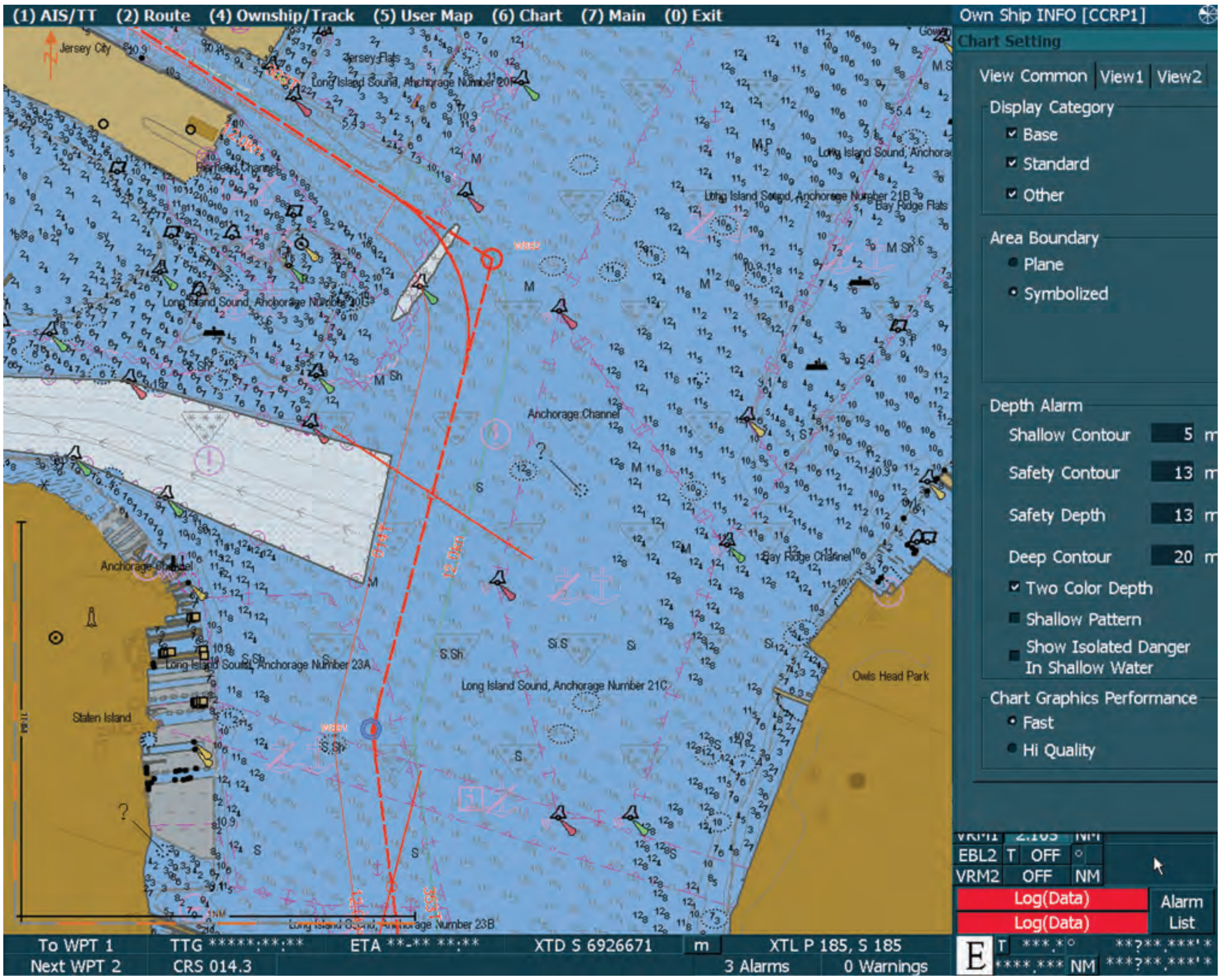

Fig: 9 Safe draft not equal with one of the available depth contours

For scenario two the situation becomes unclear (Fig 9 above). ECDIS systems are designed in such a way that when the selected safety contour does not coincide with an available depth contour they default to the next deeper depth contour. In the above example the safety contour will not perform its function namely, to be the depth boundary between 'safe' and 'unsafe' waters. This of course results in an ENC image that does not reflect the reality and herein lays the problem.

3) Possible Workarounds for Scenario #2

Scenario two can be addressed/worked around in a variety of ways. Each one has distinct advantages and disadvantages but all of them include the manual drawing of No-Go Areas so that the safe area is easily visible to the navigator. Any approach to this No-Go area will give a visible and audible alarm to the navigator. **Without drawing the No-Go Areas none of the following can be considered safe.**

i. Workaround #1

Two colour pattern is used.

Safety contour and safety depth are set equal to safe draft and No-Go Areas are drawn manually by the navigator.

Advantages

- Procedure for deciding the safety contour and safety draft are clear, simple and always remains the same, irrespective of the situation.
- Isolated dangers which are applicable for the vessel will be shown ***(please note that isolated dangers will be shown only if the function "show isolated danger in shallow area" is activated).***

Disadvantages

- Vessel will sail through blue waters, which is considered 'unsafe' in scenario one.
- Safety contour alarm will not sound at the proper depth but will sound at a much earlier stage.
- Area portrayed as 'unsafe' (area inside the safety contour) will not correspond to reality.
- Image not clear in dusk and night time setting.
- Misinterpretation and feeling of complacency by navigating with an activated anti-grounding alarm.

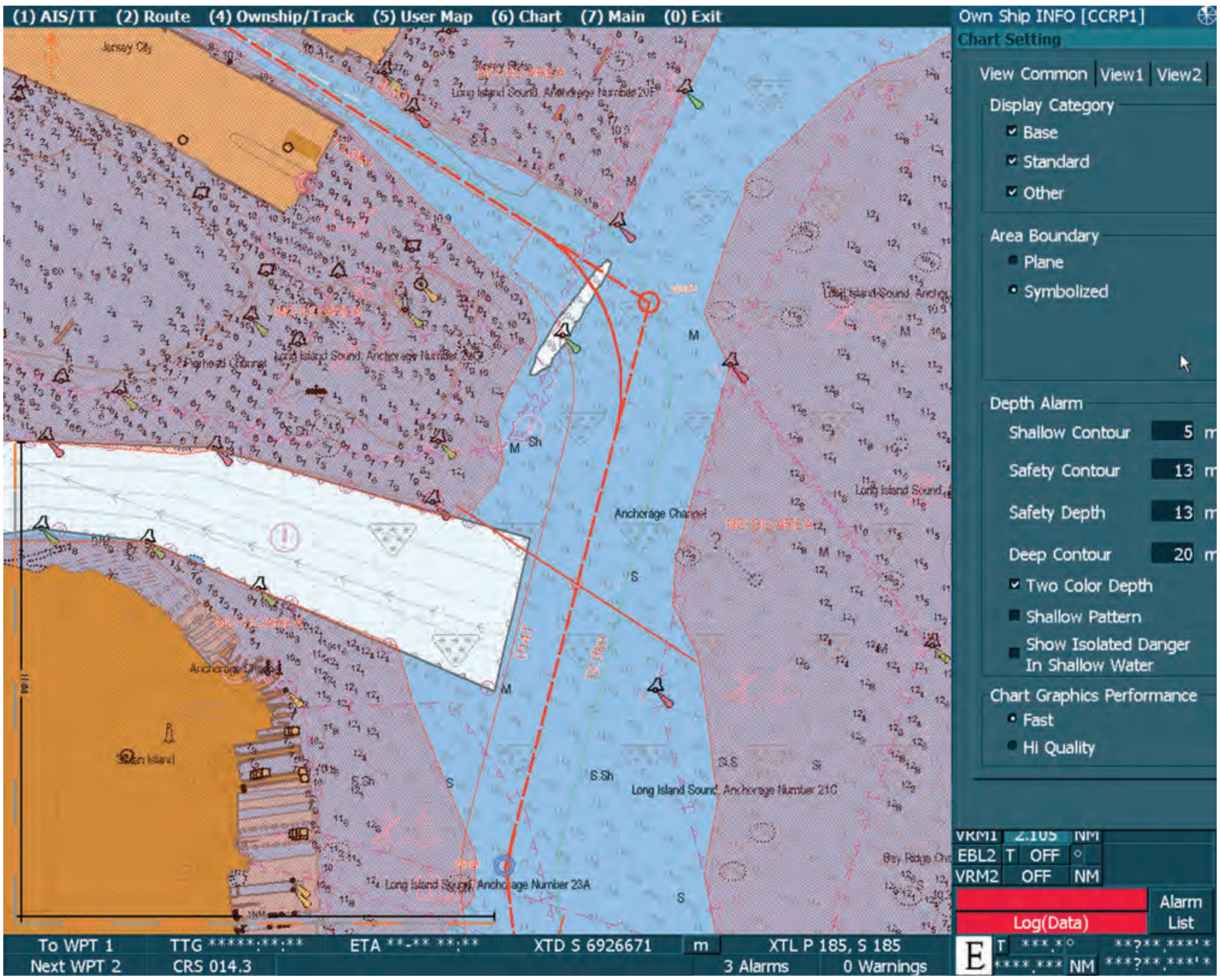

Fig 10: Safety contour=13m, Safety depth=13m, two color depth selected No-Go Areas are drawn manually by the navigator

ii. Workaround #2
Two colour pattern is used.

Safety contour is set to the previous shallower depth contour than the safe draft. For example if the safe depth is 13 metres and the available depth contours are 10m and 20m then the safety contour is set at 10m.

Safety depth is set equal to safe draft and No-Go Areas are drawn manually by the navigator.

Advantages

- Image clear even in dusk and night time setting.
- Applicable isolated dangers will be shown up to the safety contour depth setting.
- Vessel will sail through 'safe' waters. This might be considered as a disadvantage as more water will be portrayed as safe than what is actually safe but the advantage will be that the navigators are getting accustomed to how the display should look.
- Safety contour alarm will not sound without it being actually applicable.

Disadvantages

- Procedure for setting depth alarm settings (safety depth, safety contour) is more complicated than the procedure in Workaround #1
- Area portrayed as safe (area outside the safety contour) does not correspond to the reality.
- Safety contour alarm will not sound at the proper depth but will sound at a later stage.

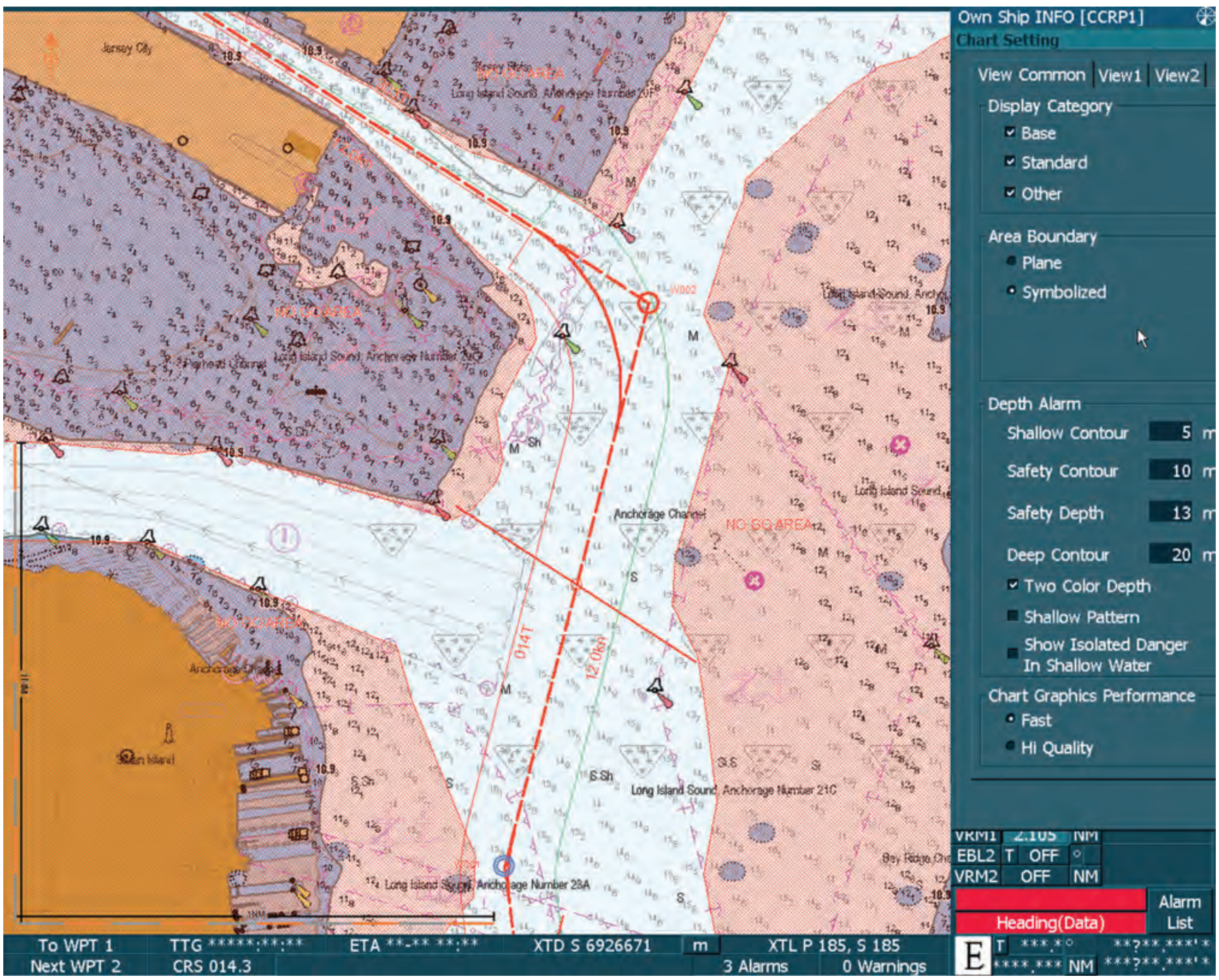

Fig 11: Safety contour=10m, Safety depth=13m, two color depth selected and No-Go Areas are drawn manually by the navigator

iii. Workaround #3
Four colour pattern is used.

Safety contour is set to the previous shallower depth contour than the safe draft. For example if the safe depth is 13 metres and the available depth contours are 10m and 20m then the safety contour is set at 10m.

Deep contour is set to the next deeper depth contour than the safe draft. For example if the safe depth is 13 metres and the available depth contours are 10m and 20m then the deep contour is set at 20m.

Shallow contour may be set to any available contour lower than the safety contour.

Safety depth set equal to safe draft and No-Go Areas are drawn manually by the navigator.

Advantages

- Applicable isolated dangers will be shown up to the safety contour depth setting.
- Vessel will sail through 'safe' waters. This might be considered as a disadvantage as more water will be portrayed as safe than what is actually safe but the advantage is that the navigators are getting accustomed to how the display should look.
- Safety contour alarm will not sound without it being actually applicable.
- The navigable waters area in this case is narrower and provides to the navigator an extra visual warning that they are approaching dangerous waters.
- No doubt about the safety of the white area (deep water area in the four colour pattern) as this area is clearly distinguishable and contains all of the area which is deeper than the deep contour setting.

Disadvantages

- Procedure for setting depth alarm settings (safety depth, safety contour, deep contour, shallow contour) more complicated than the procedure in workaround #1 and workaround #2
- Area portrayed as safe (area outside the safe contour) does not correspond to reality.
- Safety contour alarm will not sound at the proper depth but will sound at a later stage.

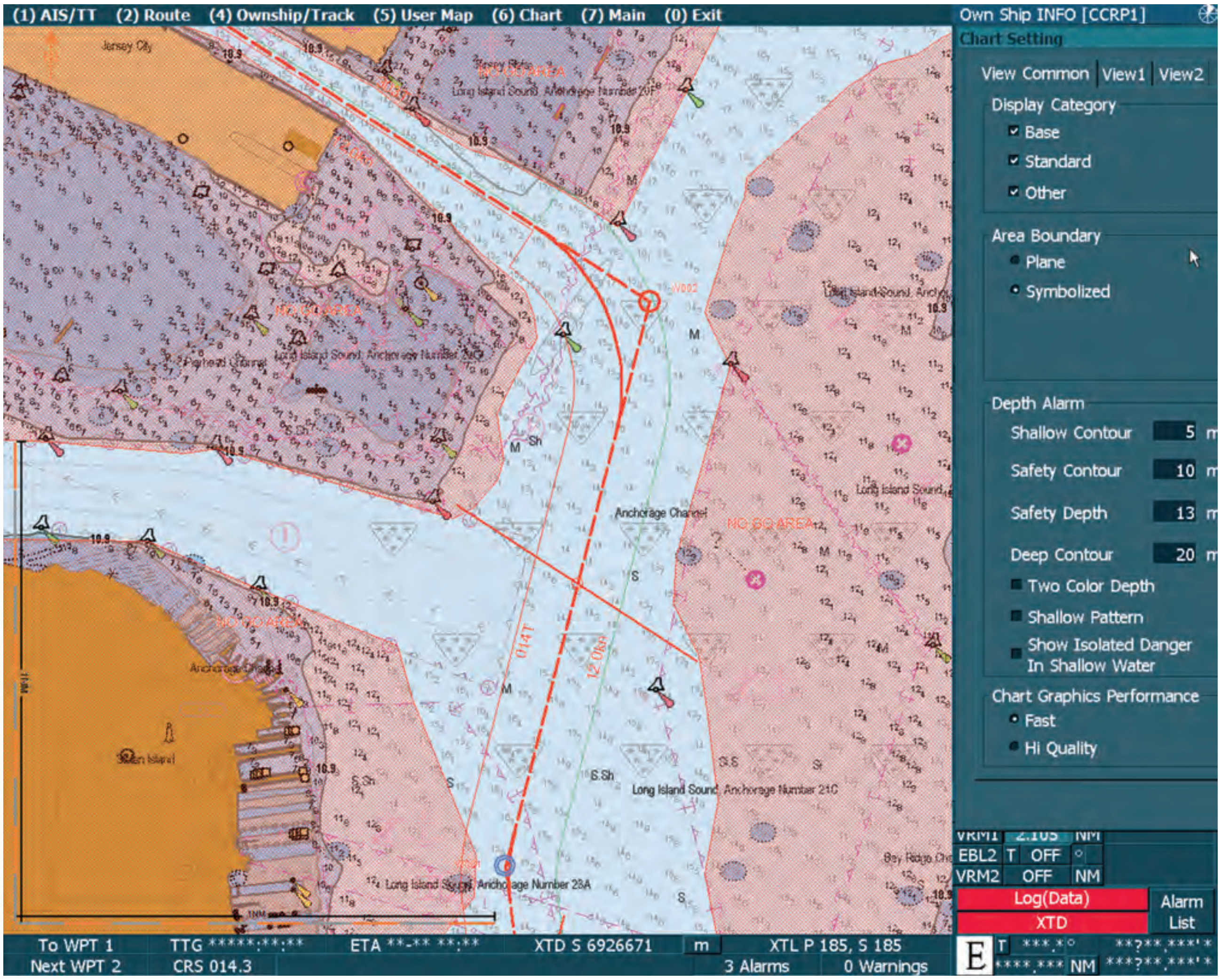

Fig 12: Safety contour=10m, Safety depth=13m, Four Colour Depth selected and No-Go Areas drawn manually by the navigator

4) Conclusion

Until the day when bathymetric data are portrayed in ENCs with greater density (so that the safe draft always coincides with a depth contour) each company should choose for itself one of the above workarounds after it weighs each one's advantages and disadvantages.

It is worth clarifying the fact that the main tool to clearly distinguish between safe and unsafe waters remains the No-Go Area manually plotted by the navigator.

INTERTANKO, along with other industry stakeholders, will push regulators to legislate measures which will solve the problem.

7. Temporary and Preliminary Notices (T & Ps)

Temporary and Preliminary Notices is a paper chart feature that has somehow found its way into the digital chart domain.

Currently, there is no unified approach by Hydrographic Offices (HOs) with regards to their approach about T & Ps on general ENCs. A number of HOs include the T & Ps in the weekly corrections of their ENCs, while others do not. There are some HOs that do not produce T & P notices and also some for which the status of T & P production and their incorporation is unclear. Annex 1 contains the links to the two lists prepared separately by UKHO and PRIMAR showing the status of T & P production and incorporation in ENCs for all the HOs. The International Hydrographic Organisation (IHO) is aware of the problem and with the help of organisations such as INTERTANKO is trying to address it. IHO is developing guidelines for all HOs to ensure all hydrographic data, whether it has a temporal aspect or not, is promulgated via ENC updates. However, since this has not yet been put into force at the time of publishing, we have laid out below how this could be managed today.

However, the fact remains that the unresolved situation described above is a problem for Owners, Operators and Managers of seagoing vessels when they try to decide how they will manage the T & P application procedure for their fleets.

We recognise that there are currently two options available to address the issue.

The first option is only available for ECDISs which use Admiralty ENCs. Admiralty provides an option to users called Admiralty Information Overlay (AIO). The AIO feature is an optional additional overlay that can be turned on and off within ECDIS, independently of the display of ENC data. When activated it displays all the T & P notices produced by the UKHO as an overlay to the ENC and is intended to support passage planning and demonstration of compliance.9

Although the UKHO is trying its best to avoid duplicate presentation of T & Ps in ENCs, duplication of T & Ps remains an issue for ENCs made by HOs which produce and include T & Ps in the electronic navigational charts. IHO's Inter-Regional Coordination Committee has tried in the past to resolve the issue and in its 8th session reached a decision on Marine Information Overlays such as AIO. In its decision, IHO recommends to Member States that in order to avoid problems like the one described above, the HOs which are concerned are to work together bilaterally and agree on the content of the MIO before it is promulgated.

The second option is to enter the T & P notices manually into the ENCs. A log should be kept on board and used for inserting/removing/controlling all T & P notices as appropriate. Specifically, the Navigation Officer will go through the T & P notices in force during passage planning and see which T & Ps are applicable for the current voyage. The navigation officer will then use the drawing tool of the onboard ECDIS unit and insert/draw manually the T & P notice in the vessel's ECDIS unit. Finally, the Navigation officer monitors the validity and applicability of the T & Ps throughout the voyage and insert/remove as appropriate.

[9] AIO features are shown as simple polygons drawn on top of the ENC data with a text description. Where necessary, text and picture files are included to provide further detail. The Navigator should assess them and decide if, for the safety of navigation, the Notice should be inputted as an actual manual correction.

8. Air Draft

Each shipping company issues instructions on their own particular air draft policy. In order to assist Members, the following is what we understand to be generally deemed as safe and within the expectations of the oil companies.

The overhead clearance is calculated for each overhead object the mariner plans to pass under with the vessel. The overhead clearance is the difference between the highest point of the ship and the lowest point of any bridge, cable or other overhead obstruction.

Allowance should be made for tidal height and swell. In case of bridges with a maximum clearance in the centerline only, allowance should be made for the ship's steering performance and drift angle.

Many bridges of the suspension type have the highest point in a narrow section. In such cases the ship is required to pass with the highest point (normally the main mast) positioned in this narrow gap. The crew will, therefore, need to assess the ship's steering performance.

If there are currents or wind affecting the ship as she is passing under an overhead obstruction, the heading might need to be adjusted to maintain the desired course. In such cases the effect of this change in heading will need to be considered.

The minimum required overhead clearance to general obstacles should normally be **one (1) metre**.

Power lines need an additional safety margin due to the risk of electrical discharge between the ship and the power line. In some charts, the safe passing height that includes an extra margin is indicated, and in other charts the actual distance to the power line is shown. A ship's overhead margin to the indicated safe passing height should not be less than **two (2) metres**, unless the power line is confirmed powered off (in which case it is considered a "general obstacle").

Below is a summary of factors which can affect the overhead clearance:

- Ship's air draft, as measured from the baseline (keel)
- Ship (baseline) draft
- Effect of trim
- Movements in sea and swell
- Tidal height / water level.

If the Master, for operational reasons, wishes to reduce the stated safety margins, a formal risk is conducted and forwarded to the head office for approval/consent. The overhead clearance should never be equal to or less than zero, and should not be based on sinkage by squat. The results of the risk assessment should be included in the passage plan.

When making a risk assessment to decide on a safe overhead clearance, the following factors should be considered.

General

- Clearance according to chart or authorities
- Air draft of own ship
- Tidal height
- Width of the overhead clearance
- Steering performance and leeway
- Ship's movement in sea and swell
- Reliability of all data used in calculation.

Power lines

- Voltage – the risk of electrical discharge
- In rare occasions: Lower clearance due to heavy ice build-up on the cables.

9. Use of ECDIS on Ships Having Paper Charts as Primary Means of Navigation

When paper charts are used as the primary means of navigation, ECDIS equipment should be actively used by the bridge team during the whole voyage to the extent practicable, as if it were designated as the primary means of navigation.

In particular, the following requirements related to use of the ECDIS equipment should be complied with:

- Official ENCs providing coverage to an appropriate scale for navigation are available and used during sailing.
- All electronic charts for the intended voyage should be kept up to date.
- Plotting of the planned route should be carried out in the ECDIS equipment for the whole voyage, berth-to-berth. All ECDIS-related settings, checklists and plotting of information relevant to safety of navigation should be carried out by the crew to the extent appropriate for efficient and effective use of ECDIS as an aid for navigation during the voyage.
- The ship's positions fixed on the paper charts should be regularly cross-checked with the ship's positions on the ECDIS equipment.

It should be noted that there are Maritime Authorities which consider that the ECDIS should be used as the primary means of navigation. Where the Master/Company has decided to navigate using paper charts, the Maritime Authorities expect that a formal risk assessment would have been carried out and properly documented for inspection.

10. Annex I

Links for the two lists prepared by UKHO and PRIMAR showing the status of T & P production and incorporation in ENCs for all the National Hydrographic Offices:

UKHO: **https://www.admiralty.co.uk/AdmiraltyDownloadMedia/AVCS/ENC-TandP-NM-Status.pdf**

PRIMAR: **https://www.primar.org/t-p-notices**

11. Annex II

IHO S-52 ECDIS Presentation Library Edition 4.0 Main Changes

IHO S-52 Changes	Mariner's Benefits
A new section "Detection and Notification of Navigational Hazard" has been added. For each ENC feature and its associated attributes this defines the priority of the alert to be raised when a navigational hazard is detected.	Ensures all ECDIS raise the required alerts in a consistent manner, reducing training needs and improving safety at sea. Reduces the number of alarms raised as a result of ECDIS safety checking.
A new section "Detection of Areas, for which Special Conditions Exist" has been added. Lists the ENC features and attributes that will raise an indication or alert in the ECDIS as defined by the mariner	Ensures all ECDIS raise the required alerts in a consistent manner, reducing training needs and improving safety at sea. Reduces the number of alarms raised as a result of ECDIS safety checking.
Detecting the Safety Contour: The IMO ECDIS Performance Standard (PS) states that rocks, wrecks and obstruction detected inside the safety contour should result in an indication on the ECDIS. The previous edition of S-52 included rocks, wrecks and obstructions to the detection of the safety contour, resulting in alarms, as opposed to indications, being raised. They have been moved to "Detection and Notification of Navigational Hazards".	Reduces the number of alarms on ECDIS, whilst ensuring that the mariner remains aware of dangers as rocks, wrecks and obstructions will still be detected if they meet the "Detection and Notification of Navigational Hazards" criteria.
Added a new symbol 'Indication Highlight' – designed for warning and caution conditions that require an indication highlight on the ENC.	Clear and unambiguous presentation of features that require an indication highlight.
New standardised symbols have been added to identify where automatic ENC updates have been applied.	Ensures the mariner is aware of updates that have been applied automatically to their ENCs.
New symbol to indicate where in the ENC features with temporal attributes are located.	Will allow mariners to quickly identify where features that have temporal attributes are located, such as seasonal buoys, traffic separation schemes etc.
A means for the mariner to insert a date or date range within the ECDIS to display date dependent features.	Will allow the mariner the ability to plan and check routes, viewing the conditions they will encounter on a given date or time period in the future.
Ability to turn isolated dangers in shallow water on/off.	In certain circumstances mariners must navigate across the safety contour, this change allows the mariner the flexibility to navigate in shoal areas with or without the isolated danger symbol displaying on the ENC.
Mandatory selector for the display of the shallow water pattern.	Important feature in ECDIS as it becomes increasingly difficult to detect the changes in the ENC depth shades during night navigation.
Added guidance on the implementation of the optional "hover-over" function available for a limited number of ENC features.	If provided, the hover-over function speeds up the process of ENC enquiry by the mariner. The new guidance ensures that the hover-over function does not result in the ENC presentation becoming obscured.

IHO S-52 ECDIS Presentation Library Edition 4.0 Main Changes (cont...)

IHO S-52 Changes	Mariner's Benefits
Display of complete tidal stream panel in ECDIS pick report.	Provides the mariner with tidal data in a form that is similar to the paper chart equivalent.
Changes to S-52 display provisions: • Anchorage area – display of name in ENC; • Fairway – display of name in ENC; • Nautical publication – new visible presentation for the meta feature nautical publication.	Allows the mariner to navigate to an anchorage without the need to repeatedly interrogate each area on the ENC by: **1.** Presenting the name of fairway on the ENC for quick identification of location; **2.** Presenting a graphical indication on the ENC to give mariners the ability to easily select the nautical publication feature using the pick report.
Standardization of the ECDIS pick report.	Ensures all ECDIS present pick report information in a consistent manner, reducing training needs and improving safety at sea.
The viewing groups may be used by the mariner to customise the ENC information presented on the ECDIS display. The names of these viewing groups have been standardized.	Ensures all ECDIS use viewing group nomenclature in a consistent manner, reducing training needs and improving safety at sea.

Source: Information on IHO Standards related to ENC and ECDIS (International Hydrographic Organization)

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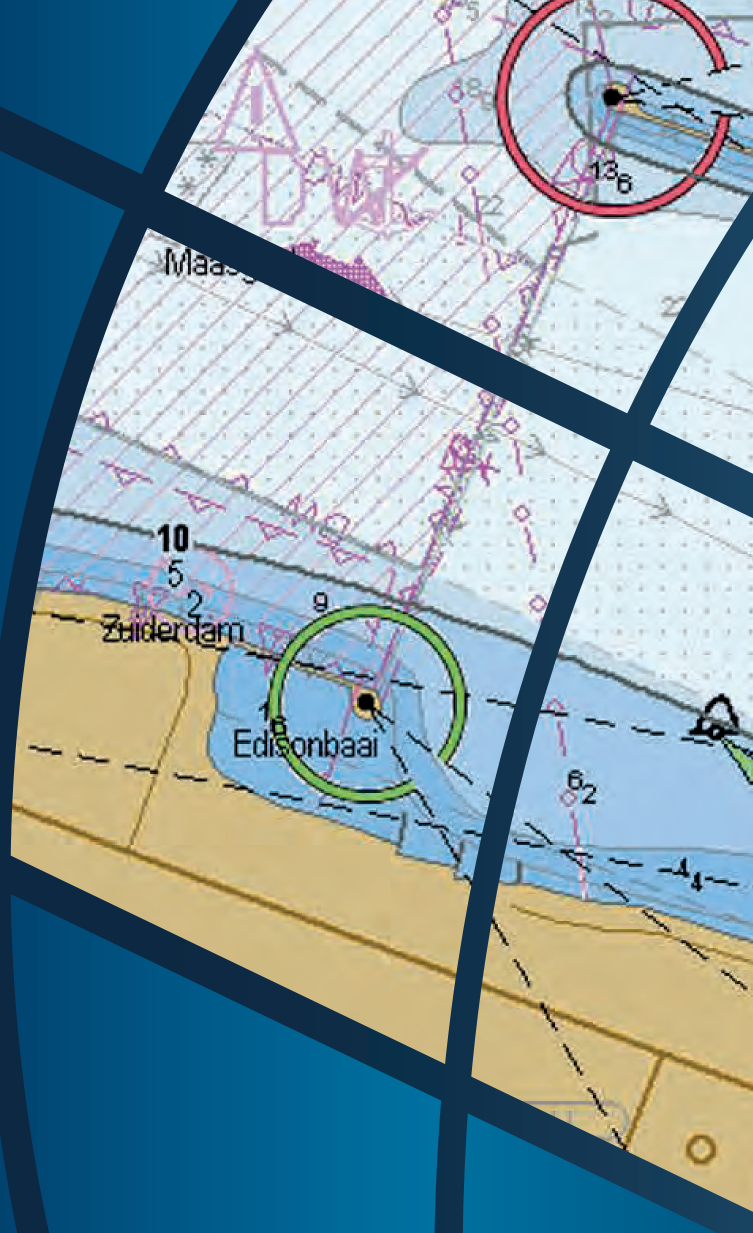

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