INTERTANKO

Guide to Safe Navigation (including ECDIS) 2nd Edition

TWENTY 21

INTERTANKO Guide to Safe Navigation (Including ECDIS) 2nd Edition 2021

Foreword

Shipping has evolved significantly over the years. Research in maritime safety and operations over the past few decades has been intensive and has resulted in significant improvements. Chart carriage requirements are now satisfied by using Electronic Chart Display Information Systems (ECDIS), which require careful handling and functional expertise by the end users. When used correctly, this technological leap offers a high level of navigational safety, while at the same time reducing the workload and increasing situational awareness.

However, the additional ECDIS features have introduced challenges; the voyage planning and execution processes have been affected significantly from this transition and require particular consideration and knowledge of how all the newly introduced functions should be handled and set up. As has been proven, when ECDIS functions are not used effectively, the intended advantage over paper charts is reduced.

With the aim of assisting operators and users, INTERTANKO'S Nautical Sub-Committee has produced the revised *Guide to Safe Navigation (Including ECDIS)* to standardise and clarify operational procedural uncertainties, cyber security vulnerabilities, correct configuration, alert management, contingency actions and many more.

I would like to thank the INTERTANKO Secretariat, Working Group chair (Capt. Iosif Voutsinos) and Working Group members (Capt. Rele Santosh, Capt. Antonios Prasinos, Capt. Virender Singh, Capt. Fletcher Martins, Capt. Peter Juul Christensen and Andrey Vorobiev) for their essential input and dedication.

Capt. Pantelis Patsoulis – Euronav

Chairman of the INTERTANKO Nautical Sub-Committee

Introduction

INTERTANKO's *Guide to Safe Navigation (Including ECDIS)* has become the standard reference publication used by navigators.

The first edition was published in 2017 and through the combined efforts of industry multidisciplinary subject matter experts, this second edition has been enhanced to reflect current best practice and legislation to ensure that it continues to maintain its position as a definitive reference guide for modern-day navigators in the vessel's wheelhouse.

It is important to point out that this is a guidance document only and that nothing stated must be strictly implemented or followed, rather the guidance can be used as a reference document, allowing the reader to 'pick and choose' those parts that are relevant according to the ships operated and their trading patterns etc.

Category Zone of Confidence (CATZOC)

Category Zone of Confidence (CATZOC) values are used to indicate the accuracy of data presented on charts to assist mariners with determining a safe Under Keel Clearance (UKC) as well as safe horizontal clearance from charted dangers.

Analysis of recent groundings shows that the accuracy of charted hydrographic information and/or failure to adequately assess the level of this accuracy as declared by a hydrographic office turned out to be major contributing factors for these accidents.

Consideration of the accuracy of the charted data is not new and not relevant only to ECDIS. Source diagrams on paper charts were supposed to be taken into consideration while planning a route and navigating on paper charts as part of good seamanship. Since the original survey data is the same – no matter if drawn on a paper chart or displayed as Electronic Navigational Charts (ENC) on the ECDIS, the problem of bathymetric data accuracy understanding by the mariner is valid for both cases

To facilitate the practical use of CATZOC definitions for voyage planning and monitoring, the International Hydrographic Organisation (IHO) has developed a special publication under the subject IHO S-67 "Mariner´s guide to accuracy of depth information in Electronic Navigational Charts (ENC)".

Zones of Confidence symbols in ENCs

There are two validations of Zones of Confidence:

- Assessed
- Unassessed

Areas that have been assessed are symbolised by the number of stars. Areas that have not been assessed are symbolised by the letter U.

The number of stars is an indication of the CATZOC value:

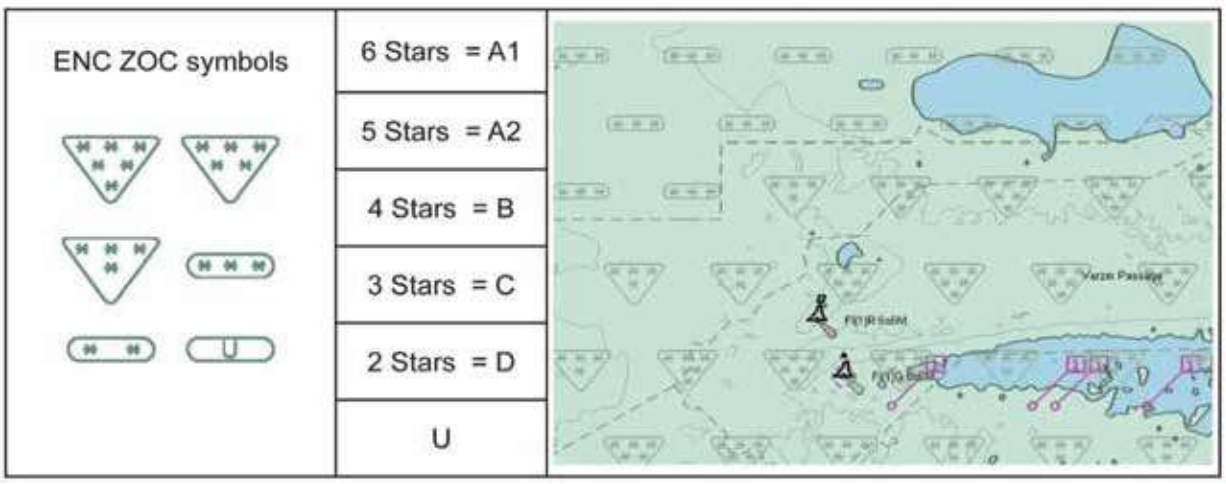
6 stars = A1 (in a triangle)

5 stars = A2 (in a triangle)

4 stars = B (in a triangle)

3 stars = C (in a horizontal bar)

2 stars = D (in a horizontal bar)



Zones of Confidence symbols, categories and depiction on an ENC

To view the Zones of Confidence symbology, the mariner is required to activate the "information on chart display layer" (or a similar setting, depending on the type of ECDIS used).

This kind of symbology tends to clutter the screen, therefore during execution of a voyage, mariners are recommended to de-activate this setting. However, when planning a new route or changing an existing route whilst en route, mariners are recommended to activate the CATZOC display and use the information provided to support their decision-making process before accepting the new route in the ECDIS system.

Quick reference:

- 5 stars or more = high accuracy depth information area.
- 4 stars = medium accuracy depth information area.
- 3 stars or less = poor accuracy depth information area.
- U = unassessed, take appropriate caution.

NOTICE TO READERS
For more information about the accuracy of depth information in ENCs, the most recent IHO publication on the subject, Mariners' Guide to Accuracy of Depth Information-S-67, can be accessed here: **https://bit.ly/3BY7ERn**

Practical steps to integrate ZOC assessment into route planning

As stated in IHO publication *S-67 Mariner's Guide to Accuracy of Depth in ENCs* (September 2020), the level of confidence on each ZOC classification is as follows:

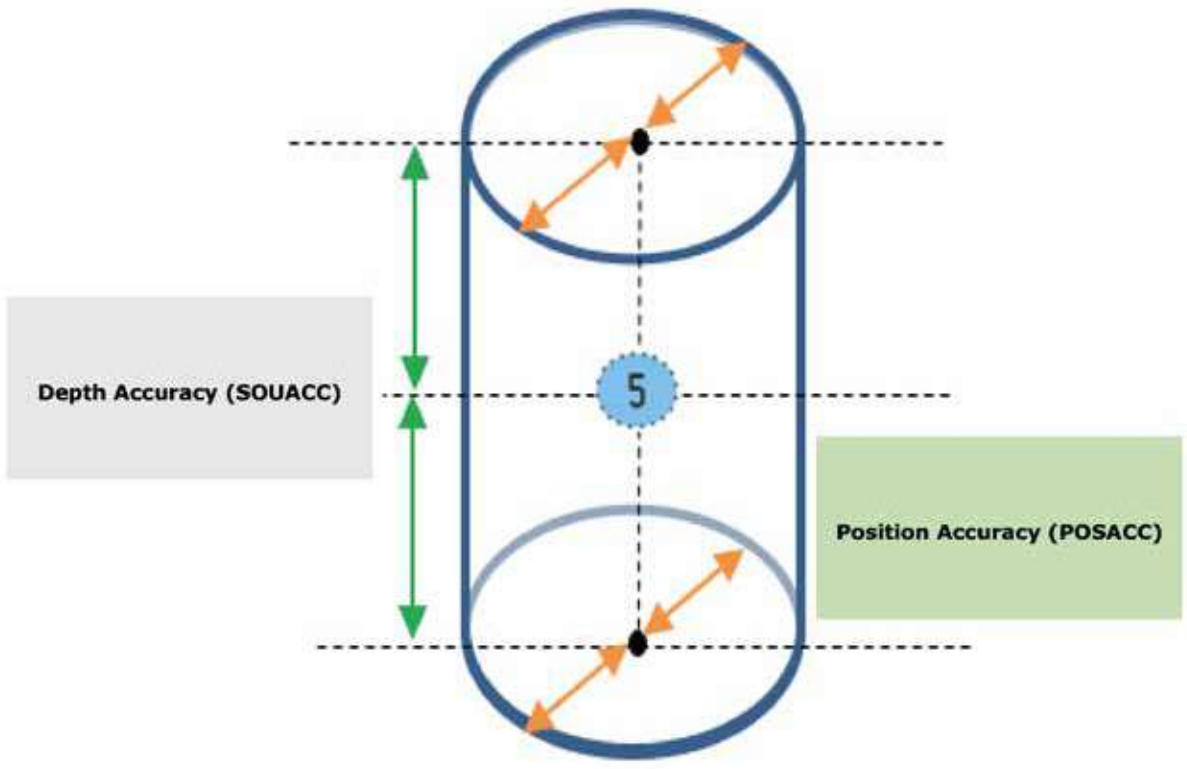
ZOC A1+A2 mariners navigate with confidence.
ZOC B mariners navigate having in mind that possibly – but unlikely – an uncharted danger affecting the surface navigation exists.
ZOC C mariners navigate with caution since hazardous uncharted features may be expected, particularly in or near reef and rocky areas.
ZOC D mariners navigate with high degree of caution, as these areas contain either very sparse data or may not have been surveyed at all.
ZOC U mariners navigate with the same degree of caution as ZOC D.

The following quotation from IHO publication *S-67 Mariner's Guide to Accuracy of Depth in ENCs* (September 2020) summarises the current condition of the seas: *"The key point to note is that the standards of surveying in ports are only very rarely encountered outside those ports. Shipmasters may therefore be at greater risk away from ports, even though depths may be deeper."*

Both texts above constitute generic guidance provided by the IHO in an effort to provide a rough estimation of the extent of the problem to mariners. The IHO also provides exact figures with vertical and horizontal allowances for the mariner to consider when the UKC is calculated.

ZOC	Position Accuracy	Depth Accuracy	Seafloor coverage
A1	± 5 m + 5% depth	0.50 m + 1% depth	Full area search undertaken. Significant seafloor features detected and depths measured.
A2	± 20 m	1.00 m + 2% depth	Full area search undertanken. Significant seafloor features detected and depths measured.
B	± 50 m	1.00 m + 2% depth	Full area search not achieved; uncharted features hazardous surface navigation are not expected but may exist.
C	± 500 m	2.00 m + 5% depth	Full area search not achieved; depth anomalies may be expected.
D	Worse than ZOC C	Worse than ZOC C	Full area search not achieved; large depth anomalies may be expected.
U	Unassessed – The quality of the depth data has yet to be assessed.		

The accuracy of the hydrographic data, as displayed on the table above, is a subject that shipmasters and deck officers must be familiar with and their considerations are depicted on the UKC calculation. It is also very important that the mariner considers not only the depth accuracy (vertical accuracy) and the position accuracy (horizontal accuracy) of the ENC data but also the seafloor coverage.



Position accuracy

As a matter of fact, in ZOC categories C, D and U, the horizontal error could be in excess of 500 metres. Therefore, the following points are suggested to the navigator:

- Open sea navigation:
  - Identify hazards to surface navigation and mark them with an alarmable area.
  - Maintain a safe distance from the hazard(s).
  - Verify ship's position on the ENC before approaching and on clearing the position.
  - Navigate using the ENCs at the compilation scale.
- Coastal navigation:
  - Identify hazards to surface navigation and mark them with an alarmable area.
  - If there are many hazards in a small area, mark them as one area and maintain a safe distance from the hazard(s).
  - Consider using parallel indexing when passing by areas with numerous hazards to surface navigation.
  - Consider increasing the frequency of position verification.
  - Navigate using the ENCs at the compilation scale.

It is strongly suggested that shipmasters and navigators define safety horizontal margins for the specific voyage based on the size of the vessel, the area of sailing and the prevailing weather. The agreed safety horizontal margins are reflected in the passage plan and countersigned by all bridge watchkeepers.

Yet, in order for the UKC calculation to be accurate, familiarity with all other factors affecting the UKC is required, such as, among others, the height of the tide and how it is affected by the prevailing weather conditions, the nature and stability of the sea bottom, the water density as the voyage is developed, the increase in draught due to heel, the reliability of the draft observations and calculations including estimates of hogging and sagging, the reduced depths over pipelines and other obstructions and the wave response allowance (the vertical displacement of the hull due to heave, roll and pitch motions).

Depth accuracy

Having discussed the provisions of the IHO S-67 and the given allowances, it is worth highlighting the fact that there is no minimum allowance currently recommended for different CATZOCs. Accordingly, shipmasters and navigation officers must make an "informed decision" taking into account all of the factors. Practically, the allowances provided by IHO have to be compared with the available UKC.

When the required minimum UKC is not met (having applied the IHO vertical allowances based on the CATZOC category in the area of sailing), consider the following:

- **Available UKC > than the CATZOC uncertainty**; navigator can consider excluding the CATZOC allowance from the UKC since the available safety margin is larger than the CATZOC uncertainty.
- **Available UKC < than the CATZOC uncertainty**; navigator can consider requesting additional information for the port in order to assess the risk and decide whether it is safe to proceed, taking into account the fact that the uncertainty is larger than the remaining safety margin.

In addition, if the vessel must sail in areas where the zone of confidence is D or U, the navigator can also consider the following:

- Sailing directions recommended route for the particular voyage.
- Regular shipping lanes for the particular voyage.

- Previously used route by the vessel.
- Contact local authorities seeking details about draft restrictions. The information that shipmasters can collect includes:
  - 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 not an exhaustive list and other information may be requested.
- Course is plotted in areas with dense spot depth soundings.

Furthermore, it is also recommended to the navigator that if required to sail in CATZOC areas C, D or U, the navigator should also follow the company's risk management system.

Seafloor coverage

Seafloor coverage is another important factor when assessing and categorising a survey. It is actually a clear indication of how thorough the survey was and whether the navigator should expect any surprises in an area. The possibility of dangers being missed typically arises from older surveys, which were simply not as effective as using modern systems.

As a rule of thumb, it is only in ZOC areas A1 and A2 where full seafloor feature detection has been achieved. It is therefore only in these areas that the accuracy of the charted depths directly defines where a ship can go, and how deep the draft of that ship can be. ZOC B, C and D areas result from surveys that were progressively less detailed. In these areas there is an increasing possibility of undetected features absent from the chart (ranging from a small rock or shoal through to a submerged reef).

In a ZOC B area there is unlikely to be anything affecting surface navigation, though it remains possible. The hydrographic office responsible for the chart will have (or should have) made their assessment based upon the quality of the survey, the depth of water and the size of vessels using the area.

In a ZOC C area there is a strong possibility of undetected features, or charted features significantly out of position. These areas can be considered inadequately surveyed.

In a ZOC D area there is a very strong likelihood of large undetected features absent from the chart. As these areas either have no systematic survey, or are completely unsurveyed, these features may well be as large as an entire submerged reef rising to just below the surface. If contemplating entering a ZOC D area, extensive precautions should be taken in order to ensure there is sufficient time to react to dangers as they are revealed.

Taking into account the above, when preparing a passage plan, consider the following:

Open sea navigation

- Plan transit through deep water (more than twice the static draft).
- If no deep-water route is available, check the CATZOC value.

Coastal water navigation

- Avoid operating in coastal water unless entering or leaving a port.
- If unavoidable, check the CATZOC value.

If CATZOC value is C, D or U, consider following:

- The recommended route from sailing directions.
- Regular shipping lanes.
- Previously used route.
- Received advice from local authorities.

When executing the passage plan, consider:

- Using echo sounder to monitor depth consistency between measured and charted depth to receive a warning before approaching any depth anomalies.
- Increasing bridge watch level to ensure monitoring of information and enhanced lookout.

Master/Pilot exchange

Furthermore, when the pilot boards the vessel, the shipmaster presents the passage plan to the pilot along with the UKC calculation of the transit. The shipmaster also brings to the attention of the pilot the parts of the transit through shallow waters and discusses the following points in detail:

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

It is advisable for the shipmaster to maintain a record of the exchange of information in the relevant Safety Management System (SMS) form (Master/Pilot exchange of information checklist).

Under Keel Clearance (UKC)

Each shipping company issues instructions on their own particular UKC policy. Below is an example of a generic, acceptable UKC policy, however, Members should produce their own policy. The generic policy here is for demonstration purposes only.

(a) Open/Deep Sea[1]

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

[1] A vessel is considered to perform Open/Deep Sea passage when transiting at a distance more than 12 nm from the coastline and/or outside the 50 metres contour.

[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 and/or within the 50 metres contour.

(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

- Unprotected waters should not be less than 20% of ship's static draft.
- Protected/Sheltered[3] waters should not be less than 10% of ship's static draft.

Note: when there is a combination of any of the above cases, the stricter policy applies.

If Charterers[4], Port and Canal Authorities have rules that are stricter than the above criteria then such stricter UKC allowance are 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[5].

(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).

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.

[3] Sheltered waters are water bodies with shorelines that are not subjected to the direct action of undiminished ocean waves (source FEMA.GOV)"

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

[5] Confined waters or pilotage waters are considered areas of shallow waters having limited room to navigate. There is no rigid distinction between coastal and confined waters and the limits of those are to be set by the Master and navigation officer while preparing the passage plan. The following are some examples of "Confined Waters": Canals; lock systems; rivers leading to port; confined areas among islands and reefs; waterways; Traffic Separation Schemes; bays; harbours; port approaches.

There may be occasions when the Master is unable to meet company UKC policy requirements, for instance the Master 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 the technical operations department immediately and does not proceed until a full appraisal and risk assessment has 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 the 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 fullest extent possible that the data is **valid**. Port authorities can often be a good source. This includes tidal data that 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 that 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 that the Master presents to the pilot the passage plan along with the UKC calculation of the transit. The Master should bring to the 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).

Area settings

Sufficient information should be available on the electronic charts in use to safely navigate the vessel. In contrary to the paper chart, ENCs provide the ability for objects and chart information to be selected and grouped in display categories depending on the navigational phase (planning, execution and monitoring) and to control the level of detail by removing distracting information and clutter.

BASE display provides basic chart objects which cannot be removed but are not adequate information for planning or navigating.

STANDARD display provides the International Maritime Organization's (IMO's) bare minimum information required for route planning and voyage execution and to which the ECDIS display can be immediately restored to.

On the top of the 'BASE' and 'STANDARD' display categories (by default selected), all additional information can be depicted from the 'OTHER' display category, depending on the navigational significance and the prevailing conditions. The additional information and objects can be preselected in the OTHER category and should be carefully predefined in the planning phase.

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 [6]**
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		X	
5	Prohibited and restricted areas	X	X	X
6	Chart scale boundaries			
7	Cautionary notes	X	X	X
8	Ships' routeing systems and ferry routes	X	X	X
9	Archipelagic sea lanes	X	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 sounding depths	X	X	X
12	Submarine cables and pipelines		X	X
13	Details of isolated dangers	X	X	X
14	Magnetic variation			
15	Depth contours	X	X	X
16	Seabed			X
17	Tidal			X
18	Miscellaneous			

[6] Including Anchoring and Berthing/Unberthing

Frequency of position verification in ECDIS

When paper charts were used, the position fixing 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 that the navigator was not aware of the vessel's position. Nowadays, the Global Navigation Satellite System (GNSS) units constantly feed the ECDIS with position information and therefore the navigator witnesses the vessel's position in real time. This is actually one of the key benefits of using ECDIS. Since the ship's position is "live" on the ENC, 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 cross checks that the vessel is indeed on the position appearing on the screen.

Since the ECDIS consists of many parts, their harmonious interaction needs to be verified. The navigator must verify that all of the following function harmoniously:

- the hardware (ECDIS unit);
- the software (operating system and ECDIS presentation software);
- the sensors (position, course, speed);
- and the data (ENCs and their corrections).

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 this in mind, 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 arrival at the port. The same applies to the main engine. It is tested ahead and astern before arrival at port and we rely on the test to safely enter a port.

The same methodology should be applied to the ECDIS, particularly when the vessel is sailing in coastal waters/port approaches and the Master needs all of 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, 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 were not actually 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 minimises their input to the bridge team. In addition, the value of their 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, the ship's position on the ECDIS is compared with other means at least hourly.

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

- Visual cross bearings;
- Radar observations;
- Radar overlay;
- Parallel indexing and use of clearing bearings.

When the vessel is at open sea and cross checking between the actual ship's position and a fixed object ashore is not possible, then it is suggested that the navigator checks the GNSS receiver for the following accuracy indexes:

- Dilution of Precision (DOP) checking;
- Signal or Carrier to Noise Ratio (SNR or CNR).

Whichever of the above methods the Officer On Watch (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.

Safety contour in ECDIS

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 they could safely navigate and areas they 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 of 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. Navigators can effect this change by simply inputting in metres the safety contour ***(safety contour [7] = depth boundary between 'safe' and 'unsafe' waters).***

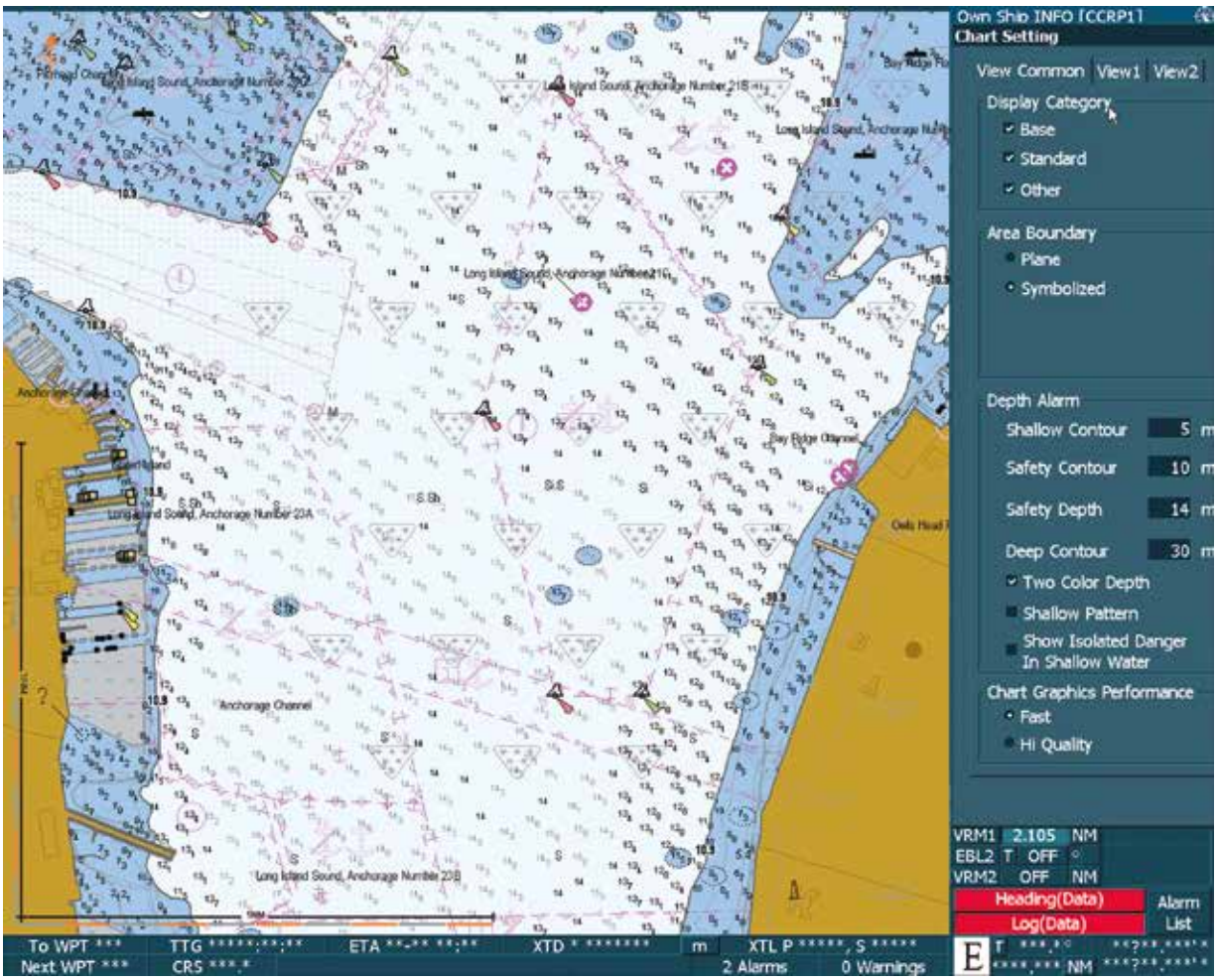


Figure 4: Safety depth 14 metres, safety contour 10 metres, isolated dangers with a depth equal to or below 10m shown

[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.

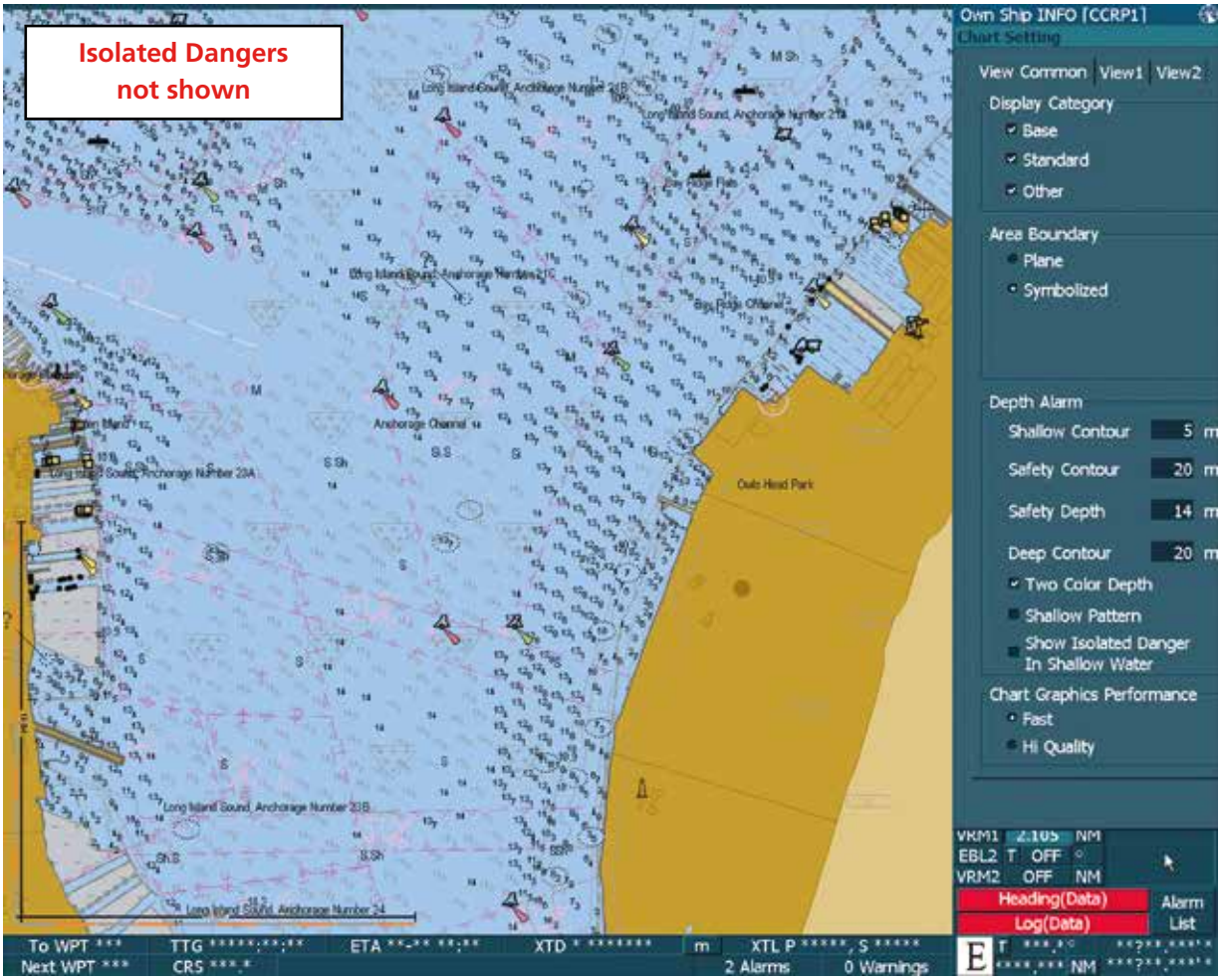


Figure 5: Safety depth 14 metres, Safety contour 20 metres, isolated dangers with a depth equal to or below 20m not shown, compare with Fig 4

The 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 a 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 navigator 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 that 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.

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

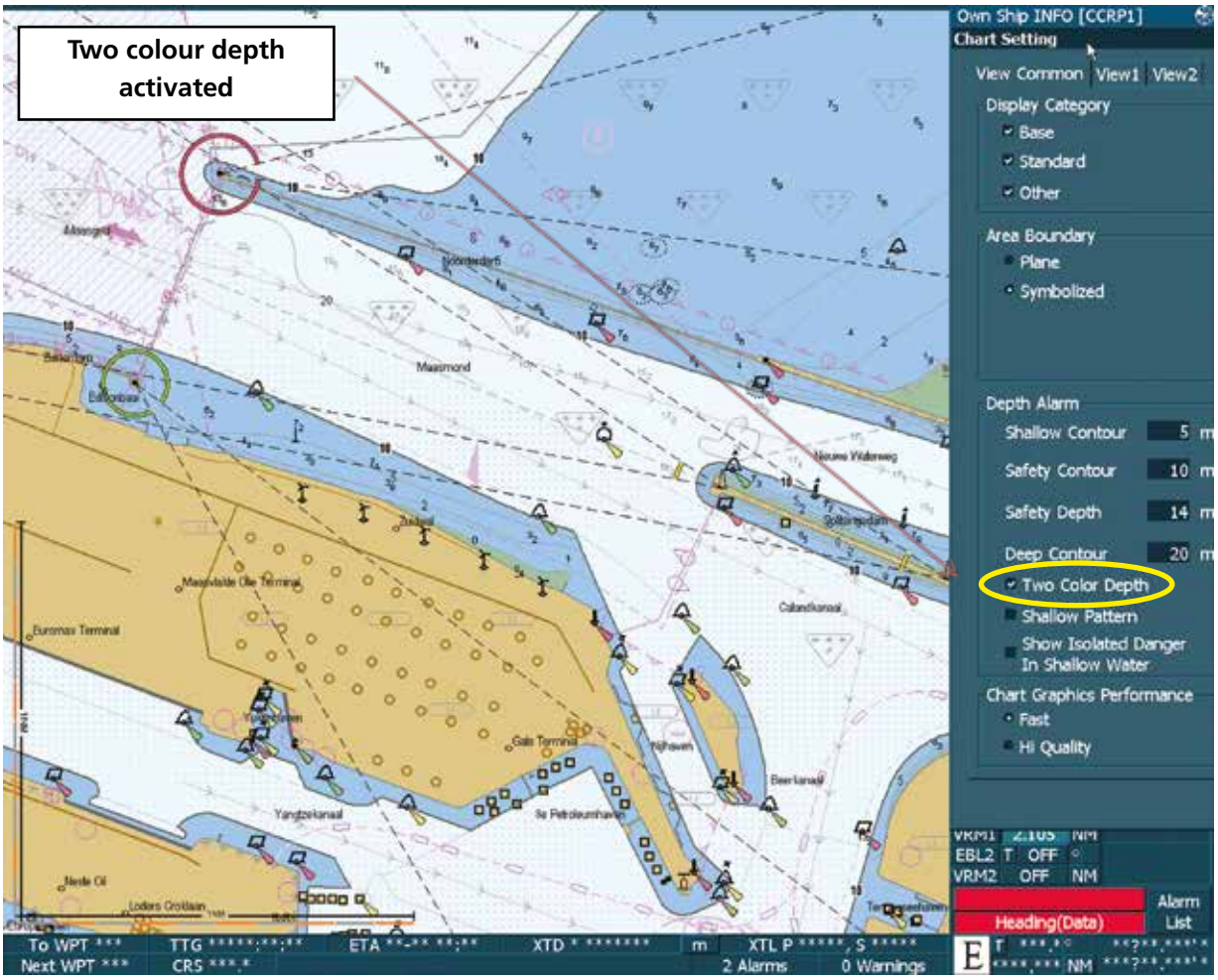


Figure 6: A sea area with "Two Colour Depth" display

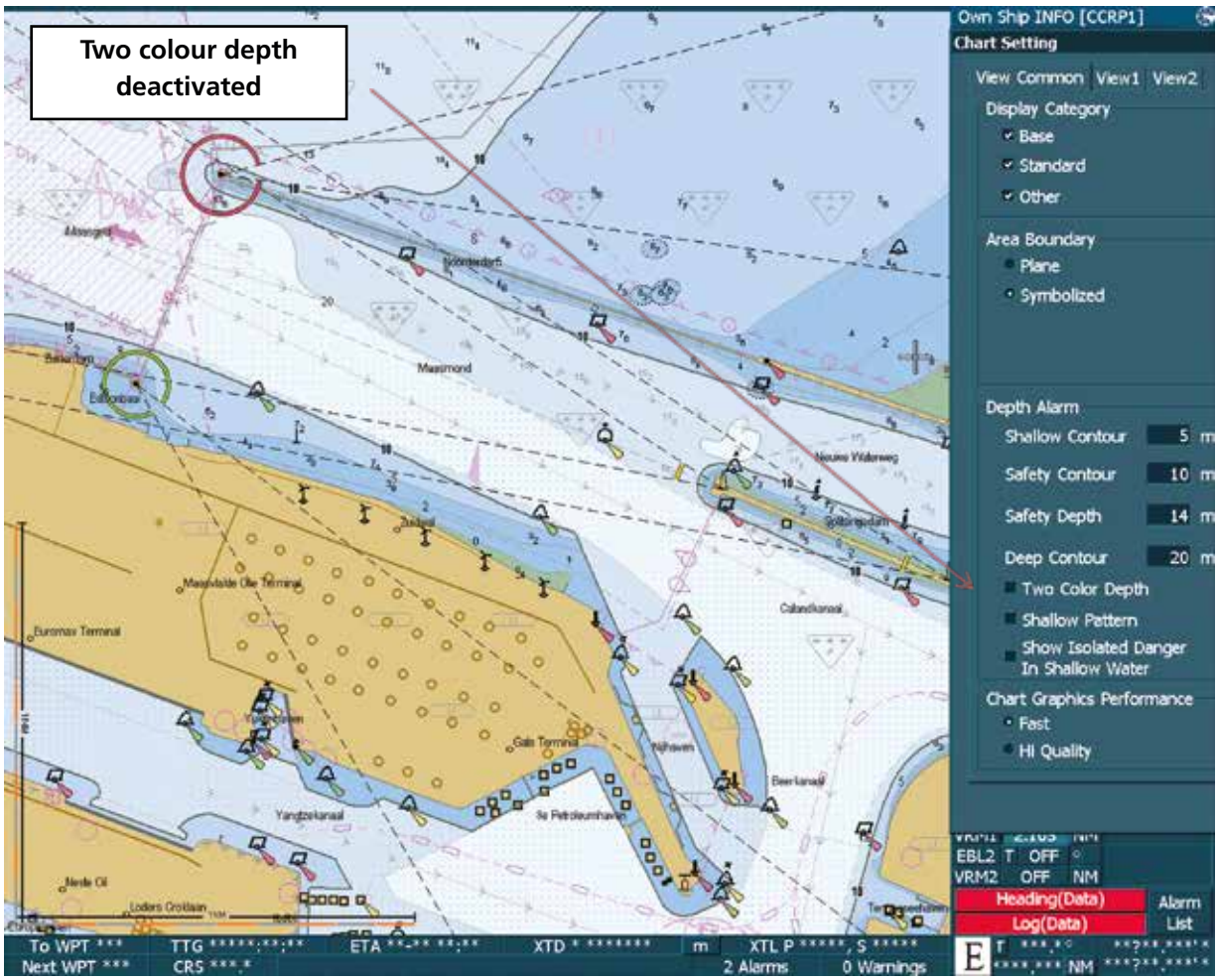


Figure 7: The same sea area as Fig 6 with "Four Colour Depth" display

TWO COLOUR DEPTH						
Area	***Colour***	***Navigational information***	***Next deeper depth area colour***	***Next shallower depth area colour***	***Setting defining deep border of area***	***Setting defining shallow 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 shallower 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 shallower depth area colour***	***Setting defining deep border of area***	***Setting defining shallow 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 contour	Medium blue	N/A shallowest area for four colour setting)	Shallow contour setting	N/A

Table 3

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 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 two possible scenarios.

[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.

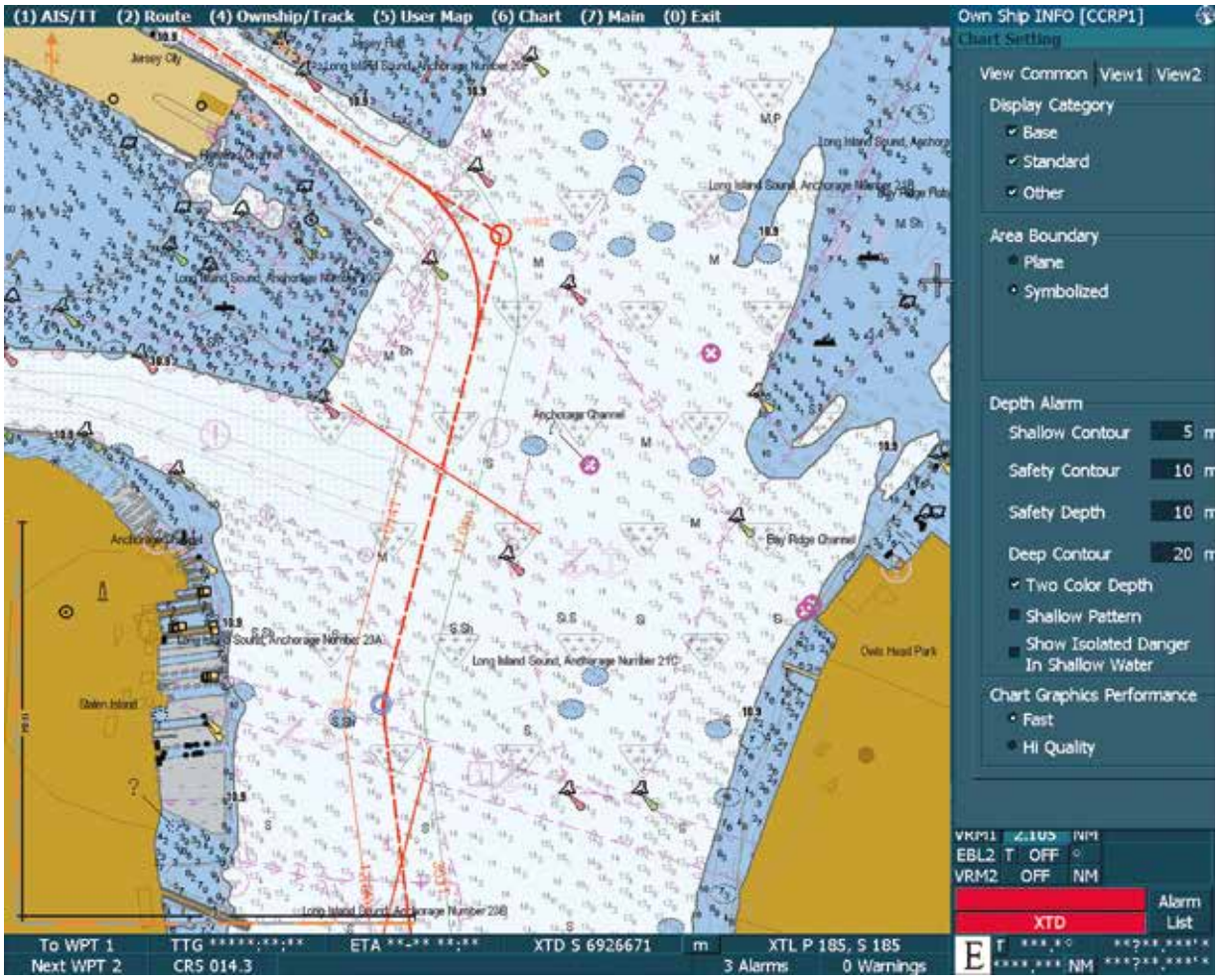


Figure 8: Safe draft equal with one of the available depth contours

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.

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). 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.

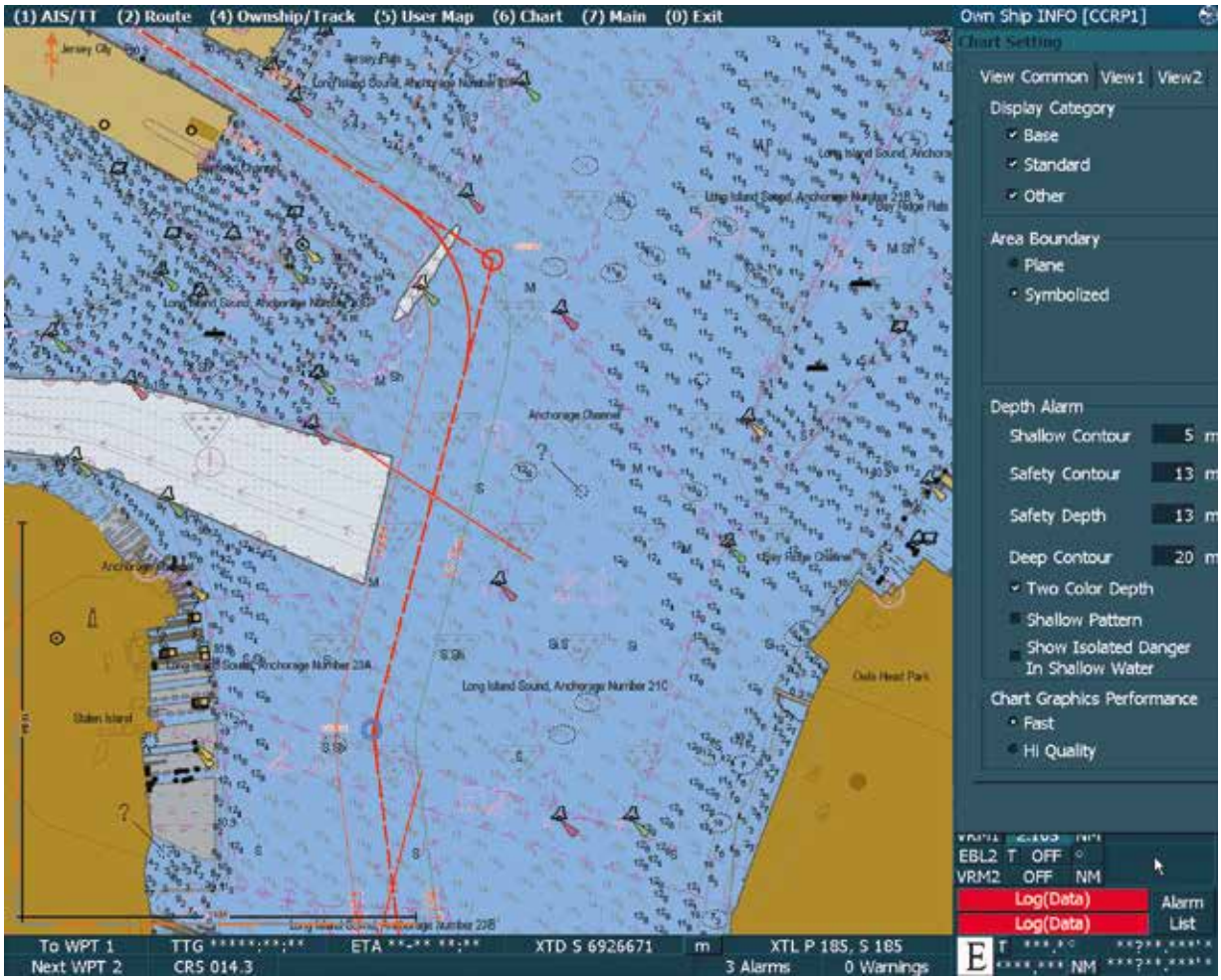


Figure 9: Safe draft not equal with one of the available depth contours

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 lies the problem.

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.**

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 depth is 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 is not clear in dusk and night-time setting.
- Misinterpretation and feeling of complacency by navigating with an activated anti-grounding alarm.

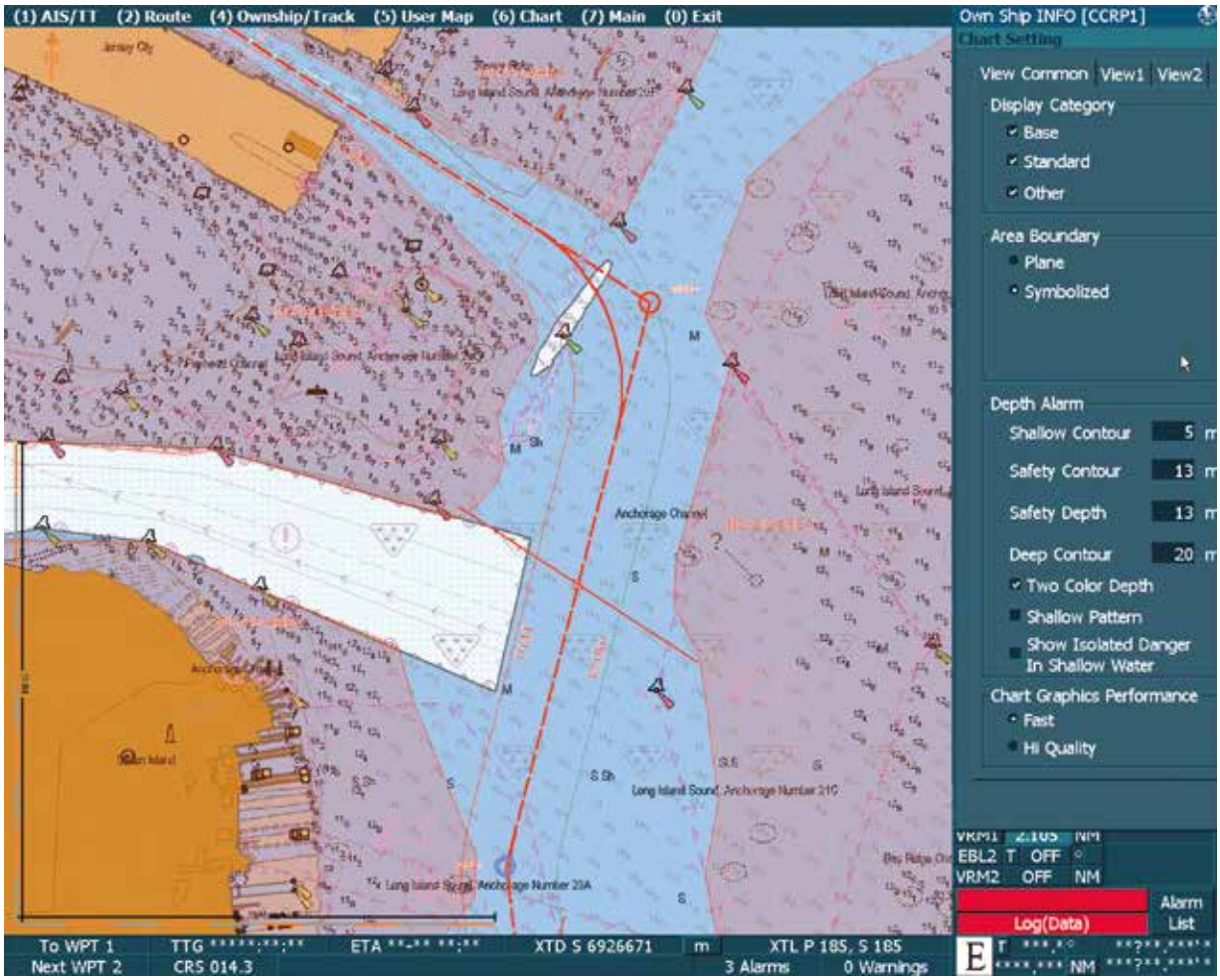


Figure 10: Safety contour=13m, safety depth=13m, two colour depth selected, No-Go Areas are drawn manually by the navigator

Workaround #2

Two colour pattern is used.

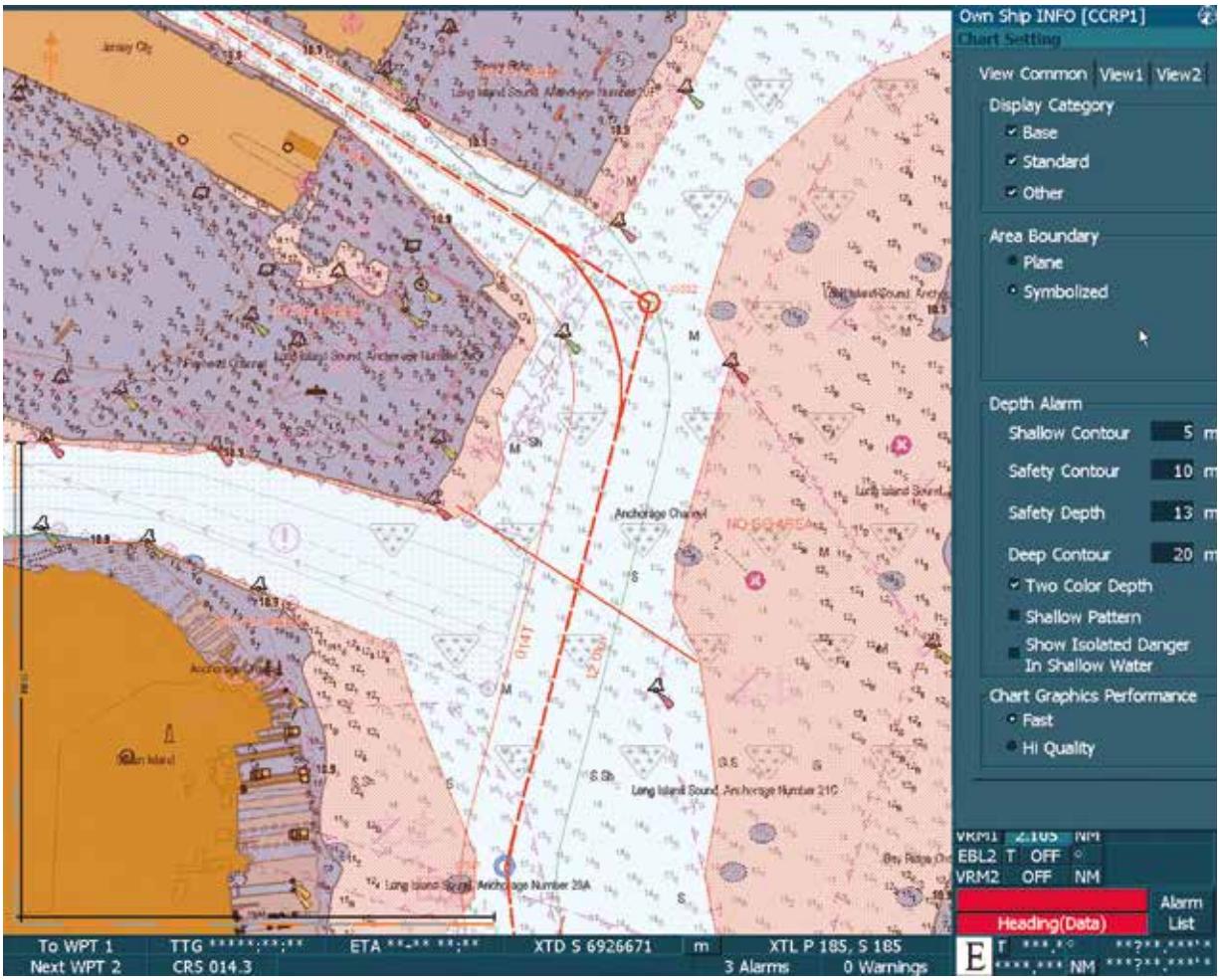


Figure 11: Safety contour=10m, safety depth=13m, two colour depth selected and No-Go Areas are drawn manually by the navigator

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 is clear even with dusk and night display 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 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.
- Applicable isolated dangers within the safety contour appear only if it is selected by the navigator.

Workaround #3

Four colour pattern is used.

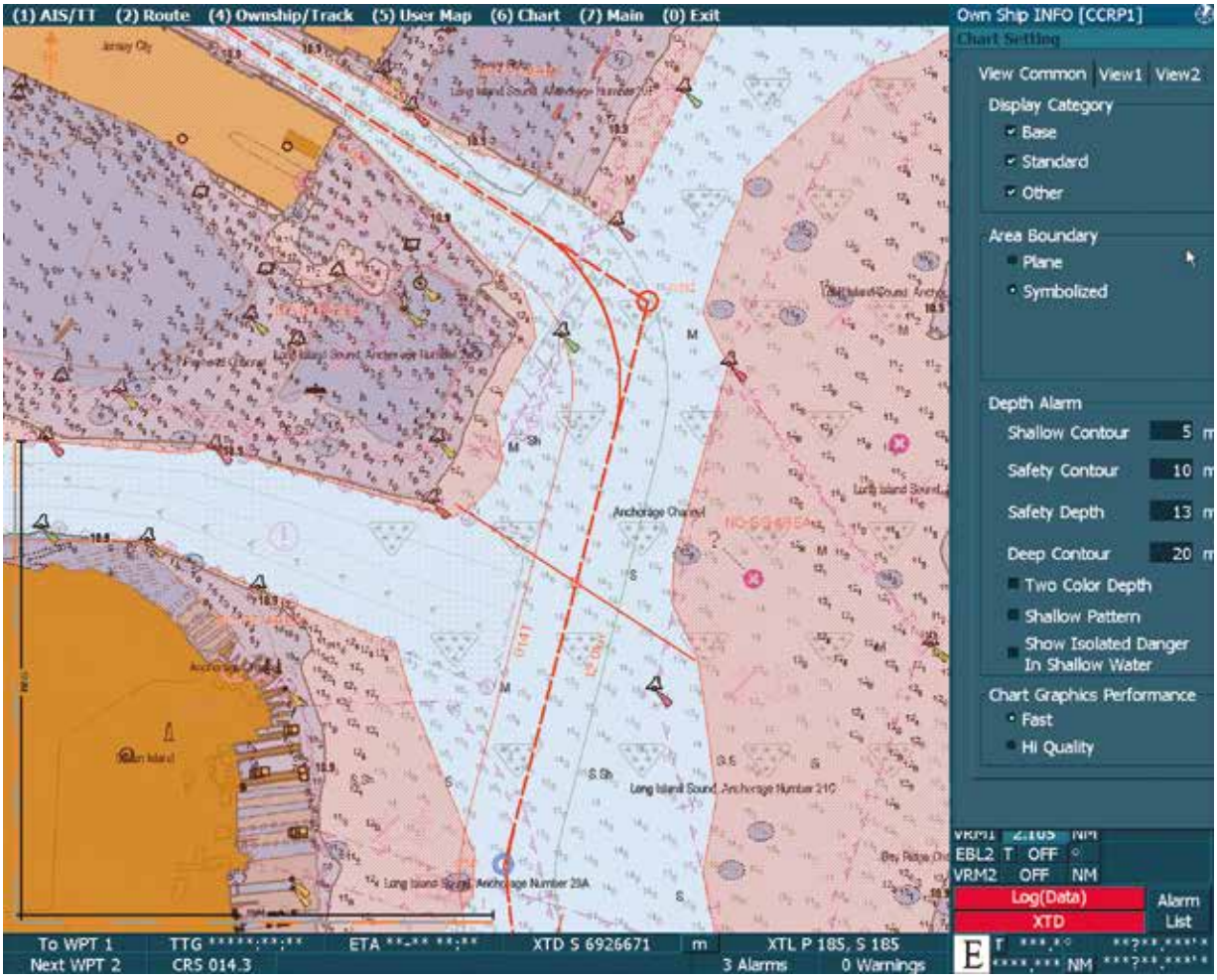


Figure 12: Safety contour=10m, safety depth=13m, four colour depth selected and No-Go Areas drawn manually by the navigator

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 is 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 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.
- There is 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) is 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.
- Applicable isolated dangers within the safety contour appear only if it is selected by the navigator.

Conclusion

Until the time when bathymetric data is portrayed in ENCs with greater density (so that the safe draft always coincides with a depth contour) companies should choose one of the above workarounds after weighing up the advantages and disadvantages of each.

It is worth clarifying the fact that the main tool to clearly distinguish between safe and unsafe waters remains the No-Go Area[9] manually plotted by the navigator.

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

[9] The NO-GO AREAS should not degrade the displayed information and it should be clearly distinguishable from the ENCs information.

Temporary and Preliminary Notices (T&Ps)

Temporary and Preliminary (T&P) corrections is an area of maritime safety information affecting charts. This information needs further investigation, including correspondence with the ENC producer to resolve the issue. Sometimes this takes time, so a temporary method of informing the mariner of a potentially dangerous situation is necessary.

Such information is provided to mariners as NavArea warnings and sometimes as T&P corrections.

In general, with the introduction of ECDIS and ENCs on ships, T&P notices should not exist on ENCs any longer. It is the responsibility of each hydrographic office to provide by electronic means, relevant updates and corrections to ENCs that they have issued.

However, currently, there is no unified approach by national hydrographic offices with regards to the T&Ps on the ENCs. Some expressly include the T&Ps in the weekly corrections of their ENCs, some do not - and there are some national hydrographic offices for which the status of T&P production and incorporation is unclear.

The 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 hydrographic offices to ensure all hydrographic data, whether it has a temporal aspect or not, is promulgated via ENC updates.

Both UKHO and PRIMAR have prepared lists of countries indicating the status of their T&P production and incorporation in ENCs for all the national hydrographic offices. Links are provided below 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/#/updates**

It is observed that both lists are not 100% consistent due to a lack of clarity in including and excluding the T&P corrections as ENC updates.

To assist mariners, many chart distributors have started a value-added service to distribute the information on T&P corrections as information overlays. Examples of such services are AIO by UKHO, CIO+ from ChartWorld etc.

Caution is advised to understand the limitations of such services before using them on board.

INTERTANKO has analysed the various scenarios and suggests how this could be managed today in the following:

Scenario 1:

The national hydrographic office that is responsible for ENCs includes T&P corrections in the ENC update, or no T&P corrections issued by the hydrographic office.

Producer code	Producer and link to NMs on their web sites	Information included in ENCs		ADMIRALTY T&P NMs included in AIO	Notes
		Temporary (T)	Preliminary (P)		
AL	Albania	No	No	Yes	
AR	Argentina	Yes	Yes	No	3
AU	Australia	Yes	Yes	No	

Note: This picture is only an example and up-to-date information shall be obtained from the UKHO or Primar

The example of the UKHO document above confirms that e.g. both Argentina and Australia include T&P in their ENCs and updates. In this case, **no further actions are required** as soon as up-to-date and detailed enough ENCs coverage is loaded into the ECDIS.

Note: Some hydrographic offices are providing ONLY selected T&P as part of ENCs. It is recommended to check the content – see Scenario 2 and Scenario 3 below.

Scenario 2:

The national hydrographic office that is responsible for ENCs does not include T&P corrections in the ENC update, but UKHO or other service providers include such information in the overlays.

Please pay attention to the notes, which may describe special conditions.

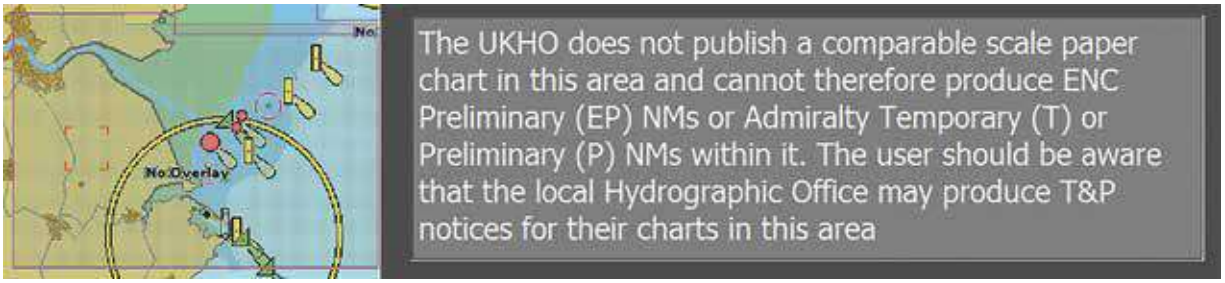
Where AIO data is available, the T&P Notices to Mariners (NMs) are displayed as polygons over the ENCs on the ECDIS (subject to compatibility of make/model, since AIO is not part of any minimum requirements).

The full text of the NM is included as an associated text file which can be displayed.

When using the AIO product to obtain the relevant information, the following should be kept in mind:

1. ***"There may be a time delay between the publication or cancellation of national T&P NMs and the publication or removal of the equivalent ADMIRALTY T&P NMs that are included in AIO".*** (Source: User Guide, ADMIRALTY Information Overlay (AIO) Version 2). This means that some of the T&P that have been issued by the local authorities and are available from local hydrographic offices are NOT yet part of AIO as it takes time (up to several weeks) for the information exchange and production process.

2. ***"Where the ENCs do not include temporary information, the overlay contains ADMIRALTY Temporary & Preliminary Notices to Mariners (T&P NMs) that are issued for paper charts."*** (Source: User Guide, ADMIRALTY Information Overlay (AIO) Version 2). This means that detailed T&P information is included in AIO only if an appropriate scale paper chart is published by the UKHO for the area. If that is not the case, then AIO does not cover all T&P from local hydrographic offices and hence some local T&P information may be missing. In this case, AIO object is shown as "No overlay" boxes: on the ECDIS:



3. The above points need to be considered and in case of doubt refer to Scenario 3 below.

Scenario 3:
The national hydrographic office that is responsible for ENCs does not include T&P corrections in the ENC update and UKHO or other service providers do not include such information in the overlays or no information is available.

In this case, relevant information shall be obtained from the local authorities, such as hydrographic offices. Relevant T&Ps are to be plotted on the ECDIS by means of manual corrections or equivalent.

Use the PRIMAR Status of T&P production and incorporation in ENCs document to obtain the local source, where available. Consider an additional source for this information:

- Digital NM services (like Digitrace, ChartCo, ChartWorld etc.)
- Digital ECDIS T&P overlay services

NAVAREA and Local Radio Warnings

Use a NAVTEX receiver and SafetyNET to receive NAVAREA and Local Radio Warnings. As a minimum, the message content information is available in text format. However, some ECDIS models are capable of interfacing to these devices for import and (where possible) automatic geo-referencing and plotting of relevant positions on the ECDIS.

Note: particular attention should be paid to filter settings (e.g. Navtex stations and message types) on both the NAVTEX receiver and ECDIS to make sure that relevant information is not filtered out. In addition, the range of transmitting NAVTEX stations should be considered.

Where direct interface between the ECDIS and NAVTEX/SafetyNET is not available, the content of the messages shall be checked at source (e.g. NAVTEX receiver) as to the relevance of the ship´s current position and route. All radio warnings in force are normally repeated at a certain time interval.

Some hydrographic offices (e.g. UKHO) provide a list and content of NAVAREA messages in force for relevant areas. The same is also available from most digital nautical data suppliers.

T&P and NAVAREA information on the ECDIS

When T&P are included in ENCs, then in terms of effort to get the information into ECDIS, it is the best case, as no additional actions are required once the regular ENC updates are applied to the SENC collection of the ECDIS.

There is, however, one condition to keep in mind. Since the T&P updates are incorporated into ENCs, there is a relative lack of visibility of T&Ps compared to paper charts. When correcting the paper charts with T&P or MSI information, Officers mostly use bold annotations to ensure the visibility of T&Ps and draw the OOW's attention to important changes in sailing conditions – sometimes received at short notice. When T&Ps are included in ENC data, they are applied as a standard update, but with a date dependent attribute (a valid to/from date). Although the latest performance requirements for ECDIS can provide the functionality to highlight updates, T&P updates remain the integrated part of ENC and therefore are not always obvious to the user.

Whenever T&P information is NOT a part of ENCs, steps are to be taken to get the relevant information to the ECDIS display:

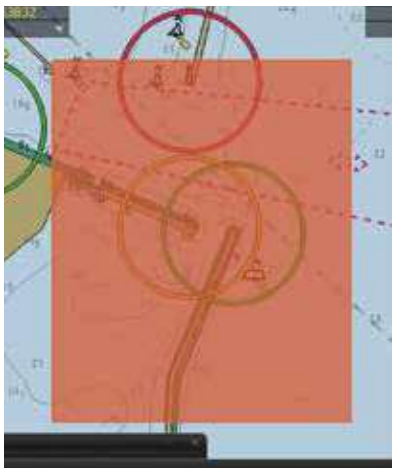
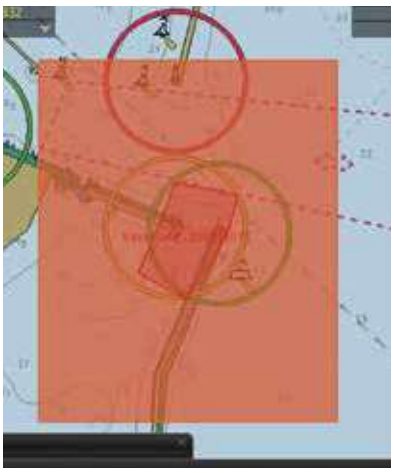
1. **Manual correction or Mariner´s notes? "If you wish, you can use Mariner's Notes to highlight temporary information in ENC or AIO on your ECDIS."** (Source: User Guide, ADMIRALTY Information Overlay (AIO) Version 2). According to regulations, every ECDIS must have both Manual ENC update and Mariner´s notes (sometimes called user´s charts) functionality. However, use of manual updates is not

always practical for T&P as the process of selection of the exact object and its attributes to reflect the information in necessary details (reference IHO S-52 requirements) is quite a time-consuming process. Normally manual correction is linked to one ENC cell according to the same IHO S-52 requirements and therefore will only be displayed while this particular cell is in use for the chart area generation. In case of zooming in or out, the manual update information may disappear since the cell (to which updates were applied) is no longer displayed due to scale difference. In addition, some ECDIS systems by design may apply a time limit for manual correction to be kept which may conflict with longer validity of T&P. **"Manual updates need to be retained only until a new edition of the cell is incorporated"** (Source: IEC61174:2015).

2. **When AIO is in use to provide the T&P information.** The way that AIO T&P is presented on the ECDIS facilitates quick access to T&P text applicable for a geographical area, rather than details and exact positions relevant to the content. As per UKHO's description "The ADMIRALTY Information Overlay (AIO) provides easy reference to T&P information", however, it is not stated anywhere that the use of AIO releases the bridge team from having T&Ps properly plotted on the ECDIS. On the contrary: the UKHO "*Guide to ECDIS audits and inspections*" suggests using manual correction to insert T&P. Sometimes one AIO object on the ECDIS display refers to a T&P notice with a large number of reference positions (e.g. submerged measurement instruments or temporary buoys etc.) and therefore covering a large area. It is not immediately clear how positions of different objects in T&P text are relevant to the route when it crosses one big rectangular object of AIO. Hence it is recommended to extract positions and plot objects relevant to the route by means of manual correction or equivalent.

3. **Digital ECDIS T&P & NAVAREA services.** T&P Notices and NAVAREA warnings for ECDIS can be prepared ashore and distributed to vessels in a form of ECDIS-compatible overlay files such as Mariner´s notes files or user charts. The concept to support an updating process for charts from ashore is not a new one. In some ways it can be compared to paper chart corrections to the latest NM and T&P, applied to the paper charts by shore-based service companies, prior to delivery on board. The T&P service for ECDIS is in fact a digitalisation of T&P, issued by national hydrographic offices.

Example of Digital ECDIS T&P services:

Furuno MFD I - A small construction area closed for navigation is shown instead of large rectangle:		
AIO only, KR5G3B32 (week 36/17)	AIO & CIO+, KR5G3B32 (week 36/17)	CIO+ only, KR5G3B32 (week 36/17)
		

Attention: NavArea warnings that are transmitted via Navtex and EGC, as well as T&P NM information, may additionally be provided as a value added service as MIO such as AIO or CIO+, but this does not replace the obligation to receive such information in its original form, including via Navtex and EGC.

Conclusions and recommendations

We have great hope that the IHO and its members are well in progress to provide a modern, efficient, safe and consistent solution to tackle the T&P issue and relieve the bridge team from any manual and time-consuming handling of this information. This would allow for a better user experience with ECDIS, something that was promised to the maritime industry quite some time ago.

It is also expected that the IHO will finally convince its hydrographic office members to handle the issue of T&P with priority and consistency (as to policy not being different from one hydrographic office to another).

However, it is understood that this will take time - and until then, the following steps may be considered to reduce the risks:

- Update shipping company SMS to reflect exact criteria for T&P relevance to the voyage (e.g. distance to the planned route), source and way of application to ECDIS;
- Regardless of the source (AIO Local HO T&P, NAVAREA etc.) advise the bridge team to have the content of T&P to be plotted on the ECDIS with reference number, short text and appropriate symbol/line/area;
- Regardless of the source (AIO, Local HO T&P, NAVAREA etc.) advise the bridge team to have the content of T&P to be plotted on the ECDIS with danger and/or depth value (as and if applicable) so it can be detected by the ECDIS route check function. Route check should be repeated after entry (up weekly update) of the T&P information is completed in the ECDIS.
- Ask the nautical data supplier to provide the content of T&P relevant to the voyage or at least to advise the reliable source;
- Ask the nautical data supplier for a Digital ECDIS T&P services to provide T&P as a "ready to load" graphical layer into your ECDIS (not just AIO "boxes") to relieve the crew from a lot of manual work to graphically enter T&P.

Check if on-board NAVTEX or SafetyNET can be connected to ECDIS for automatic plot of the MSI messages. In some cases, it is better to have overlapping information than to miss it.

Air draft

Each shipping company issues instructions on its 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 assessment 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.

Use of paper charts

In accordance with SOLAS regulation V/19.2.1.4, ships must carry all nautical charts necessary for the intended voyage. In order to meet the chart carriage requirements of SOLAS where ENCs are not available at all or are not of an appropriate scale for the planning and display of the ship's voyage plan, Raster Navigational Charts (RNC) and/or any needed paper charts should be carried.

If an area covered by the ECDIS display includes waters for which no ENC at a scale appropriate for navigation is available, the mariner can refer to the paper chart or to the RCDS mode of operation. However, the ECDIS

equipment should be actively used by the bridge team during the whole voyage to the extent practicable and should remain the designated 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.

The IMO performance standards for ECDIS require that adequate backup arrangements should be provided to ensure safe navigation in case of an ECDIS failure. One of the ways to achieve this is the use of paper charts. Where this backup option is used, the paper charts must be kept up to date with the latest Notice to Mariner corrections. Also, an Appropriate Portfolio of Paper Charts (APC) will be required for the whole of the intended voyage.

A reference to coastal States guidance on any requirements for paper charts to be carried in the waters under their jurisdiction may be accessed by visiting the website of the relevant national hydrographic authority, as listed in IHO Publication P-5, available at:
https://iho.int/uploads/user/pubs/periodical/P5YEARBOOK_ANNUAIRE.pdf

Contingency planning

ECDIS consists of hardware and software in order to operate properly. It also receives data from other navigation equipment (sensors) in order to be able to present the vessel sailing live on the ENC. It is well known that any hardware and/or software can fail during operation and/or data transfer can be interrupted. Therefore, the OOW must be able to respond and maintain safety of navigation while the ECDIS is temporarily and/or permanently unavailable because of hardware, software or sensor failure. ECDIS also needs a power supply in order to run. Therefore, the OOW must understand and be familiar with the main and backup power supply of the units so as to be able to take the necessary corrective action and restore the operational condition of the vessel.

Taking into account the above causes of ECDIS disruptions, an ECDIS contingency plan must be prepared, aimed at providing a set of course of actions to the OOW in case of any ECDIS unavailability (single or total failure, sensors and power supply failure). In addition, the contingency planning provides guidance for OOW training to the respective subjects.

ECDIS primary or total failure

Hardware and software failures result in the unavailability of the unit. Therefore, it is necessary to take advantage of the number of ECDIS units on board the vessel (one, two or three units) as well as the features

of each unit (single or dual hard disk drive). Proper management of resources reduces the down time of the service and means that the safety of navigation is not compromised. Accordingly, we suggest the following practices with regards to the number of units in operation:

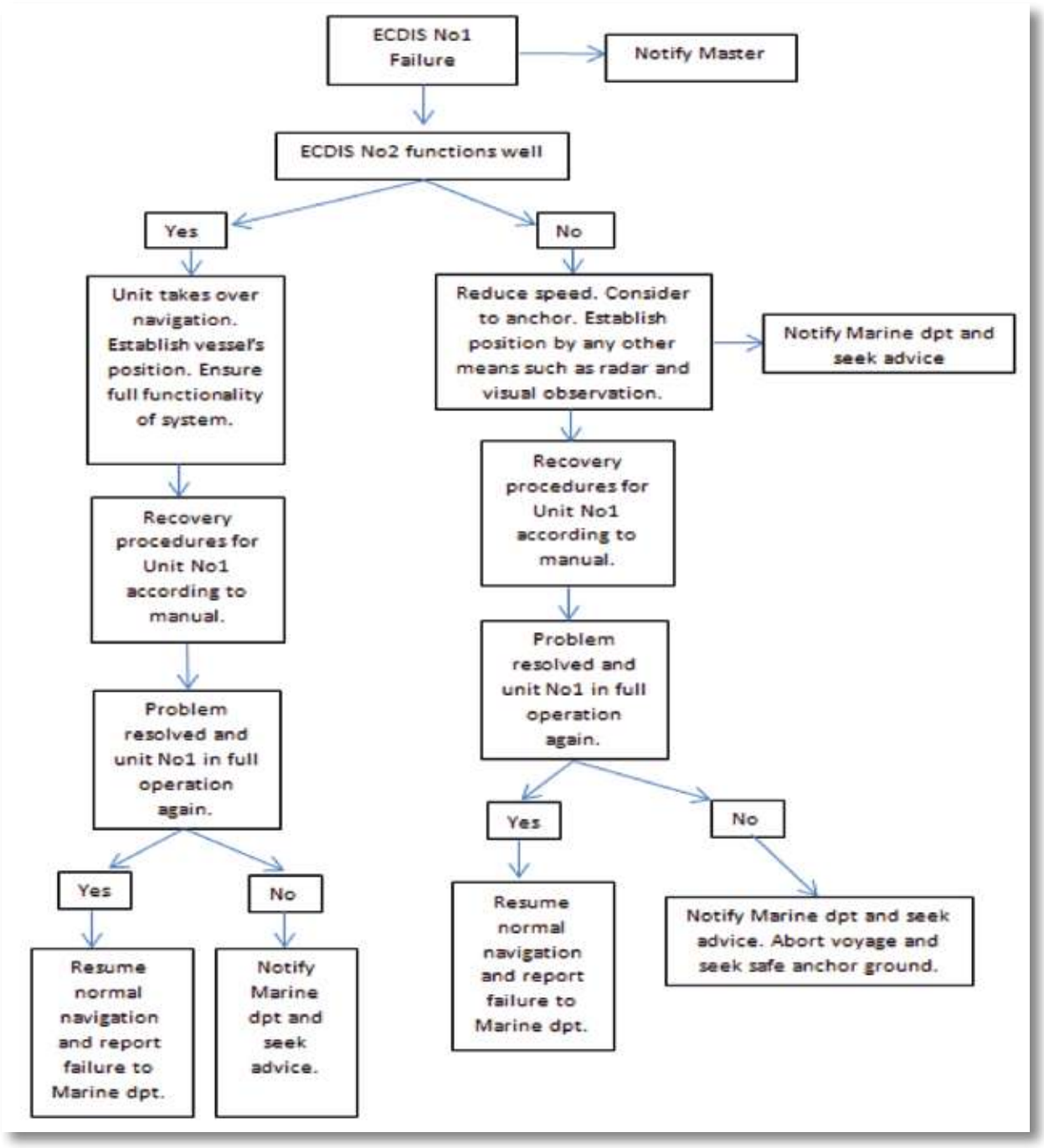
- Only one (1) ECDIS unit is in operation, provided two (2) units are fitted on board, when the vessel is in open sea or during coastal navigation. As soon as the primary unit fails, the secondary is switched on and takes over navigation.
- Two (2) ECDIS units are in operation, provided two (2) units are fitted on board, when the vessel approaches a port. As soon as the primary unit fails, the secondary takes over navigation. Should both units fail, emergency folio of paper charts or ENCs is activated.
- Vessels fitted with three (3) ECDIS units, sailing in open sea, during coastal navigation and during approach to a port and canal transit, maintaining (switched on) two (2) units. The third unit remains as a backup in case either of the two units fail.

While managing the number of units on board the vessel is important, another important aspect is to take advantage of the ECDIS features. When the ECDIS unit is fitted with two (2) hard disk drives (HDD), the working condition of the unit can usually be restored by activating the second HDD. Where the ECDIS unit is not fitted with two (2) HDD, an additional back-up HDD (plug and play, with latest updated software) for all ECDIS units should be stored on board in a safe place for emergencies.

Therefore, management of the number of units on board is essential to minimise the downtime of the service, yet familiarity in switching between the HHD is also essential to restore the working condition should the unit fail.

Since switching from one unit to the other requires familiarity with the software, it is necessary for the company to establish quarterly drills. ECDIS primary or total failure drills should form part of the annual drill schedule. In addition, the expected course of actions in case of primary or total ECDIS failure should be contained in the Emergency Response Plan of the vessel.

It is also suggested the company develops its own contingency diagram, offering guidance to the shipmasters and OOW. A sample contingency diagram is presented opposite:



Sample contingency diagram

Total ECDIS failure redundancy

Additional measures to provide redundancy in case of a complete ECDIS failure (both main and backup units) are not regulated and hence unlikely to be endorsed or demanded by a Flag Administration and/or Classification Society. Nevertheless, many companies have decided to adopt such additional arrangements voluntarily. Options may include (but are not limited to):

- "Get me Home" folio of paper charts,
- An additional (3rd) ECDIS unit,
- Emergency Navigation System (a tablet or laptop) with ENC display and positioning input capabilities (e.g. from GPS or AIS PilotPlug).

It is NOT a requirement to have any of these options in place, but if a shipping company still decides to implement one, it is recommendable to have it reflected in the SMS.

GNSS/Sensor failure

When the GNSS and/or any other sensor fails, the ECDIS remains in operation, yet the information could mislead the OOW. Therefore, the OOW must constantly monitor the alarms of the ECDIS and cross check its performance (position fixing with radar, GNSS accuracy indicators). In addition, the OOW must monitor the alarms that may appear on other bridge equipment that could lead to ECDIS unavailability or poor performance. Then, if considered necessary, the OOW selects a secondary sensor to restore the good working condition of the ECDIS. Yet, the OOW must be familiar with the process in order to complete it quickly and not compromise the safety of navigation. Accordingly, quarterly drills must be set up to assist the OOW in familiarising themselves with the course of actions should either the GNSS or any other sensor fail. The expected course of actions in case of GNSS failure and/or sensor failure should form part of the annual drill schedule. In addition, the expected course of actions in case of GNSS or other sensor failure should be contained in the Emergency Response Plan of the vessel.

ECDIS power failure

The ECDIS unit can temporarily remain out of service because of power failure. All ECDIS units are fitted with an internal battery that can maintain the hardware in operation (without the monitor) for at least forty-five (45) seconds, sufficient time for the Emergency Diesel Generator (EDG) to start and provide the system with power in case of a black out. In addition, vessels can be fitted with Uninterruptible Power Supply (UPS) batteries to keep the system up and running for a sufficient time to allow restoration of the power supply.

Since the OOW response in case of ECDIS power failure requires familiarity with the equipment features and the respective course of actions, it is necessary for the company to establish quarterly drills. The ECDIS power failure drills should form part of the annual drill schedule and the expected course of actions should be contained in the Emergency Response Plan.

ENC management during passage planning

As per the Bridge Procedure Guide, only up-to-date official charts should be used for passage planning. Consider the following during passage planning appraisal:

- Appropriateness of scale.
- Accuracy of data.
- Notices to Mariners.

Based on the review of ECDIS-related accidents and INTERTANKO's risk based approach, the following hazards have been identified related to the use of ENCs, which need to be addressed during passage planning appraisal:

- ENC not ordered.
- No ENC coverage.
- Not appropriate scale.
- Overlap ENCs.
- Withdrawn/Cancelled ENC.

The following checks are recommended as a part of the passage plan appraisal process to eliminate these hazards.

Checks for appropriate scale/no ENC coverage

Once the rough route has been created, transfer the route to the chart handling software.

Using the chart catalogue in the chart handling software, identify if the route is covered by an appropriate scale ENC.

The operator should provide guidelines - How to select appropriate scale ENCs and what to do in case of no appropriate scale ENC or no ENC coverage, in the SMS procedure.

Note: The latest edition of paper charts corrected to latest NM should be carried where the ENC is not available, or where local regulations so warrant.

Checks for up-to-date/withdrawn ENCs

After obtaining and loading all ENCs required for the voyage, carry out the ENC update procedure.

The operator should provide guidelines on the ENC update procedure in the SMS.

After the completion of the ENC update procedure, the easiest way for the mariner to check that all the ENCs for the planned passage are up to date is by using the "ENC update status report" function on the ECDIS. Run the ENC update status report to confirm:

1. If all ENC cells required for the voyage have been loaded into the ECDIS and are up to date.
2. Withdrawn or cancelled charts, if any.

The operator should provide guidelines on the handling of withdrawn/cancelled charts in the SMS procedure.

Note: ENCs may be withdrawn from ADMIRALTY services without the issue of a cancellation update because of concerns about their content or overlaps with other data. The withdrawal of ENCs is communicated in the README.TXT file and in Section VIII of the ADMIRALTY Notices to Mariners Bulletin until all relevant permits have expired from AVCS licenses.

If withdrawn ENCs are installed in your ECDIS, you are advised to use them with caution and refer to the appropriate paper chart coverage as they may be out of date. It becomes the only case where despite having vector charts, you may need to order paper charts as well. (As per the latest Readme.txt file there is no withdrawn chart).

Checks for the overlap/withdrawn ENCs

The Readme.txt is an important file to be consulted in relation to passage planning, containing the latest information available on the use of ENCs in ADMIRALTY services. Refer to the following sections of Readme. txt file:

Section 1: Overlapping ENCS in the same usage band:

Detailed check to be carried out where ENCs overlap, to ensure no critical data has been obscured.

Note: Some data providers issue ENCs which contain overlapping data coverage, both internally and with adjoining nation's coverage. This may make them difficult to use in certain ECDIS systems which default to displaying both overlapping cells. Caution should therefore be exercised when using such overlapping data. Mariners should be aware that there will be a possibility that items of significance

may be present only in one data set within an area of overlap. They should therefore take care to examine both data sets when planning a voyage through such an area.

SECTION 2 – Withdrawn cells

Route check during passage planning

Route check is another important aspect of passage planning and many hazards can be identified and eliminated during the route check.

Before carrying out the route check, complete the following tasks:

1) ECDIS settings.

2) Markings on chart.

ECDIS settings before the route check:

ECDIS should be set correctly to reflect the ship's condition (draft) and time of the voyage (to activate the time dependent features of the ENC).

1. Set the safety contour and safety depth values calculated for the voyage.
2. Set the XTD value for each leg (refer to ECDIS alert setting procedure for XTD value recommendations). **Caution:** If this value is too small, dangers within close proximity of the route will not be detected. If this value is too large, then a substantial number of alerts will be generated.
3. Set the rate of turn/turn radius within the manoeuvring characteristic of the ship.
4. Configure the route check criteria.
5. Select the chart viewing dates valid for the entire duration of the voyage.
6. Use the display scale at the ENC compilation scale (1:1).
7. Select display layers – all.
8. Select SCAMIN – off.

Markings on the chart before the route check:

1. Markings to be carried out to draw No-Go Areas using user Maps function for the following:
    a. If the ship is sailing inside the safety contour, then No-Go Area highlighting the unsafe water. *Refer to NavGL Section – Depth contours in ENCs in relation to safety contour and safety depth for more details.*
    b. Isolated Danger – Make No-Go Area at a safe distance as per the CATZOC position accuracy. *Refer to NavGL on practical steps to integrate ZOC – Position Accuracy.*
    c. Restricted area in close proximity to ship's route identified by:
        1. NavArea warnings.
        2. AIO or Local T&P notices.
        3. ENC.

Note: No-Go Areas should be highlighted but should be reserved for those areas where the attention of the navigator needs to be drawn to a danger. Extensive use of No-Go Areas should be discouraged.

2. Markings to be carried out using user Maps function as Aids to Navigation:
    a. *Parallel indexing (not from floating objects unless they have been first checked for position).*
    b. *Landfall targets and lights.*
    c. *Prominent navigation and radar marks.*
    d. *Clearing lines and bearings.*
    e. *Transits, heading marks and leading lines.*
    f. *Highlight significant tide and currents.*
    g. *High or crossing or precautionary traffic area.*
    h. *Speed check points.*
3. Markings to be carried out using user Maps function for contingency planning:
    a. *Abort points.*
    b. *Point of no return.*
    c. *Alternative tracks and emergency anchorages.*
    d. *Port of refuge.*
4. Markings to be carried out using user Maps function for relevant information:
    a. *Tug pick up point.*
    b. *Minimum tidal height required before crossing.*
    c. *VTS and reporting points.*
    d. *Methods and frequency of position verification.*
    e. *Changes in machinery status.*
    f. *Minimum UKC.*
    g. *Positions where the echo sounder should be activated.*
    h. *Anchor clearance i.e taking off lashing etc.*
    i. *Air draft when passing under bridges/power lines/cable cars etc.*
    j. *Safe speed and necessary speed alterations.*
    k. *When entering a Marpol Special Area which requires additional control.*
    l. *Change in watch level.*
    m. *Changes in machinery status.*
    n. *Changes in operational conditions – Open/coastal/restricted.*
    o. *Change in steering control – Manual/ auto.*
    p. *Call Master.*
    q. *When to clear anchors.*
    r. *Change of chart, if applicable.*

Caution: *Do not obscure chart details with comments or marks.*

Route check:
Route Check should be conducted by at least the navigating Officer and the Master using both visual and auto route check functions within ECDIS.

Auto route check versus visual route check - which one should be carried out first? It is advisable to carry out the auto route check first to identify most of the hazards, before carrying out a detailed visual check to ensure that no hazards are left unidentified.

Automated route check:

1. Carry out the automated route check using the built-in ECDIS functionality.

   Caution: Do not use the "Accept all" alerts functionality, if provided.

2. If the route is planned across the safety contour, *then Refer to NavGL Section – Depth contours in ENCs in relation to safety contour and safety depth for more details.*

3. If an alert highlight is crossing a No-Go Area, then eliminate the risk by amending the route.

   Caution: Do not cross the No-Go Area.

4. If a large number of alerts are generated, then consider the following to reduce the number of alerts:

   a. Amendments to the route.

   b. Adjustments to the XTD limits.

5. Investigate all remaining alerts using pick report and place additional control, if required (highlight the controls in the written passage plan).

Visual route check:
A visual check on ECDIS can be carried out, similar to the route check on a paper chart ("running your fingers along the route").

Confirm the ENC band (overview, general, coastal, approach, harbour, berthing) is appropriate for the voyage leg.

If the ENC band is not appropriate with the voyage leg operational area, then assess the risk and eliminate it by:

a. Ordering appropriate scale paper charts, if available, or

b. Requesting additional information and carrying out a risk assessment.

Confirm if the passage plan meets the ZOC assessment on Sea Floor Coverage. *Refer to NavGL on practical steps to integrate ZOC - section 3.1 – Sea Floor Coverage.*

Check if the ship is following:

a. Ships' routeing systems.

b. Sufficient sea room for the safe passage of the ship throughout the voyage.

Go through the markings on the charts and confirm if they are relevant and sufficient for the voyage.

Jamming and spoofing of GNSS

A GNSS transmits positioning and timing data to GNSS receivers - and is fundamental to the safety of navigation. Examples of GNSS include the USA's NAVSTAR Global Positioning System (GPS), Russia's Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS), Europe's Galileo, China's BeiDou Navigation Satellite System, the Indian Regional Navigation Satellite System (IRNSS) and Quasi-Zenith Satellite System (QZSS) owned by Japan.

We are more and more reliant on types of GNSS like GPS for safe navigation. However, growing threats to these systems have been identified. INTERTANKO has published a guide on "*Jamming and Spoofing of Global Navigation Satellite Systems (GNSS)*" with the aim of providing guidance on the various types of GNSS and introducing the threats associated with these systems. The above publication is not intended to cover all of the technical aspects of these issues, but aims to identify practical and pragmatic ways to mitigate disruptions.

Guide for navigators

A primary and important function of the OOW is to detect spoofing and jamming at the earliest opportunity.

Some scenarios may include:

1. Multiple instances of significant GPS interferences reported by vessels and aircrafts. The interference is resulting in loss or otherwise altered GPS signals affecting bridge navigation, GPS based timing and communication equipment.
2. Hostile control of ships via false GPS signals and hijacking situations.
3. While transiting coastal areas, nearby ships are appearing and disappearing from the ECDIS display. The vessel proceeds into port and later loses signals on both GPS units just before berthing.
4. GPS equipment is unable to obtain a GPS signal intermittently since nearing the coast. The display shows HDOP ** 0.8 accuracy within 100m, but given location is actually 25 nautical miles off.

   *** Note: The value of HDOP as '1' is best and if the value of HDOP is more than '4' then position accuracy is unreliable. Sometimes there is only a flickering of the HDOP Alarm light on the GPS when the value goes above '4' but no audio alarm.*
5. Potential interference warnings, which are proactive warnings by service providers for unreliable signals due to their internal maintenance.
6. Over dependence on a single GNSS, lack of training on how to use it and failure to recognise a malfunction can also lead to processing incorrect information (human factor).

Techniques to detect jamming and spoofing

- Use of radar (e.g. parallel indexing) and ECDIS interlay (overlay or underlay), when land is visible on the radar.
- Position verification at appropriate intervals as laid out in company's SMS.
- Observing significant difference between DR position (position arrived with Gyro Course steered and distance by speed log) and GNSS fix.
- Observing and verifying by using an echo sounder to compare the depths, when sailing in suitable depth areas.
- Observe the proactive navigational warnings by the GNSS service provider well in advance.
- When overlay display of AIS AtoN with ECDIS, the position of floating AIS AtoNs depends on the accuracy of GNSS and the OOW should be fully aware of such situations.

Actions if jamming and spoofing is detected

Immediate actions:

1. Manually select a secondary position sensor.
2. Select other GNSS input if provided and use a "GNSS divergence" alarm to check any marginal difference between positioning sources.
3. If a secondary sensor is unable to provide a vessel's position and no other means are available to input position fixing, the navigator should select the DR or EP mode.
4. Start to manually plot the ship's position if near enough to shore and seek greater sea room if possible.

<< The Automatic Identification System (AIS) is likely to be affected by a jamming or spoofing attack as well and should be used with extreme care (this refers to the other ships' positions that are likely to be affected by an attack, not the VHF AIS signal).

Caution: AIS virtual navigation aid position will be correct, since the position transmitted is a true static position and is not derived from GNSS signals.>>

5. Use the parallel indexing method during coastal navigation to keep safe distances and determine turning waypoints.
6. Increase position verification frequency with available means in coastal waters.
7. Vessel to maintain safe speed considering the circumstances of the case.
8. If unable to ascertain vessel's position relative to navigational hazards, then stop the vessel.

When the situation is somewhat stable:

- Check the vessel's GNSS position frequently to detect when the service is available again.
- Report GNSS disruptions or anomalies to the authorities (for details, refer to INTERTANKO's guidance "Jamming and Spoofing of GNSS" in Appendix A: Reporting of jamming and spoofing events).
- Take note of critical information such as the actual location (latitude/longitude), date/time, and the duration of the outage or disruption.
- When possible, provide photos or screenshots of equipment failures during a disruption to assist analysts with identifying a potential cause.

In addition, for vessels using paper charts:

- Continue plotting with alternate position fixing or DR.
- Increase position plotting frequency in coastal waters.

During normal operation

Periodically check sensor input for position and source. The Officer should be familiar with changing the settings when operational limitations demand, see the section on effective training below.

Effective training

It is recommended that regular GNSS failure drills with jamming and spoofing scenarios are part of SMS procedures and carried out to maintain the familiarity with handling such events.

Use of jamming and spoofing scenarios in bridge simulator training will assist with improving detection skills.

Alert management

An alert announces an unsafe or an abnormal condition requiring attention. Based on the purpose of the announcement, it is suggested to divide these alerts as follows:

Safety Alert: Alert announces an unsafe condition which requires immediate attention, such as:

a. Danger of collision.

b. Danger of grounding.

Safety alerts draw the attention of the operator to assist in making an operational decision. Activation of these alerts is based on operator settings (safety settings).

Deficiency Alert: Alert announces an abnormal condition of the equipment, such as:

a. Incorrect settings.

b. Loss of sensor.

c. Failure of equipment (control system failure, loss of power, faults in system, etc.).

Deficiency alerts draw the attention of the operator towards deficiency and help to avoid decision making mistakes. These alerts are based on the default settings by the maker and the operator has no control over them.

Management of alerts

Use of alerts improves situational awareness and helps in the prevention of human error "Slip". The alerting is effective when performing skill-based tasks to get the attention of the operator, hence significantly improves safety and operational performance.

General cautions and recommendations on the management of alerts:

1. Caution: Do not disable the alerts using the password provided for maintenance.
2. Caution: Do not block or cover the alarm speakers/twitters with any foreign object to reduce the sound or intensity.
3. Caution: Do not operate equipment in alert conditions.
4. Recommendation: Master should consider the risk before allowing the use of equipment in alert condition.
5. Recommendation: Carry out familiarisation training on safety alerts before assigning watchkeeping duties.

Handling of alerts:

The navigating Officer shall:

1. Investigate all alerts while maintaining situational awareness.
2. If unable to maintain situational awareness, call Master.
3. Identify the type of alert.
4. Act on **safety** alerts as per the watchkeeping procedure.
5. Act on **deficiency** alerts as per the maker's operation manual/ procedure.

Safety alerts:

- Safety alerts highlight an unsafe condition which is defined by the user 'Safety Settings'.
- Safety alerts help the OOW as a decision support system.

Recommendations on safety alerts:

- SMS watchkeeping procedure should include the ***guidance on the use of safety alerts*** during watchkeeping.
- SMS procedures should include ***guidance on the safety settings*** or equipment set up procedure.

Management of safety alerts:

Monitoring the danger target or danger of collision:

Number	Alarm	Function & recommendations	Source of Information
1.01	CPA & TCPA alarm	Highlights the identification of danger target as per safety settings. Act as per ROR	Radar / ARPA, AIS
1.02	Target in guard zone	This assists in identifying the new target and automatically tracking it.	Radar / ARPA

Monitoring the progress of the passage plan:

The following alerts assist in the monitoring of the passage plan:

Number	Alarm	Function & recommendations	Source of Information
2.01	Deviation from route or Cross Track Error (XTE)	Comply with company procedure - Deviation from passage plan.	ECDIS, GNSS
2.02	Crossing safety contour	If crossing safety contour, refer to passage plan and act. Comply with company procedure on navigation across safety contour.	ECDIS
2.03	Approach to critical point	If approaching a critical point, act as per passage plan.	ECDIS, GNSS
2.04	Crossing a navigational danger in route monitoring mode	If crossing a navigational danger, review your passage plan or call Master.	ECDIS
2.05	Arrival	End of route.	ECDIS
2.12	Anchor watch alarm	Highlighting dragging of anchor.	GNSS, ECDIS
2.21	Depth below keel alarm	Monitoring the depth to meet safety settings.	Echo-sounding device

Deficiency alerts:

Deficiency alerts highlight an abnormal condition which is inbuilt by the Maker or recommended in the performance standard of the equipment.

Management of deficiency alerts:

1. Investigate if the alert highlights:
   a. Incorrect or non-conforming setting.
   b. Loss of sensor.
   c. Failure of equipment.
2. If incorrect setting, correct the setting as per the set up procedure.
3. If loss of sensor, switch to backup sensor or manual input.
4. If failure of equipment, then report to Master.
5. Use equipment after RA and additional control.
6. Report the defect as per PMS procedure.

Incorrect or non-conforming setting:

Number	Alarm	Recommendations	Source of Information
1.01	Default safety contour	This indicates user did not set up safety contour and ECDIS is displaying default safety contour of 30 m. Suggest checking safety contour settings as per SMS procedure.	ECDIS
1.02	Different Geodetic datum		ECDIS
1.03	Information overscale	This indicates the overscale ENC.	ECDIS
1.04	Customised display	Highlight if the chart display settings are different from standard settings.	ECDIS
1.21	No ENC available	Highlight the absence of any ENC data.	ECDIS
1.22	Larger scale ENC available	This helps in identifying if a larger scale ENC is available. Increase the scale to load / view larger scale ENC.	ECDIS
1.23	Area with special conditions	We need to include this in passage monitoring above.	ECDIS
1.24	Different reference system	Applicable for ARCS mode.	ECDIS
1.25	Lost target	Included below.	Radar / ARPA

Identifying the hazard during passage planning:

Number	Alarm	Function & recommendations	Source of Information
3.01	Route planning across safety contour	This alert assists in identifying crossing of safety contour during passage planning.	ECDIS
3.02	Route planning across specified area	This alert assists in identifying special conditions during passage planning.	ECDIS

Recommendations on safety settings:

- Safety settings should be relevant to operational requirements and minimum safety margin.
- If the safety settings generate frequent alerts, they will cause distraction and alert fatigue. Long term use of such situations may lead to alert normalisation, which is a habit of silencing alerts without checking the reason for the alert.
- If recommended values cause distraction, then a suitable value can be set by the Master with additional control.
- Equipment settings:

Equipment	Safety Settings	Recommendations
ECDIS	Safety contour	Dynamic Draft + Min UKC - Height of tide.
ECDIS	Safety contour	Safety contour to be equal/same or little less than safety depth.
ECDIS	Guard Zone/Safety Frame/Look-ahead settings	Arc x Length x width Open water - 20 Deg X 30 min x 10 times of beam. Coastal water - 10 Deg X 12 min x 5 times of beam. Restricted / Pilotage Water - 5 Deg X 1 min x Min twice the beam but less than channel width.
ECDIS	Cross Track Distance (XTD)	Open water - 2 - 5 NM Coastal water - 1 - 2 NM Restricted / Pilotage Water - 0.2 - 1 NM
Radar / ARPA	CPA limit	Open water - 1 NM Coastal water - 0.5 NM Restricted / Pilotage Water - As per Master's standing instructions.
Radar / ARPA	TCPA limit	Open water - 15 min Coastal water - 05 min Restricted / Pilotage Water - As per Master's standing instructions.

Loss of sensor:

Number	Alarm	Recommendations	Source of Information
2.01	Positioning system failure	Check GNSS sensor. Switch to secondary sensor or DR mode.	ECDIS
2.11	Lost target	Highlight the loss of tracked target.	Radar / ARPA, AIS
2.12	Target capacity	Equipment reaches to its target capacity.	Radar / ARPA, AIS
2.21	Loss of position	Highlight the loss of position / DR mode.	GNSS
2.22	HDOP exceeded	Highlight inaccuracy in the position.	GNSS
2.23	Differential integrity status	Highlight the status of DGPS.	GNSS
2.24	Differential corrections not applied	Highlight if differential signal not applied.	GNSS
2.25	Loss of differential signal	Highlight the loss of differential signal.	GNSS

Equipment failure:

Number	Alarm	Recommendations	Source of Information
5.01	Malfunction of ECDIS	Highlight the defective ECDIS. Activate ECDIS failure procedure and call Master.	ECDIS
5.02	System test failure	Highlight the failure of system test. Comply with your defect reporting procedure. Report the result of this failure to technical support of the maker for further assistance.	ECDIS
5.03	Power supply failure	Check the backup power supply.	BNWAS
5.04	System fault	Comply with your defect reporting procedure. Report the fault to technical support of the maker for further assistance.	Compass – Gyro

Report the defect to the person responsible for the maintenance of equipment for troubleshooting.

ECDIS configuration

ECDIS provides invaluable information to the OOW and enhances the safety of navigation. Yet, the quality of information that the OOW receives by the ECDIS depends on its configuration. Respectively, the configuration of the ECDIS depends on its generic, display and safety settings.

Since the ECDIS configuration depends on three (3) main sources of information, it has numerous configuration options - and the possibility of distorting the outcome is high. Therefore, it is recommended that handover of the watch is accompanied by a detailed checklist with the ECDIS generic, display and safety settings. It is worth highlighting the fact that the checklist is ineffective if the OOW does not understand the settings. Accordingly, the company SMS should contain proper guidance to the OOW by either providing detailed check-off cards with the proper settings according to the area of sailing or a detailed description of each and every setting, offering proper guidance/training to the OOW.

If the company opts for providing detailed instructions, these are outlined as follows:

(i) ECDIS generic settings

- Static data; Radar and GNSS antennas' position are referenced in relation to the Consistent Common Reference Point (CCRP). If the offset values are incorrectly entered into the unit, the information provided by the radar and GNSS are wrong.
- Mandated sensors; GNSS, gyro and speed sensors are connected to the ECDIS and are described along with the areas of attention.
- Alarms and warnings; they are described so that the OOW knows when an alarm or warning is expected.

(ii) DISPLAY settings

- ENCs loading options; it is necessary for the OOW to be well aware of the ENCs loading, scaling and prioritisation options of the equipment. Automatic loading of ENC along with auto scaling, taking into account the ship's position, are functions that are available on the market. In addition, there are models that automatically select ENCs and RNC based on availability. Therefore, the OOW should know how to activate and deactivate these services to reach the desired outcome.
- ENCs display category; IMO has subdivided the viewing settings in three (3) categories; "base", "standard" and "all/other". Since the OOW can select which features may appear on the display, the company should clearly define the display settings to ensure that navigation hazards can be detected by the OOW. In addition, other important display settings such as "shallow waters dangers", "shallow patterns", "two or four shades", "chart symbols", "SCAMIN" and "CATZOC" should be explained and defined in the SMS.
- VESSEL display parameters; it is necessary for the SMS to provide the settings that apply to the vessel, affecting how the vessel appears on the screen. The ship can be displayed as a symbol or an outline, the ship could be displayed in the centre of the screen or can have an offset position, the vessel may appear with one or two motion vectors (heading, course over ground), the past track could be shown with specific colours and intervals. Therefore, the SMS should highlight the options as well as the preferable settings.
- ROUTE display parameters; when the route is prepared and/or amended, the display settings are selected and applied on the route. The SMS clearly defines the minimum route display settings (course, planned speed, XTD, W/O, turn radius, among others) when the voyage is plotted on the ENCs. In addition, IMO required route alarms (XTD and approach to a critical point) are described along with the suggested values. Any other route alarm such as W/O or W/P approach alarms provided by the maker are described in the SMS and the proper guidance about the settings is provided.

(iii) SAFETY setting

- Safety contour and safety depth; the company's policy is described along with the calculation of the safety contour and safety depth.
- Cross Track Distance (XTD); the company's policy is described along with the details in amending the XTD based on the area of sailing and the surrounding navigational hazards.
- Detection area; the company's policy is described along with the details in amending the detection area based on the area of sailing and the surrounding navigational hazards.
- Isolated dangers; the relation of the isolated dangers and the safety contour is described enabling the OOW to understand when the isolated danger symbol appears on the ENCs.

If the company opts for check-off checklists, they should be developed based on the areas of sailing, such as open sea, coastal navigation, confined waters and pilotage. In addition, within the checklist, the three main areas of concern above should be available, along with the detailed expected settings for each type. For example:

AREA OF SAILING: Confined waters

SETTINGS OF CONCERN: Display settings

DISPLAY SETTINGS OF CONCERN: ENC display settings

AVAILABLE OPTIONS: Base, Standard, Other

RECOMMENDED: Minimum standard + spot soundings, isolated dangers, names, cables, pipelines, seabed, buoys names

A detailed handover checklist should be developed listing all of the details so that the OOW taking over is well aware of the configuration.

Remote navigation assessment process

Although the need for remote navigation assessment was felt during the Covid-19 pandemic, this can be useful even during ordinary circumstances e.g. where restrictions apply due to the trading pattern of the vessel or to conduct assessments in a natural environment without the pressure of the assessor's presence. However, it is to be noted that remote navigation assessment does not replace the physical attendance of a vessel for assessment. Both methods of assessment have their own benefits and limitations.

Scope of the Remote Navigation Assessment Programme

- To ensure compliance with the requirements of the TMSA and companies' internal Safety Management System requirements.
- To provide the shore teams with an overall compliance of navigational practices and procedures. Where any gap is highlighted, the team will work with the vessel to plug the gaps.
- Prevent an extensive backlog of audits due to various reasons (vessel trading pattern, pandemic etc.).
- Maintain as far as practicable a mentored audit approach.
- Act as a training exercise for persons on-board conducting audits.
- Ensure focus areas set for audits are verified.

The general guidance for conducting remote assessment

- The assigned assessor shall schedule the assessment as per the vessel's schedule in discussion with the vessel.
- The assessor shall be a qualified person.
- Decide on which documented evidence needs to be verified by the office via email or video conferencing.
- Use video conferencing were possible to visually verify critical items.
- List specific photos required to be submitted.
- Use VDR data and ECDIS playback for navigation assessment.
- Use recorder printouts for verifying machinery/ bridge equipment tests.
- Set up daily meetings for progress and feedback on deficiencies/observations.
- Upload audit results of the navigation audit following a closing meeting with the bridge team.

Opening meeting
Shore team – assigned assessor.
Vessel team: Master, Chief Engineer, Chief Officer, Watch officers and ratings.
Processes utilised: Navigational assessment checklist.
Assessment guidance will be provided to personnel on board and a plan established to ensure key focus areas and the important on-board processes are covered.

Assessment process

What is a remote audit?
A remote audit is one that is conducted completely off-site. The audit will cover everything that is usually covered on-site but uses technology to support the assessor when a site visit is not possible/appropriate.

The assessment shall be carried out:

- Within the ship's normal working time.
- Without interfering with critical operations e.g. while navigating the critical navigational area, when in port (unless at anchorage for over a day).
- Without resulting in distraction to navigational watchkeepers. The watchkeeper must not be audited during their watchkeeping time.

What do I need to make available for the remote assessment?

1. Personnel
   - The Master and assessor must work closely and agree on suitable audit dates/ time.
   - Designated location with a phone number for assessment. Skype account with video is recommended.
   - All bridge team members will need to be available as per the agreed assessment schedule.
   - Master and Chief Officer will need to be available during the leadership part of the audit as well as the opening and closing meetings.
2. Documentation
   Review as much of the implementation of the management system as possible remotely, including passage plan review and ECDIS screenshot of the critical area.

   Have the following documentation sent for assessment:
   - Voyage order.
   - Passage plan (berth to berth).
   - ECDIS data – saved in VDS for shore review.
   - Bell book copies.
   - UKC and Pilot cards.
   - Deck logbook entries.
   - Use of navigational handbook.
   - Master's standing order.

3. Utilisation of bridge equipment
   Where possible, you should show the assessor around using a CCTV control panel located on the server. CCTV snippets would also help (at a time to be chosen and agreed by the assessor and vessel).

A typical remote assessment shall include a review of the following:

- Previous navigation audit results.
- Marine, technical attendances.
- Pre-vetting/ vetting.
- PSC results.
- Internal audit results.
- Previous two navigational audits and verification of preventive actions.
- Review and understanding of the last navigational alert.
- Discussion on navigational incidents for the previous two years.

What should I expect?
The remote assessment will typically be the same duration as your onsite assessment. You may be asked to email documents to the assessor for review.

What do I need to make sure I am ready?
As you would expect, remote assessment is heavily reliant on technology. There are a few simple logistical items that you will need to prepare for your remote assessment:

- A system that will allow online conference calls (e.g. with Skype etc where possible).
- If online connectivity is not possible, the assessor may ask you to send them information via email and follow up with a telephone call.

Timeframes
Allow a minimum five days or as decided by the individual assessor, based on the progress of the assessment. The assessor will agree on the logistics for the assessment, the assessment plan/ timescales and the personnel, records and evidence required. Before the start of the assessment, prepare any documents and personnel in advance of the remote assessment. Ensure submission of any documents to your assessor if agreed in a prior call.

Limitation of a remote assessment
Even with the very best telecommunication facilities, an assessor cannot read the body language of interviewees, and this is sometimes the first indication for an experienced assessor that a site may have issues.

Also, where English is not the first language of the participants, long-distance communication can prove challenging, and this needs to be considered during assessment preparations.

Computer desktop sharing technologies go some way towards facilitating explanations, but only if the interviewee is proficient in using them.

Validity

The assessor should try to complete as much of the assessment remotely as possible. Where it cannot fully verify the effectiveness of your management system and is therefore unable to complete your entire assessment remotely, the assessor will arrange to complete the onsite activities at a later date.

In these circumstances, an assessor may choose to temporarily extend certificate validity by a maximum of six months, subject to a successful remote assessment. The duration of an assessment may be reduced based on the risk level of observations. The assessor will then follow this up with an on-site assessment within the (6) months or earlier and before the next anniversary date of the sailing assessment.

Those aspects which were not adequately covered during a remote assessment will be followed up on-site in a subsequent special assessment or at the next assessment.

This will be determined by the assessor and will be based on the risk level of findings.

Assessment activities

Assessment Activity	Remote Assessment Methodology
Engagement	Assessors use email and telephone to arrange assessment and meet with management via web/video conferences and follow up with email.
Assessment planning	Make an assessment schedule for the bridge team in consultation with the Master.
Individual review	Identify gaps in understanding and share with the assessee. Ask assessee to gather information and revert.
Documentation/ Recordkeeping	Examine the documents and records.
Provide training	Provide training as required based on the identified gaps.
Closeout	Discuss the findings with the on board team.
VDR analysis	Where practicable, the remote audit should be supplemented with a VDR analysis.

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