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ECDIS – The common problems
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The majority of errors made on the Electronic Chart Display Information System (ECDIS) are in the user's interpretation of how the ECDIS displays information. The user is given the freedom to present the chart in a number of ways: as such without a thorough understanding of how the system works, there may be some confusion in what the system in presenting.

Traditional paper charts are drawn by a cartographer who has exceptional skill in arranging the chart in such a manner that the mariner can clearly distinguish all the information necessary.

Electronic Navigational Charts (ENC) are vector electronic charts that conform to IHO specifications. They are compiled from a database of individual items ("objects") of digitized chart data, which can be displayed as a seamless chart. Unfortunately this digital image has the effect of portraying a sense of accuracy that may not be present. ENCs have recently been constructed onto a digital format, however many mariners often fail to remember that they may very well have been constructed using the same source data that contrived the construction of the paper chart; that is, since the ENCs cell construction no additional survey has been conducted.

Paper charts come with a source diagram that explains when the chart was surveyed. Traditional navigation dictated that during a voyage plan the navigator would consult these charts and determine if the source data was adequate and how reliable the soundings on the chart might be before proceeding with the passage.

ENCs do not have source diagrams; instead they include provision for the population of data fields with information about the reliability of "objects". The object "Category of Zone of Confidence" (CATZOC) in ENCs gives an estimate of the reliability of source data related to five quality categories for assessed data (ZOC A1, A2, B, C and D), with a sixth category for data which has not been assessed (ZOC U). At present, many ENCs have data populated as category U, hindering the user from making a proper assessment of the quality of charts during the planning stage.

The symbology implemented on electronic charts has altered from those established on paper charts. ECDIS has the ability to present the symbols on the chart in superfluity of ways, dependant on what software it is running. These symbols can range from, traditional paper chart symbols, to simplified ENC symbols and some have Enhanced ENC symbols.

The simplified ENC symbols are designed to be prominent on an electronic chart; using colours and shapes to clearly identify the object, as shown below (fig 1 & 3). It is not uncommon for the user, having previously utilised traditional paper charts, to be more comfortable with paper style chart symbols (fig 2 & 4) and therefore carry the assumption that such symbols will be easier to understand. This however, is not always the case, as the traditional symbols were never designed for use on electronic charts and are not as distinctive as their ENC counterparts. Additionally, most ECDIS systems have four display colours during day mode and only two colours during night mode. When the system is set to night mode these darkened, hollow traditional charts symbols turn white and can almost disappear.

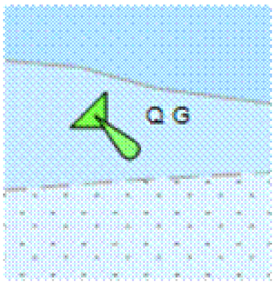


Fig 1 – Stbd Mkr Simplified

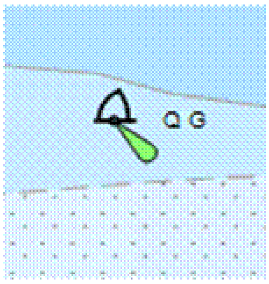


Fig 2 – Stbd Mkr Traditional

Fig 3 – Safe Water Mark Simplified

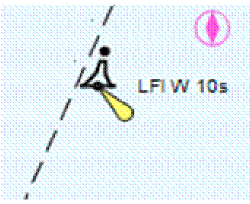


Fig 4 Safe Water Mark Traditional

IMO specifications require ECDIS to trigger certain alarms in the following circumstances:

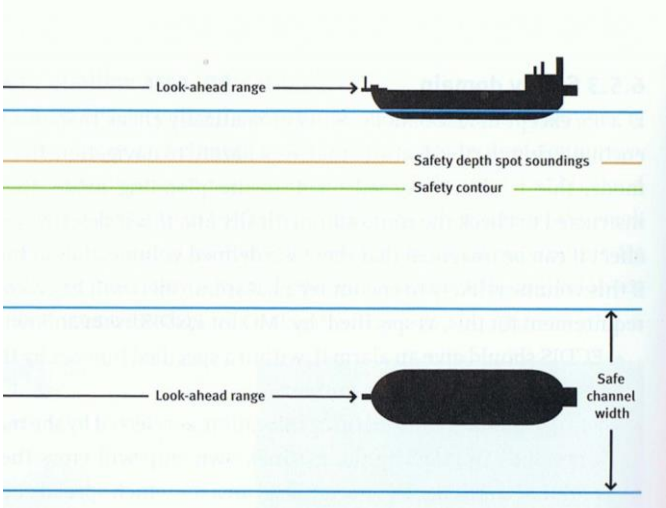
- If, within a specified time set by the user, the ship will cross the safety contour;
- If, within a specified time set by the user, the ship will cross the boundary of a prohibited area or of a geographical area for which special conditions exist;
- When the specified cross track limit for deviation from the planned route is exceeded;
- If continuing on its present course and over a specified time or distance set by the user, the ship will pass closer than a users-specified distance from a that is shallower than the mariner's contour or an aid-to navigation.

The user has to input the parameters for both depth and beam clearance. When the passage is checked and any hazards are present along the proposed route then alarms will be activated.

ECDIS manufacturers meet these requirements by allowing users to specify a safety area for the vessel, effectively contained by the following parameters:

- In depth, by the safety contour and safety depth
- In forward extent, by the look-ahead time or look-ahead range
- In lateral closeness by a specified distance.

The following diagram, reproduced courtesy of Dr. Andy Norris clarifies the concept.

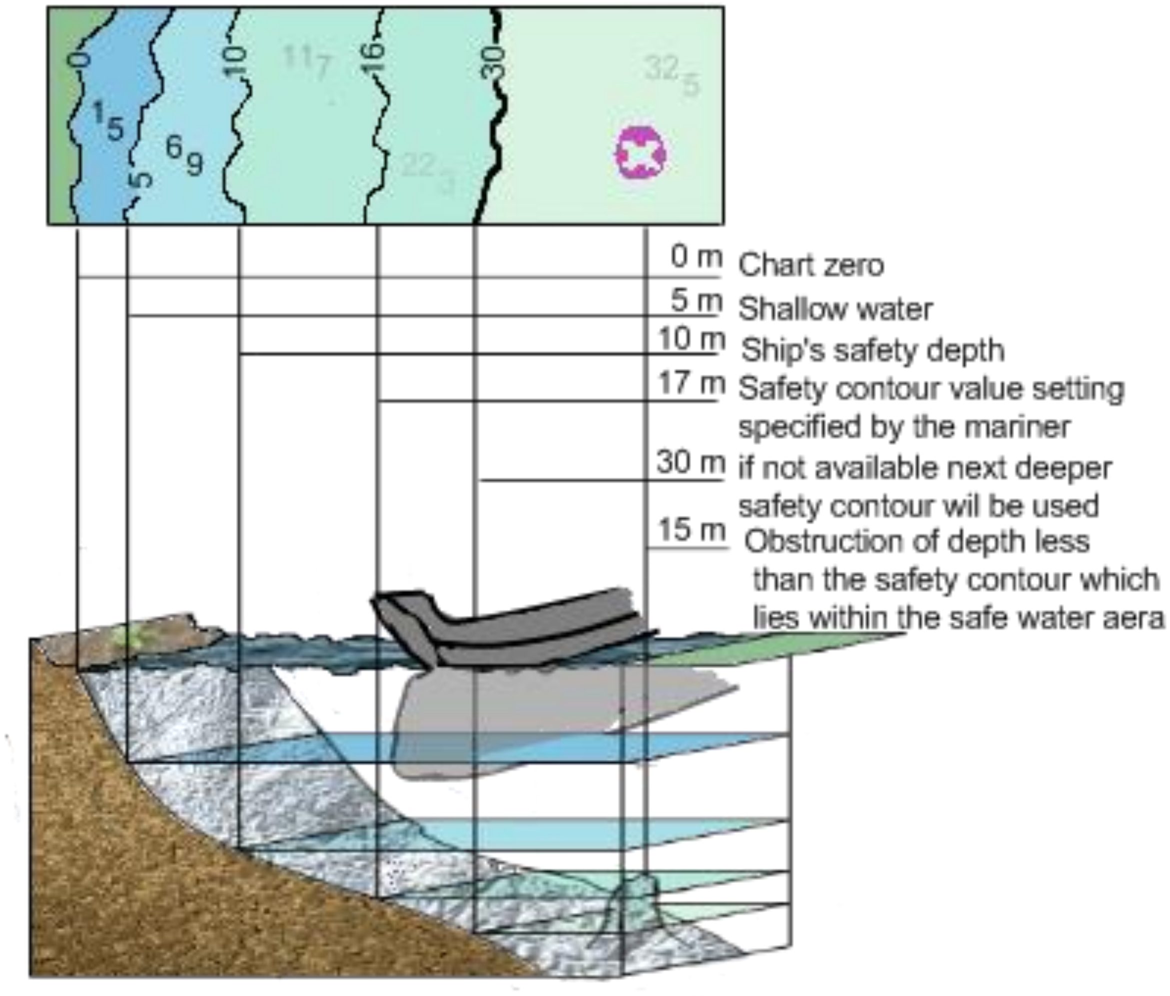


Setting all of these voyage safety features will require type specific knowledge of the ECDIS, underlining the importance of specialist training

Once the parameters have been set the passage plan can be created. Used correctly, ECDIS planning provides for a safer passage but if the user is indolent or pressed for time, then some important information may be overlooked. If these parameters are not correctly entered into the ECDIS then the user will not benefit from the inbuilt safety devices, critical warnings may be missed resulting in an increased possibility for catastrophic results.

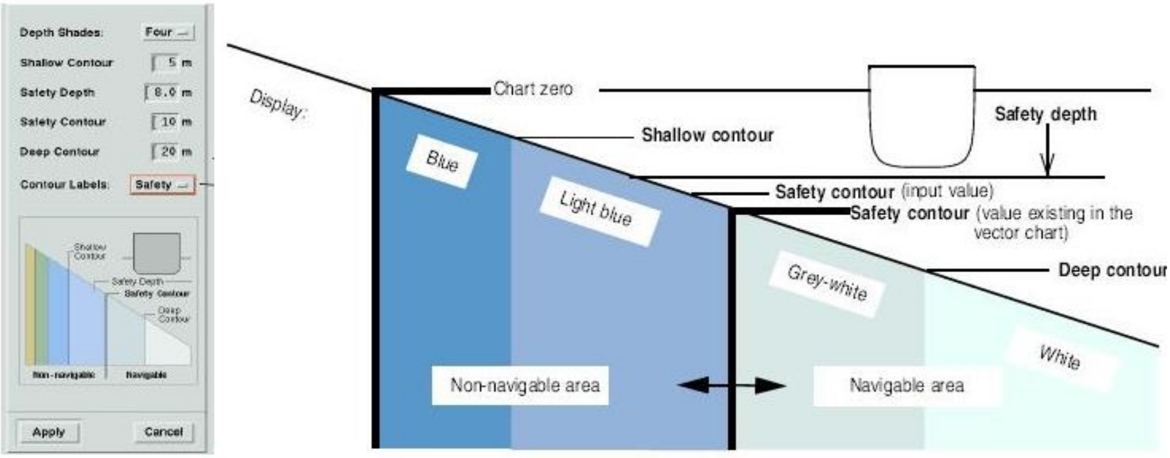
The own-ship safety contour, selected by the user from among the contours in the SENC, is double coded by a thick line and a prominent change in depth shade. If the safety contour selected by the user is not available in the SENC, the ECDIS should default to the next deeper contour and inform the user. If, when the ship moves onto a new chart, the safety contour previously in use is no longer available, the ECDIS should again select the next deeper contour, and inform the user.

The own-ship safety depth is intended as an aid when no appropriate safety contour is available in the SENC. Soundings equal to, or less than, the safety depth selected by the user are made more conspicuous than deeper soundings.



If these setting are not understood and greater values used than are needed, then the display on the chart can be confusing and a lack of situational awareness can ensue.

The below image demonstrates how an ECDIS, displays information on a four colour ECDIS.



Fundamentally, anything past the safety contour is non-navigable; this would be your limiting danger line or "no go" area in traditional navigation.

However if a vessel sets her safety contour to a value above that which she is already in, the whole screen will be displayed as blue or light blue. This is because the ECDIS has been instructed by the user that through the settings inputted, the vessel is already inside the non-navigable. By simply selecting the wrong safety contours important information, such as obstructions or shallow contours would be omitted from the chart.

The following examples are taken from real incidents however the names of the ships have been removed.

Example 1 – grounding in English Channel

Example 2 – allusion with fixed structure

Example 3 – grounding of the English coast

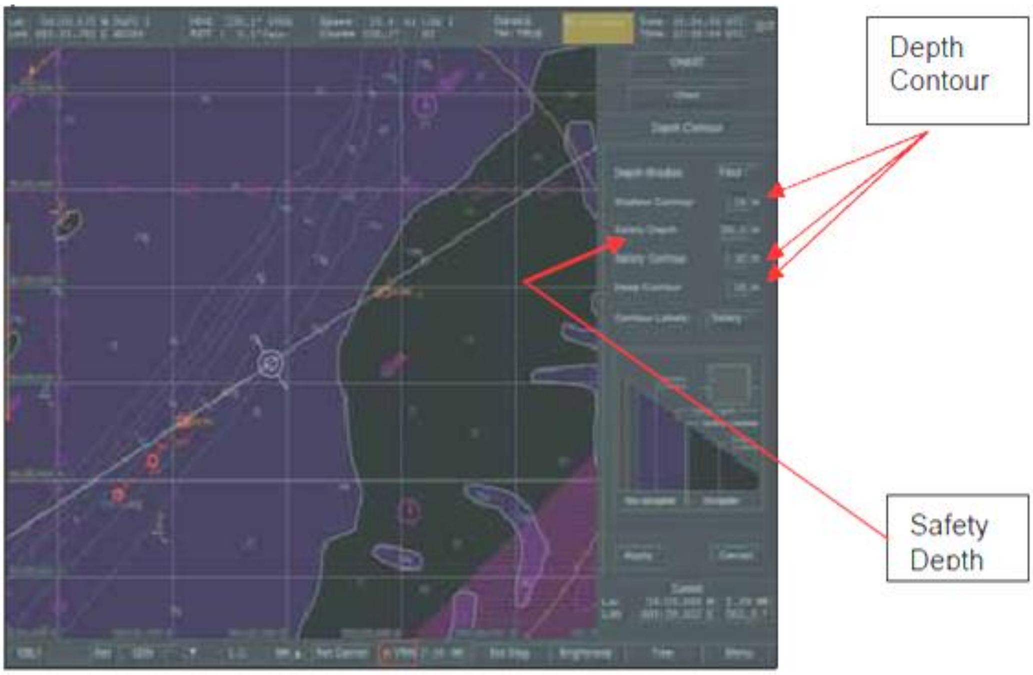
Example 1

This case shows a combination of all the factors discussed above. The grounding occurred in 2008 passing through the English Channel west-bound.

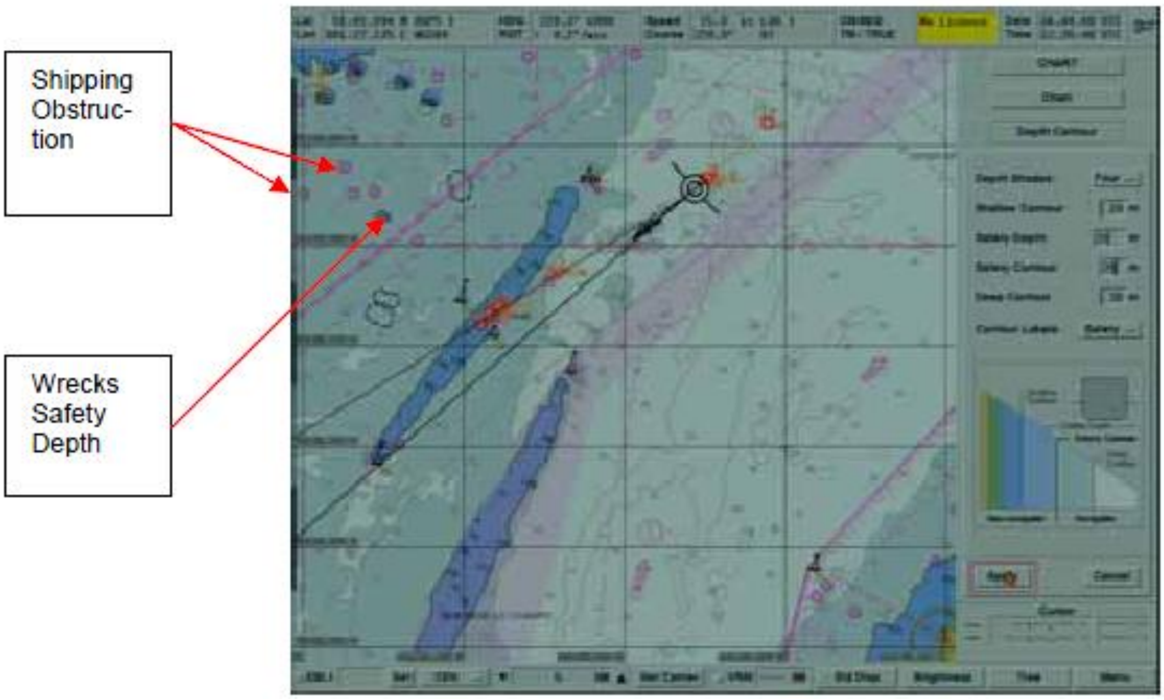
During early morning in 2008, a vessel ran aground on a sand bank in the English Channel. The ship was en route from Northern Europe to the Suez Canal. At the peak of the evening high tide, the grounded vessel was freed with the aid of four tugs.

One of the main conclusions from this accident was that the crew had inadequate voyage management system skills and the resulting incorrect settings, particularly in relation to the depth contours, chart alarms and depth settings. The following pictures show how the ECDIS was set up;

The safety depth in the picture above is set to 30 meters and the chart is in day mode displaying four colours. The sand bank is identifiable as dark blue, it is still behind the safety contour as it is set to 30 meters and thus does not stand out.



In the picture above the same settings are used as before, 30 meter safety depth, however in this case the ECDIS is set for night mode only showing two colours. The sand bank, as well as the buoy symbols (note symbols are set to traditional not simplified making them almost undetectable), are not prominent as they are already in the unsafe area, where according to the definition, no maritime shipping should take place and therefore should be avoided.

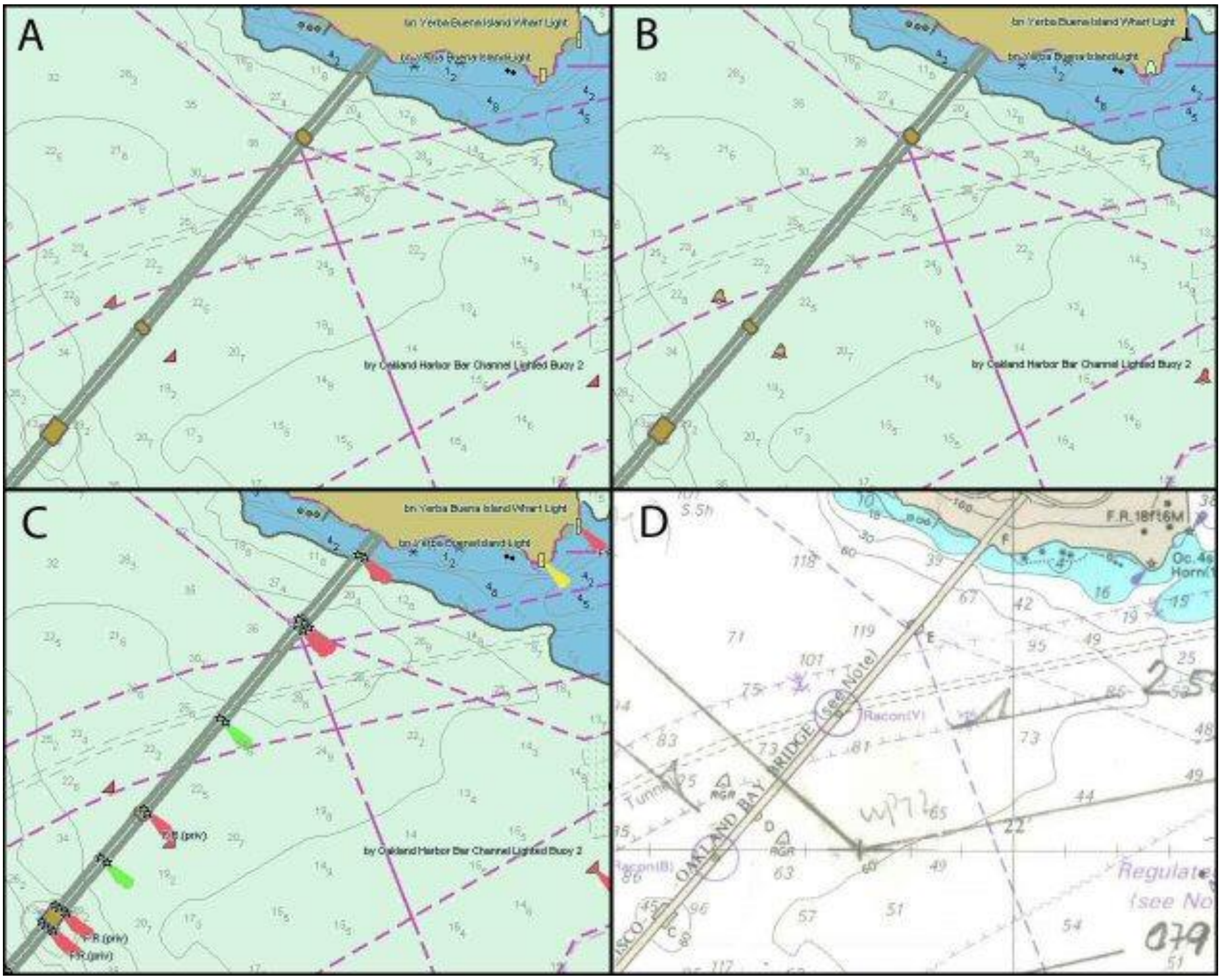


With the safety depth and safety contour set on 20 meters, the display grows even clearer. The passage between both sand banks is visible and more shipping obstruction and less wrecks are displayed.

Example 2

The case involves an oil spill that occurred in 2007 between San Francisco and Oakland, California, in which a significant quantity of fuel oil was spilled.

Investigators found that the maritime pilot was unable to use the onboard radar and electronic navigation charts correctly, misidentifying what the symbols on the chart indicated. He became confused as to where the center of the channel was and what the red triangles on the ECDIS indicated. This occurred despite the fact that the Vessel Traffic Service of the United States Coast Guard warned the Pilot that the vessel was headed for the bridge.



These chartlets display the variations of how this geographical area can be displayed on the ECDIS. Figure A is simplified ENC symbols. Figure B is traditional symbols. Figure C is illuminated ENC symbols and Figure D is the paper chart.

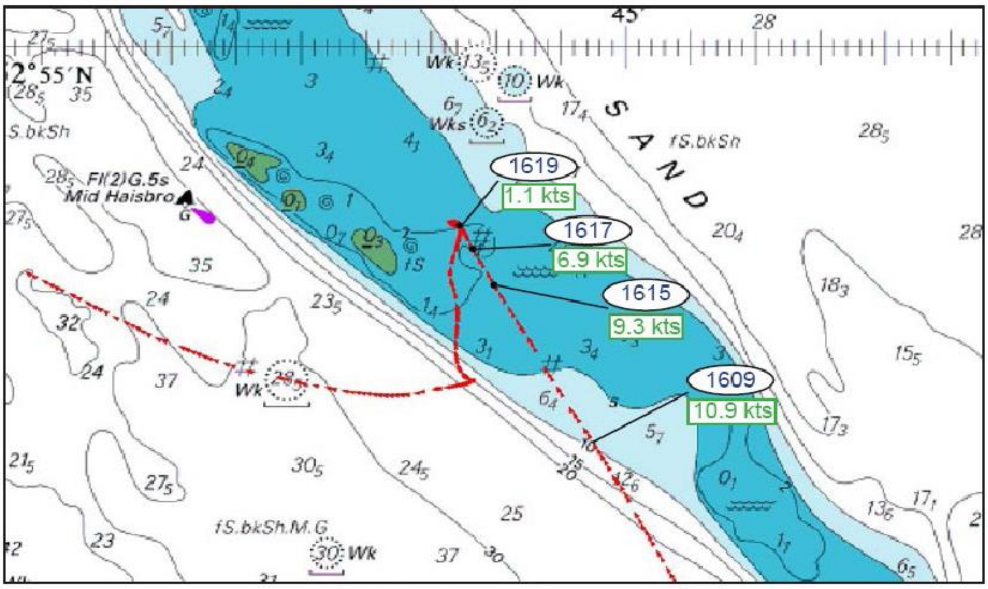
Example 3

A loaded dry cargo ship ran aground off the east coast of England. The vessel quickly refloated without assistance and continued on passage to the destined port in England, where she arrived the following morning. Fortunately there were no injuries or damage to the vessel, and there was no pollution.

The ship grounded 29 minutes after the OOW had adjusted course to follow an amended passage plan shown on the vessel's ECDIS. The route was hastily revised to ensure arrival at high water. This route took the vessel across a shallow area, where the charted depth of water was considerably less than the vessel's draught.

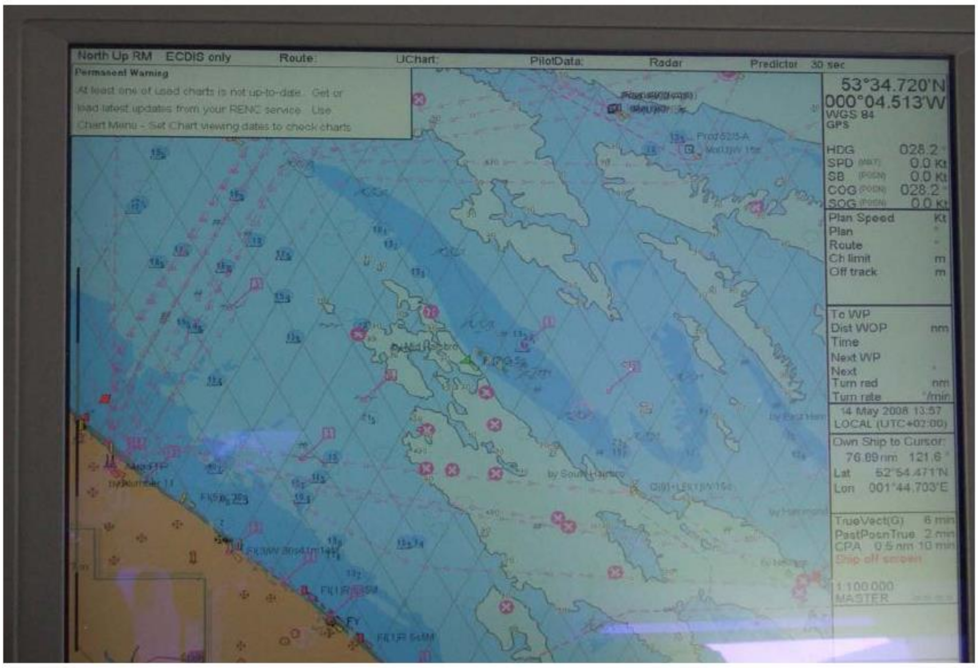
Root cause/contributory factors

1. The deck officers had not been trained in the use of ECDIS and no procedures on the system's use were included in the vessel's SMS. They were, therefore, ignorant of many of the system requirements and features, operating the system in a very basic and inherently dangerous manner.
2. The route across the shallow area was not adequately checked for navigational hazards, either when planned or when being monitored.
3. In-built safeguards in the ECDIS, which are intended to prevent accidents of this nature were not utilised and system warnings were not acted upon.
4. The safety contour alarm did not sound as the vessel approached the shallow because a watch vector had not been set.
5. It is also highly likely that the configuration of the display was not optimised to clearly show the shallows over the shallow area. At a scale of 1:100000 and with a safety contour of 30 m selected, the shallows over the bank were not readily apparent.
6. The OOW placed undue reliance on the ECDIS: it is possible that the grounding could have been avoided had he remained vigilant and continuously monitored the vessel's position in relation to navigational hazards.

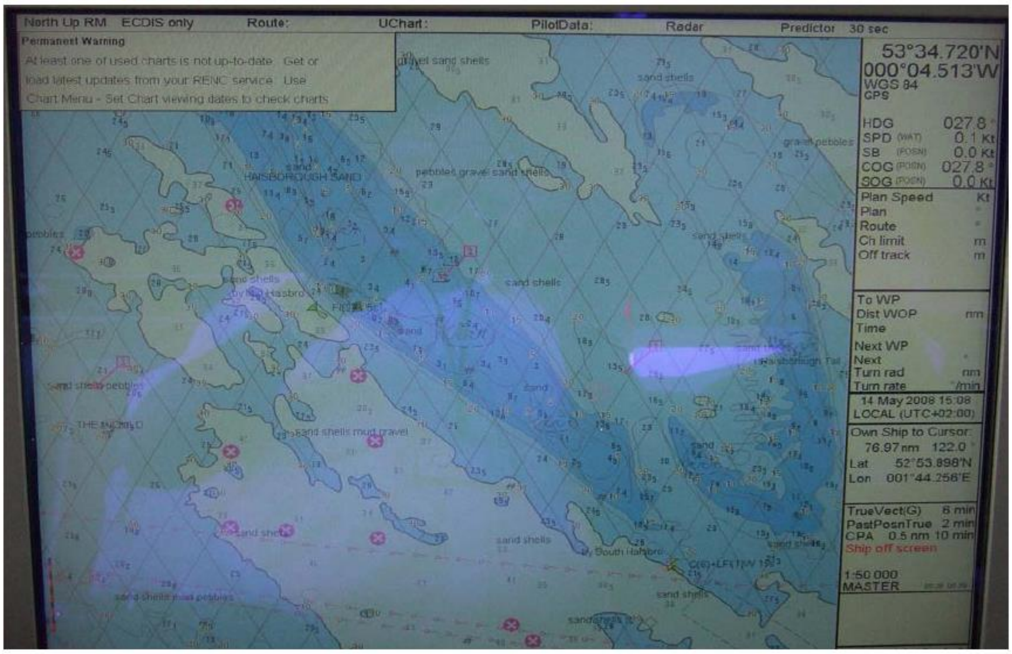


AIS Track of the Vessel

Wrong scale settings Scale 1: 100 000



Scale 1: 50 000



In conclusion these accidents highlight the need for continued training in ECDIS and the importance of ECDIS specific training for all new and existing officers. For not only is it important that the Navigator is able and aware how to plan a passage, but equally as important for the master to be able to verify it and the Officer of the Watch to be able to execute it.

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