



New ECDIS mandatory requirements Part 2: A key to safe operation

The mandatory requirement and introduction of electronic chart display and information systems is seen as a major step forward in safe ship operation and protection of the environment



Photo ECDIS Ltd

Introduction

This is the second in a series of three short articles which considers the operational aspects of ECDIS and the intrinsic function that electronic chart and navigation systems have to play in the commercially operated ship of the future.

The mandatory requirement and introduction of ECDIS is seen by the regulatory bodies guiding the shipping industry as a major step forward in safe ship operation and protection of the environment. The transition to electronic navigation and the operation of a paperless bridge is however initially viewed differently by the shipping community with increased operational costs of new equipment and additional training requirements.

It is also becoming increasingly evident that far from reducing risk, ineffective operation of complex ECDIS systems resulting from poor management practices or training can actually increase the risk of incidents such as collision and grounding with the interface between

computers extenuating the so called 'human element' reported as causative in almost every marine casualty.

Automation of traditional manual navigational tasks has been observed as delaying the opportunity for error detection and recovery allowing a navigational single point failure to develop undetected into a single point catastrophic failure ultimately resulting in an incident.

With the key to reducing management costs and navigational risk intrinsically linked with effective ECDIS practices and procedures we now consider ECDIS and its fundamental operational requirements.

The modern ECDIS system

Electronic chart display and information systems (ECDIS) in their simplest forms are single 'stand alone' units with basic sensor inputs such as course and speed displaying the ship's 'real time' position on an

electronic navigational chart (ENC) that complies with the performance standards outlined under the provisions of IMO Resolution A.817(19).

The ENC chart must further comply with the IHO chart data transfer standard S-57 (S-100 in the future) issued by an authorized hydrographic office. The system must have an adequate back up arrangement comprising of a second independent ECDIS or an adequate up to date folio of paper charts before the system can be considered as meeting the SOLAS Chapter V Regulation 19 chart carriage requirements.

Although the basic ECDIS system may be the equipment introduced during the 'retro fit' period for vessels presently in operation, the ship of the future will undoubtedly incorporate the electronic chart display and information system into the heart of the integrated bridge system (IBS) combining navigational equipment such as radar, differential global positioning systems, automated information systems, propulsion control and system alarms into a single monitoring station or navigation control module.

Although this combination of navigational systems into a single control panel is undoubtedly the way forward, the change in navigational methodology does present new challenges in relation to the requirements of safe navigation of the modern vessel.

Electronic charts

The subject of electronic charts in relation to ECDIS operation is probably an area which generates an element of confusion. This is primarily due to the fact that ECDIS can operate under the amendments to the IMO ECDIS performance standards in what is referred to as RCDS (raster chart display systems) mode utilizing raster charts when vector chart coverage of the navigational area is not available. In order to fully analyze this provision and mode of operation a clear distinction between raster and vector charts must be made.

ENCs or vector charts are compiled from a database of individual items (objects) of digitized chart data and displayed as a seamless chart. When used in an electronic navigation system, the data can then be re-assembled to display either the entire chart image or a user selected combination of data. ENCs are intelligent in that systems using them can be programmed to give warning of impending danger in relation to the vessel's position and movement.

RNCs or raster charts on the other hand are produced by digitally scanning a paper chart image. The resulting digital file may then be displayed in an electronic navigation system where the vessels position can be shown.

Since the raster chart display is merely a digital photocopy of the original paper chart, the image has no intelligence and other than visually, cannot be interrogated. The fundamental differences between vector and raster charts are identified below:

- Vector charts have no defined boundaries and provide a seamless visual display where raster charts operate similar to paper charts.
- Raster chart data cannot itself trigger automatic alarms although some alarms may be entered manual by the user.
- Horizontal datum and chart projection may differ between raster charts.
- Chart features cannot be simplified or removed to suit particular navigational circumstances.
- Without selecting different scale charts the 'look ahead' capability of raster charts may be somewhat restricted.
- Orientation of the raster display to other than chart up display may affect the readability of the chart.
- Display of a ship specific safety contour or safety depth cannot be highlighted on a raster chart unless manually entered by the user during passage planning.
- Excessive zooming in or out from the natural scale of the raster chart can seriously degrade capability.

Under the present IMO legislation, navigational areas not covered by ENC charts must be identified at the planning stage with an 'appropriate' portfolio of up-to-date paper charts available onboard to be used in conjunction with the ECDIS equipment when operated in RCDS mode.

Although the wording 'appropriate' used under the provisions of the IMO Resolution has been defined differently by the various authorities of sovereign states, specific guidance can be now be found on the IHO website www.iho-ohi.net/english/encs-ecdis/enc-available/backup-paper-charts.html.

With only a brief review of the requirements of electronic charts and their mode of operation in conjunction with ECDIS systems it is apparent that this is an area which requires careful review by competent well trained and familiarised officers at all stages of the navigational passage.

Generic training

Effective training and familiarisation of the master and officers in relation to ECDIS operation has been identified by the International Maritime Organization

(IMO) as an area of increased concern prompting a revision of the training requirements at the STCW 95 conference held in Manila on 21 June 2010.

Under the revised STCW 95 training requirements entering into force on 1 January 2012 under the tacit acceptance procedure, the Master and those in charge of a navigational watch are required to complete a generic ECDIS training course which meets the new standards laid down under the Manila amendments. This requirement pertains to all vessels fitted with ECDIS equipment irrespective of the fact that the primary form of navigation identified under the provisions of the company management system may be paper.

In the UK the present situation has recently been clarified to some extent by Marine Information Notice (MIN) 405 entitled "Training for ECDIS as Primary Means of Navigation" which was published January 2011. The notice clarifies what training is acceptable for masters and deck officers of UK-flagged vessels which have ECDIS as their primary means of navigation.

MIN 405 presently does not however make any reference to training requirements for vessels fitted with ECDIS systems identified under the company operating procedures to be used as an 'aid to navigation only' with paper charts still identified as the primary means of navigation. As MIN 405 expires on 31 December 2011 it is assumed that a further instruction will be issued reflecting the Manila amendments prior to the 1 January 2012.



Photo CSMART

Type specific training

In general terms the requirement for type specific training for ECDIS has been identified under Section 6 of the ISM Code which establishes a clear requirement for not only effective training but familiarisation with respect to safety and emergency related duties.

In addition to the ISM Code requirements, Marine Information Notice (MIN) 405 paragraph 3 now identifies a clear requirement for ship specific ECDIS training relating to the make and model of the equipment fitted on the ship on which the master or navigation officer is expected to operate. Marine Information Notice 405 further clarifies that this training should build on the MCA approved generic training format and be delivered by the manufacturer; the manufacturer's approved agent or a trainer who has attended such a programme.

The present requirement relating to type specific training for UK-flagged vessel is now partially clarified under the provisions of MIN 405. The use of the words 'and be delivered' does however suggest that the present solution adopted by many leading manufacturers providing computer based training programs may not on their own merits be considered suitable under the new guidelines.

With the dilemma relating to type specific training now clearly identified, many shipping operators may be faced with the logistical headache of either training all their operational staff in every ECDIS system within the fleet or be required to provide an onboard certified 'trainer' having previously completed a suitable 'train the trainer' course.

With many shipping operators encountering difficulties finding a solution to their type specific training requirements two alternatives have been identified below;

At the centre for training excellence at CSMART Almeria, Amsterdam (www.csmartalmeria.com) developed in conjunction with a market leading cruise ship operator, ECDIS equipment has been standardised throughout the fleet with the bridge layout replicated at the training centre. This standardisation effectively circumventing the additional requirement for type specific training as all the systems operated within the fleet is the same.

This training has been further advanced by the introduction of a revolutionary bridge team management approach moving away from the traditional rank structure adopting a function based airline style 'navigator / co-navigator' system which has been proven to effectively reduce the risk of navigational hazards.

An alternative solution to the issue of the training requirements of a multi functional and diverse shipping organisation operating many different ECDIS systems of various generations has been developed by ECDIS Ltd Southampton (www.ecdis.org).

Focusing on the needs of the modern ship manager and their respective requirements, ECDIS Ltd has

developed a centre of learning excellence providing generic training course utilising many different types of ECDIS system in a single training location. This provides increased system knowledge of ECDIS system operation, as well as complying with UK regulations and issuing MCA / STCW ECDIS certification.

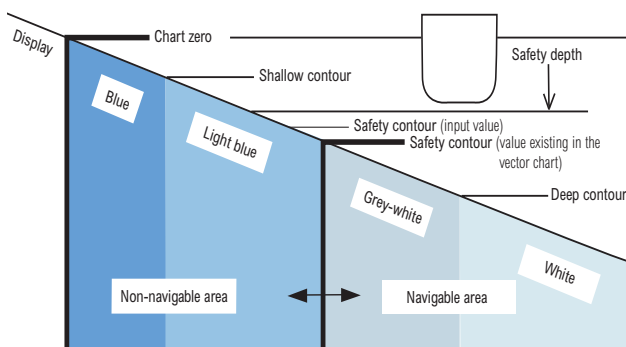
Passage planning

Effective passage planning completed by paper chart or by electronic systems is essentially the process of defining the safest navigational route in conjunction with established safety margins under which the voyage will be executed.

The passage plan should be comprehensive, detailed and easy to interpret and effectively reduce navigational risks and aid the ship and its officers to safely navigating from berth to berth. Electronic navigational planning consists of three stages namely Appraisal, Planning and Control. Although this section does not attempt to offer a guide to electronic planning the key elements will be discussed.

Appraisal – This stage of the plan should identify that the required electronic charts are available and corrected up to date. Areas where ECDIS would be operated in RCDS mode should be identified with appropriate paper charts available. The requirements of sovereign states during periods of coastal passage must be considered (IHO Website) with all relevant publications and sailing directions reviewed. Safety contours should be established and information relating to weather, current, tides, chart datum, draft, speed, environmental limits, air draft, squat and general hazards such as high traffic concentrations should be prepared and made available.

The concept of safety contours is a key function specific to electronic charts and further outlined in the diagram below.

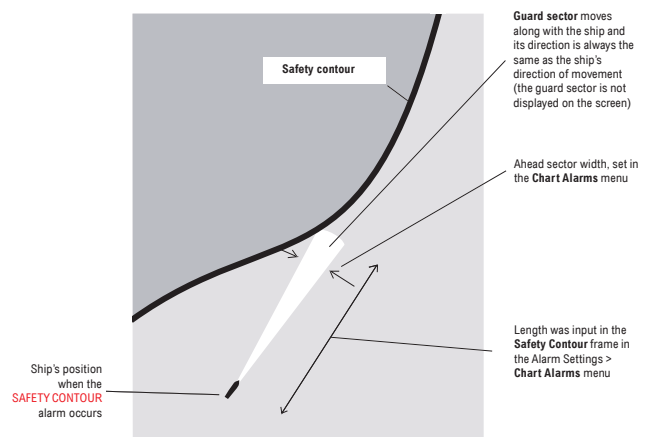


Planning– After the appraisal stage, the planning officer now begins the track planning. The planning stage can be divided into three different sub-stages or 'cuts'.

During the cuts, the planning officer will move through a quality control process from a general plan to the refined final track which will be used for navigation and approved by the master.

It is essential that the built in automatic check function is used throughout the planning stages however it must be remembered that the effectiveness of the automatic check system relies on the accuracy of the safety parameters set by the user.

The final track is then often displayed with associated waypoint information and navigational notes at the central conning station or chart table for reference by the navigational officer during the Control stage of the passage planning process.



Control – The control stage of the plan establishes how the vessel's progress and the navigational systems will be monitored throughout the passage. This will include an effective analysis identifying all risks of operation. When official ENC (vector charts) are used, systems of automatic and manual checks must be established if the danger of over reliance on automated systems is to be avoided.

Traditional track monitoring methods such as parallel index and visual bearings should be included at the control stage in addition to modern techniques such as radar overlay of the electronic chart. This should however not obscure the radar picture to the level where acquired targets may be lost or the navigation officer may be affected by information overload.

Risk analysis

On review of the increased technology available to the modern navigator one of the conundrums must be why increased computerisation and automation has not removed, and perhaps not even reduced the potential for failure in the systems in which they were introduced.

In fact new pathways to failure seem to have developed centered on an initial miscommunication between man and machinery resulting in a misalignment in the reality

of where the navigator thinks he is and where the automated system has actually taken him.

Research has shown that humans are poor monitors of automated systems and tend to rely more on system alarms than manual checks especially in relation to those systems which have proven themselves as highly reliable.

In several casualty investigations it has been determined that automation has resulted in the navigator developing an 'operational bias' relying on the automated systems rather than the salient cues provided visually through the bridge window.

In this respect an extensive risk assessment of ECDIS operation combined with a clear requirement of manual system checks of critical automated operations must be established within the company Safety Management System effectively identifying operational risk and introducing control measures to reduce the effect of single point failures.

Before we consider the assessment process, the term risk must be defined. Risk in relation to ECDIS operation can be considered as a hazard or source of navigational error with the potential to cause loss or harm to personnel, the environment or the ship (or other ships) itself.

The main areas of risk when considering ECDIS operation can be identified under three main categories:

- 1. The equipment** itself may suffer from failure (both hardware and software) including power outages sensor input failure and potential virus infection.
- 2. The charts** are operated under permit which may expire, charts in use not corrected up-to-date, updates not correctly applied, ENC chart coverage unavailable requiring the system to be used in RCDS mode without the appropriate paper chart folio being available.
- 3. The operation** of the ECDIS system onboard carried out by poorly trained crew following poor navigational practices and operational procedures such as excessive zooming or operating the chart for navigation with base information only displayed.

Effective risk assessment as a critical function of implementation of electronic navigation is rarely emphasised when the transfer from paper to digital navigation is considered.

As our short review of this subject has hopefully highlighted a full and comprehensive risk assessment clearly identifying the hazards relating to the operation of ECDIS systems should not only assist those associated with the task of transfer between the two methods of navigation but also accelerated the migration process and the positive aspects of electronic chart operation relating to increased crew efficiency whilst reducing operational costs.

Conclusion

From this short review of ECDIS operation and the functions to consider when transferring navigational practices from paper to electronic format, it is clear that the process, although complex, can if effectively completed, reduce operational cost whilst increasing levels of safety.

The effect of poor management and training in relation to ECDIS operation can however result in increased navigational risk and operational costs including detention during port state inspections and increased navigational related incidents.

In conclusion of our review of ECDIS, the third and final in this series of short articles considers the legal implications of inefficient ECDIS operation and the effect increased playback and recording facilities of modern bridge equipment may have on the casualty investigation and claims handling process.

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