

**2nd IHO-HSSC Meeting
Rostock, Germany, 26-29 October 2010**

Paper for Consideration by HSSC

Operating Anomalies Identified In Some ECDIS

Submitted by:	UK
Executive Summary:	This paper is intended to inform Member States of operating anomalies identified in some ECDIS systems and of the associated paper submitted to IMO MSC88.
Related Documents:	<ol style="list-style-type: none"> 1. IHO CLs 21/2010, 54/2010; MSC88/25/6, Navarea1 Warnings 037/10 and 230/10 2. IMO paper MSC88/25/6

Introduction / Background

1. The United Kingdom wishes to draw attention of Member States to anomalies that have come to light in the operation of some ECDIS systems when using ENC's. These anomalies have potentially significant implications for safety of navigation when using ECDIS as the primary means of navigation. On two occasions over the last nine months NAVAREA warnings have been issued to alert mariners to shortcomings in the operation of ECDIS with ENC's. The UK Maritime Administration, the Maritime and Coastguard Agency (MCA) and the IHB were consulted prior to this action being taken.

2. The anomalies described in IHO CLs 21/2010 and 54/2010 were found purely by chance. The former required ENC producers to review their data and amend the encoding of some shoal soundings. This was to ensure that ECDIS would display these significant hazards in Standard Display mode and where appropriate activate grounding alarms. The second highlighted potentially significant implementation errors in some ECDIS systems where features that might be expected to activate alarms (such as land areas) do not do so. This second case implies that current type approval procedures for ECDIS are not sufficiently robust to detect this sort of implementation error.

3. The MCA considered that these issues were sufficiently serious to justify raising them at the forthcoming meeting of the Maritime Safety Committee (MSC). They requested that UKHO investigate further to identify the extent of the problem and whether there were other circumstances where ECDIS display and alarm behaviour for navigational hazards might not be as expected. Following discussions with the IMO Secretariat and some MS and NGOs, MCA has submitted a paper to MSC88; this has been co-sponsored by Japan, Norway, UK, ICS and IFSMA. A copy of the UK paper is attached to this paper.

4. The intention of the UK paper to IMO MSC is to alert other Administrations to the specific safety issues identified and to re-open discussion on the maintenance and updating of complex computer-based navigational systems such as ECDIS. However this issue is complicated and contentious as it implies that testing alone cannot ensure such systems are safe (as is recognised in other transport domains) and that the current practice of 'life-long' type approval is not appropriate.

5. There are currently an estimated 5000 vessels fitted with ECDIS and using ENC's; an unknown proportion of these use ECDIS as the primary means of navigation and operate with very few or no paper charts. To ensure that safety of navigation is not compromised for these vessels, UK considers it essential that mariners are made fully aware of the issues identified.

Analysis of issues

6. To obtain a better understanding of the scope and scale of the safety related issues UKHO has undertaken, at the request of MCA, a systematic but necessarily limited investigation of underwater hazards and the key attribute combinations that affect their display. The investigation focussed on the most significant

navigational hazards and studied a very small sample of object, attribute and geometry combinations (64 out of the thousands possible). Having reviewed the symbology procedures and determined how the object and attribute combinations would be expected to display, test data was prepared, validated and loaded into ECDIS systems from five different manufacturers. A sample of the most significant anomalies is shown in the table below.

System	Object	Display Mode		Alarm
		Standard	Other	
A	Obstruction – Foul area	NO	YES	NO
A	Obstruction – Depth Unknown and Category of Obstruction 'null'	NO	NO	NO
B	Wreck – Showing any portion of hull or superstructure	NO	NO	YES
B	Wreck – Dangerous Wreck	NO	YES	NO
B	Obstruction – Foul area	NO	YES	NO
C	Obstruction – Fish Haven, Depth Unknown	NO	NO	NO
C	Underwater Rock Depth Unknown	YES	YES	NO
D	Wreck – Dangerous wreck, shoaler than safety contour	YES	YES	NO
D	Obstructions – Coincident with safety contour	NO	YES	YES
E	Obstruction -Fish Haven	NO	YES	YES

7. In all the above cases it would be expected that the objects listed would, due to their potentially hazardous nature, be shown in Standard Display mode and would activate an alarm during the automated route check. As can be seen from the table this is often not the case. Many of the features are displayed only in 'all / other' mode and even then they do not necessarily activate alarms. The variability between the systems tested seems to be due, at least to some extent, to differing interpretations of the conditional symbology procedures. OEMs appear to have had a particular problem with features which have no 'value of sounding' (VALSOU) attribute. This may in some part be accounted for by the textual description in the S57 standard which appears to be misleading. An additional area of confusion appears to be the differing definitions of Foul Area and Foul Ground used by HOs in paper chart compilation. These have generated some confusion for some ENC producers and may also have added to OEM implementation issues. This subject is currently a subject for discussion by CSPC and TSMAD working groups.

8. Detailed findings from the UK investigation are being provided to the Chairs of the relevant HSSC Working Groups for their consideration and further investigation. UK is willing to provide a short presentation showing real examples to HSSC attendees during the meeting.

Conclusions

9. There are significant limitations on the conclusions that can be drawn from the investigation; this is because testing was limited to a small proportion of features and attributes combinations within ENCs and five ECDIS systems out of the approximately 35 type-approved currently available in the market. However the following points are considered to be a reasonable summary of the findings:

- a. The UK investigation concentrated on underwater features most likely to be a hazard to navigation. It did not identify any further issues of the significance of 'EXPSOU=2'; however a few examples were discovered where all the ECDIS systems tested incorrectly displayed specific object/attribute

combinations. Where all OEM systems exhibit the same error it is likely that this is due to a clear deficiency in the IEC and / or IHO standards. In all the cases identified during the investigation the impact on safety of navigation as a result of these deficiencies was low.

- b. In a number of the test cases the OEM implementations of the IHO standards varied. The resulting anomalous display and alarm behaviour appears to be due to the lack of complete clarity in some elements of the IHO standards and also to the lack of definitive guidance on alarms in IMO standards. The standards need to be clear and explicit to ensure that as far as possible, all OEMs implement them in a consistent and safe manner. Some of the anomalies identified are of medium severity in regards to safety of navigation and require the mariner to be made aware of the limitations or peculiarities of the vessel's ECDIS system.
- c. Some ECDIS systems exhibit operational deficiencies that could potentially have a severe impact on safety of navigation; these deficiencies have not been found during the type approval process. This appears to be through inadequate implementation by the OEM rather than any fault of the IHO and IMO standards. There is no easy or clear way to ensure that mariners are informed when such faults are identified or that the problems are resolved. The only way to eradicate software bugs of this type is to ensure that ECDIS software is maintained; there is currently no obligation for systems to be updated as type approval remains valid for life of the system.
- d. In most cases it will not be practical or possible to amend ENC's to work around OEM implementation issues in the same way as was achieved by re-encoding shoal depths to resolve the EXPSOU=2 issue.

Recommendations

- 10. To ensure that safety of navigation is preserved, confidence in ECDIS is maintained and the full safety and operational benefits of digital navigation realised it is recommended that:
 - a. HSSC WGs review the findings of the UK investigation, check that the conclusions are valid and decide whether further investigation is necessary.
 - b. HSSC WGs engage with CIRM and IEC to inform them of the issues found and to jointly investigate the means to resolve them for future systems and for existing vessel fits.
 - c. The lessons identified are incorporated into the next generation standards S100 and S101.
 - d. Member States discuss the contents of this information paper and IMO paper MSC88/25/6 with their Maritime Administrations in advance of the MSC meeting.



MARITIME SAFETY COMMITTEE
88th session
Agenda item 25

MSC 88/25/6
4 October 2010
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ANY OTHER BUSINESS

Operating anomalies identified within ECDIS

Submitted by Japan, Norway, the United Kingdom, the International Chamber of Shipping (ICS) and the International Federation of Shipmasters' Associations (IFSMA)

SUMMARY

Executive summary: This document wishes to bring to the attention of the Maritime Safety Committee issues that have been identified within ECDIS

Strategic direction: 5.2

High-level action: 5.2.4

Planned output: 5.2.4.1

Action to be taken: Paragraph 8

Related document: SN.1/Circ.266

Introduction

1 The United Kingdom is pleased to note the increasing competence in both training and operation of ECDIS. However the United Kingdom, in consultation with Japan, Norway, ICS and IFSMA, wishes to bring to the attention of the Organization issues that have come to light affecting the operational performance of some ECDIS systems.

2 Over the course of the last 9 months, two NAVAREA warnings (Annex) have been issued to alert mariners to anomalies in the operation of some ECDIS systems. These relate to display and alarm behaviour in particular system configurations. The anomalies were discovered by "chance" inspection of ENC's within a small number of ECDIS systems and it is considered possible that other anomalies remain to be discovered.

3 The existence of such anomalies is not surprising given that ECDIS is the first complex, safety-related, computer-based navigational system. It is recognized in other transport domains that the testing of complex systems and equipment, by itself, cannot be comprehensive enough to ensure that software errors which could affect operational integrity are eliminated. It is likely that similar issues will arise with new complex systems in future.

4 Given the widespread use and the impending implementation of the ECDIS carriage requirement, it is important that any anomalies identified by mariners are reported to and investigated by the appropriate authorities to ensure their resolution. Accordingly,

Administrations should encourage vessels under their flag to report such anomalies and give consideration to alerting mariners where such anomalies might affect safety of navigation.

5 A number of points need further consideration if appropriate levels of operational integrity for complex, software-based systems are to be ensured now and into the future. These include:

- .1 how to ensure that any significant problems identified are communicated to affected users;
- .2 how to ensure that performance standards, type approval processes and training are updated in the light of any anomalies found; and
- .3 the need for a mechanism to ensure that system anomalies are rectified and any revisions are implemented on all affected systems within reasonable timescales.

Proposal

6 In order to better understand the extent of the issue, this document proposes that Administrations or another designated body or bodies should seek to collect, investigate and disseminate information about ECDIS anomalies. They should:

- .1 encourage seafarers to provide reports on such anomalies, with sufficient detail on the ECDIS equipment and ENC, to allow analysis;
- .2 treat the identity of the reporter as confidential;
- .3 agree to share information with other IMO member organizations on request; and
- .4 issue alerts to mariners where such anomalies might affect safety of navigation.

7 This document proposes that the Committee request submissions on the elements in paragraphs 5 and 6 for the next meeting of the Committee.

Action requested of the Committee

8 The Committee is invited to consider the points and the proposals above, and decide as appropriate.

ANNEX

NAVAREA I WARNINGS

Number 230/10

As previously notified by NAVAREA warning, mariners using ECDIS are advised not to rely solely on automated voyage planning and monitoring checks and alarms. It is recommended that mariners undertake careful visual inspection of the entire planned route to confirm that it, and any deviations from it, is clear of dangers. The ECDIS display should be configured to display all soundings during this inspection.

Particular care should be taken when planned routes cross areas where only small scale ENC's (Usage Bands 1 and 2) are available. In some display configurations, such as when no names are shown, small islands and other point features may be difficult to identify or could be obscured by surrounding depth contours. Some ECDIS systems appear only to undertake route check functions on larger scale ENC's and therefore alarms might not activate. This may not be clearly indicated on the ECDIS display.

The International Hydrographic Organization (IHO) is leading technical action to investigate these matters in consultation with ECDIS equipment manufacturers. Further information will be made available through Notices to Mariners.

Cancel 037/10.

Number 037/10

Mariners are advised that ECDIS may not display some isolated shoal depths when operating in "base or standard display" mode. Route planning and monitoring alarms for these shoal depths may not always be activated. To ensure safe navigation and to confirm that a planned route is clear of such dangers, mariners should visually inspect the planned route and any deviations from it using ECDIS configured to display "all data". The automated voyage planning check function should not be solely relied upon.

The International Hydrographic Organization (IHO) is leading technical action to resolve this matter. Further information will be made available through Notices to Mariners.
