REPORT 1165*

TRANSMISSION OF DIGITAL DATA FOR THE UPDATING OF
ELECTRONIC CHART DISPLAY SYSTEMS (ECDIS)

(Question 98/8)   (1990)

Introduction

Question 98/8 addresses the updating of electronic charts ·
by the transmission of digital data. In this connection, the Maritime Safety
Committee of IMO transmitted a letter to the Director of the CCIR asking that a
study of the most appropriate system and data medium to be used, involving
satellite and terrestrial methods of transmission. The notes and relevant
provisional standards of IMO are contained in Annex I to this Report.

In addition, Interim Working Party 8/14, prepared comments on the
satellite-related aspects of data transmission for the purpose of updating
ECDIS, and further suggested that the terrestrial modes of transmission should
be studied by Study Group 8.

1.   Current Updating Practices

Traditional services provided by a National Hydrographic Authority or
Hydrographic Office (HO) include a routine system for the update of all
conventional charts on sale or regularly supplied to users. Certain chart
producing nations support global portfolios, while other administrations produce
charts covering only their area of interest and responsibility.

Updates, or chart corrections, are generically referred to as "Notices to
Mariners" (NTM). Notices produced by administrations are collated on a periodic
basis and distributed to mariners by mail. Each NTM publication contains clear,
concise instructions to the mariner for the correction of his copy of the chart.
The position of each correction must be plotted, and the chart annotated with
the update information. In areas of extensive change, graphic blocks or patches
called chartlets are printed in the weekly NTM. Chartlets are cut out by the
mariner and physically affixed to the chart.

In addition to the conventional printed paper NTM published by HO's, certain
supplementary services, such as the Navigation Information Network (NAVINFONET)
operated by the US Defense Mapping Agency, provide access via telex or modem and
telephone line to the textual data used to print the NTM (chartlet graphics are
not available). . These digital files can be viewed as text on a computer or
printed out by the mariner. They are, therefore, equivalent to, but more timely
and convenient than, the conventional means of receiving chart correction
information by mail. The NAVINFONET can also be accessed by ships at sea using
INMARSAT Standard A.

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* The Director CCIR is requested to bring this Report to the attention of IMO,
  IHO and IEC.

2.   Other Navigation or Safety Update Information

More time critical, and frequently more transient, chart update information is broadcast to mariners as Radio Navigational Warnings. The mariner is expected to take note of these warnings and review them when he is approaching their geographic area of application. Radio Navigation Warnings along with meteorological broadcasts and search and rescue information, along with other safety information, are known collectively as Maritime Safety Information.

Responsibility for the broadcast of Radio Navigational Warnings beyond coastal areas is shared by 16 designated regional area coordinators. These area coordinators are the foundation of the IMO/IHO World Wide Navigational Warning Service (WWNWS). The purpose of this cooperative effort is to collect, exchange and collate navigational safety information; and to broadcast messages to ships at sea.

Three types of Radio Navigation Warnings have been established, each designed to serve the needs of the mariner in a particular location by exploiting the characteristics of the radio networks he will be using. They are:

   a.   The NAVAREA Warning Service which broadcasts warnings
         concerning routing and passage along major shipping
         lanes via radio telegraphy over HF circuits worldwide.

   b.   Coastal Warnings which have traditionally been broadcast
         using voice communications, both MF/HF and VHF. These
         warnings give short term notice of generally transient
         hazards, such as lights temporarily unlit, and are of
         interest only in a limited area.

   c.   Local Warnings which may be issued by local Authorities
         or local Coastguards over VHF voice circuits only in the
         national language.

3.   Updating in the Electronic Navigational Chart (ENC) Environment

The Maritime Safety Committee of the IMO has approved Provisional Performance Standards for Electronic Chart Display Systems (ECDIS). The transition from paper to computer driven display systems offers new advantages for the more accurate and timely update of nautical chart information. In addition, it offers the opportunity to integrate many types of geographical information which are necessary to the safety of the mariner. In the ultimate application, these would include meteorological forecasts, ice reports and oceanographic data, search and rescue information, as well as navigation warnings and NTM corrections: in short, all subject areas of Maritime Safety Information.

Within the ECDIS, updates to the HO produced ENC data must be handled differently from the update of more transient navigation warnings and safety information. Once the ENC data is entered in the ECDIS, HO produced digital NTM data should be received and processed automatically to correct the digital chart files used to generate electronic chart displays. The result of this update should have the same affect as manually registering permanent NTM corrections on a paper chart.

A rough estimation of the data volume for HO produced digital NTM data files was carried out based on an evaluation of the paper NTM corrections published by the Hydrographic Institute of the Federal Republic of Germany (DHI). The DHI estimate was confirmed by a similar evaluation performed by the Defense Mapping Agency in the USA. Only the needs of larger vessels were considered (draft of five meters or greater). The weekly volume for a broadcast data transmission to provide correction information for a global portfolio of charts should range from 135 kbyte to 270 kbyte. The 135 kbyte figure represents a realistic estimate of the average weekly data transmission volume, and 270 kbyte represents a high end or worst case estimate.

Since Radio Navigational Warnings and other safety broadcast information are generally transient in nature, this update data must not be allowed to permanently change the electronic chart display. It must be processed and held separately and applied to the chart display as an overlay or in such a manner as to notify the mariner of the presence of a warning at a particular geographic location. Since mechanisms currently exist for the broadcast of warnings to be received by the mariner either in the form of text or voice transmissions, it is most likely that computer readable digital update files must be transmitted using either the same or different channels. Rough estimates made by the Defense Mapping Agency in the USA indicate a weekly data volume on the order of 50 kbyte per NAVAREA for both NAVAREA and Coastal Warnings. It is not considered feasible at the present time to address Local Warnings since they have a very limited application area and are generally broadcast only by voice in the national language.

For the foreseeable future, it will be necessary to support both conventional paper chart updating and textual and voice broadcast warnings as well as new information transfer and updating techniques that will be needed for ECDIS. To maximize the efficiency and reliability of transferring both sets of data, the textual or voice update/warning information should be sent together with computer readable digital files to update the ECDIS. Further, the ECDIS should be capable of displaying the text of update/warning information on its alphanumeric display.

4.   Planned Changes Affecting the Broadcast of Warnings

The Global Maritime Distress and Safety System (GMDSS) has been developed by IMO (with ITU, IHO, WMO, INMARSAT and others) to upgrade existing worldwide distress and safety communications by the mid-1990's. The main purpose of GMDSS is to support distress alert and search and rescue operations. GMDSS also provides for urgency and safety communications and the dissemination of maritime safety information including navigation and meteorological warnings.

Under GMDSS, the present day NAVAREA radio telegraphy service will be replaced by a satellite broadcast service using INMARSAT's SafetyNET facilities. Further, NAVAREA warning traffic volume will be greatly reduced by the implementation of the NAVTEX Broadcast Service worldwide.

The NAVTEX Service broadcasts warnings in the area up to 200 miles offshore. Because most warnings pertain to coastal areas and the NAVTEX transmissions are frequent, many warnings now required to be promulgated through the NAVAREA Service will only be broadcast by NAVTEX in the future.

The NAVTEX receiver and SafetyNET facilities, included in the GMDSS carriage requirements, in accordance with the 1988 amendments to the SOLAS Convention, appear to be useful for receiving updating information promulgated by telecommunications.

5.   Organizational Considerations

National Hydrographic and Telecommunications Authorities have finite resources and, as with many public sector activities, they must limit their support of nautical charts to that minimum necessary to ensure safe navigation. In the area of updating, for the conventional chart now in use, that basic support is represented by printed NTM's distributed by mail. Since manual entry of the information contained in the printed Notice would be a feasible means of providing correction information to the ECDIS, a system clearly now exists for updating the electronic chart. However, distribution by mail and manual updating do not take advantage of the potential for a more timely and more accurate correction process and reduced labor for the mariner.

Similarly, under the current IMO/IHO WWNWS and planned GMDSS implementation, the mariner is being advised in a timely manner of navigation warnings and other safety information. However, the integration and application of this data to the mariner's present location is a manual process. Clearly, the opportunity exists within the ECDIS to provide the mariner automatically with a single integrated geographically referenced source of information which affects his immediate situation.

While these benefits are noteworthy, they alone do not require the establishment of an international, free-to-user, automatic updating service sponsored by National Authorities. Despite this fact, the potential for increased accuracy inherent in automatic updating and the logic of supporting digital charts with a digital update capability warrants serious consideration.   National Authorities, the CCIR, IMO, IHO, and others are working cooperatively to investigate the establishment of appropriate mechanisms for the distribution of computer readable digital NTM data and digital navigation warning and other safety information.

Annex: 1

ANNEX I

**NOTES ON THE PROVISIONAL PERFORMANCE STANDARDS FOR
ELECTRONIC CHART DISPLAY SYSTEMS (ECDIS)**

1   Introduction

The ECDIS is evolving as a completely new type of navigational system
and appears to have potential to improve the safety of navigation. ECDIS
requires extensive development before it can achieve this potential and be
considered as equivalent to the paper chart. The provisional performance
standards and associated notes which have been approved by the Maritime Safety
Committee are intended to assist in this development.

2   Reliability and availability

The safety of navigation should not be adversely effected in the case of
failure of an ECDIS. Adequate back-up provisions are required. Possibilities
include, for example, "Get you-home" charts, hard copy from the ENC or
additional back-up equipment.

3   Operating controls and procedures

It is desirable that operating controls and procedures should be
standardized. Manufacturers are invited to give this aspect consideration
at an early stage.

4   Data media

Hydrographic offices and manufacturers should endeavour to agree on the
data media to be used worldwide to supply ENC and update data.

5   Number of displays

Ships operating within limited trading areas may not require two displays
for safe navigation. However, a second display may be used for management/
operational tasks, in addition to navigation.

6   Standard display

Section 3 of the standards refers to a standard display which should be available when the ECDIS is first switched on, and subsequently by a single action by the operator. This is considered as a set of information that will be the basis for navigation under most conditions. The navigator who is ultimately responsible for selecting those items of information which are necessary to facilitate safe navigation, may add to or subtract from this standard display either to provide additional chart features that may be needed, or to simplify the display and avoid clutter which may sometimes occur.

7   Minimum display

During the development of ECDIS it will be necessary for IMO to consider which items of the 'standard display' (section 3 of the standards) will be required to be displayed permanently (the 'minimum display') to ensure safe navigation.

8   Specifications for symbols and colours

Section 6 of the standards requires IMO and IHO symbols and colours to be utilized. A defined set of symbols and colours is being developed.

PROVISIONAL PERFORMANCE STANDARDS FOR
ELECTRONIC CHART DISPLAY SYSTEMS
(ECDIS)

1   INTRODUCTION

1.1 The primary function of the ECDIS is for safe navigation. The ECDIS
should enable the navigator to execute in a convenient and timely manner all
navigational routines which are currently done on the paper chart.

1.2 The ECDIS should display accurate and up-to-date chart information
necessary for safe navigation and should be designed to reduce the
navigational workload. The ultimate objective is to produce a system that can
be accepted as a legal equivalent to the charts required by regulation V/20 of
SOLAS 1974.

1.3 The ECDIS should have at least the same reliability and availability of
presentation as the paper chart.

1.4 In addition to the General Requirements for Electronic Navigational Aids
contained in IMO resolution A.574(14), ECDIS should comply with the following
minimum performance standards.

2   DEFINITIONS

2.1 Definitions of terms used in this performance standard are given in
appendix 1.

3   DISPLAY OF ENC DATA

3.1 The electronic chart display equipment (ECDIE) should be capable of
displaying all the data in the electronic navigational chart (ENC).

3.2 When first switched on, and subsequently by a single operator action, the
ECDIS should present the following standard display (default display), as
appropriate to the chart scale:

.1 coastline

.2 drying line

.3 indication of isolated dangers

.4 own ship's safety depth contour, to be selected out of the depth
    contours provided for in the ENC

.5 indication of fixed and floating aids to navigation

.6 boundaries of fairways, channels etc.

.7 routeing systems

.8 visual and radar conspicuous features

.9 prohibited and restricted areas

.10 indication of cautionary notes

.11 scale bar

.12 chart scale boundaries

.13 indication of units of depths and heights.

3.3 On demand ECDIS should display any other information contained in the
ENC, including:

- spot soundings

- details of isolated dangers

- details of aids to navigation

- contents of cautionary notes

- ENC edition date

- geodetic datum.

3.4 It should be possible to delete from the display any items of ENC
content. A warning should always appear when any of the standard display
items are absent.

3.5 The addition or subtraction of information should be possible with a
minimum of operator controls and actions.

3.6 It should be possible to verify that the ENC data have been loaded into
the system and are being displayed without corruption.

3.7 On the display the ENC data should always be clearly distinguished from
all other data.

3.8 The ENC content and its display should be internationally standardized.

4   SCALE

4.1 ENCs will be provided at specified scales. If the data are displayed at other scales (underscale or overscale), a warning should be provided.

4.2 The same size of symbols, figures and letters should be used for all specified scales.

4.3 A display of the sailing area at a different scale, if it exists, should be generated immediately.

5   ROUTE PLANNING AND MONITORING AND DOCUMENTATION

5.1 Route planning
     It should be possible to carry out route planning independently of route monitoring in a simple and reliable manner. For route monitoring the selected route should appear automatically whenever the display covers that area.

5.2 Route monitoring

5.2.1 Own ship's position should be displayed on the screen continuously in the case of route monitoring.

5.2.2 It should be possible to position and subsequently adjust the symbol for own ship's position manually.

5.2.3 The ECDIS should be able to display:

        .1 time-labels along the ship's track manually on demand and
            automatically at intervals selected between 1 and 120 minutes;

        .2 the past track data for at least 8 hours on demand; and

        .3 points, free movable electronic bearing lines, variable and
            fixed range markers and other symbols required for navigation
            purposes as specified in paragraph 6.2.

5.2.4   It should be possible to enter, display and read on demand the geographical co-ordinates of any position.

5.2.5   The ECDIS should be able to detect if the ship's position is within a geographical area for which special conditions exist.

5.3   Documentation

It should be possible to store, protect and reproduce those minimum elements of the display required to reconstruct the past navigation in utilizing the ECDIS during the previous eight hours.

6   SYMBOLS AND COLOURS   -

6.1   Only IHO approved symbols and colours should be used to represent ENC information.

6.2   All symbols and colours other than those mentioned in 6.1 should be approved by the IMO (see appendix 2).

7   ACCURACY

7.1   Lines used for the purpose of navigation should be displayed with an angular error not greater than plus or minus 0.50°.

7.2   Ranges should be displayed with an error not exceeding 1.5% of the semi-diagonal length or 70 m, whichever is greater.   ⮥

7.3   The ECDIS should be capable of meeting the accuracy requirements of the IHO with respect to ENC data.

8   DISPLAY OF OTHER INFORMATION

8.1   If radar information or other temporary navigational information is added to the chart display it should not degrade the ENC information display and it should be clearly distinguishable from the ENC data.

8.2 If radar video is added to the chart its scale and orientation should be adjusted automatically to the ENC information displayed. The origin of the radar image should be capable of manual adjustment.

8.3 It should be possible to remove all radar information in a single action.

9   DISPLAY MODE AND GENERATION OF THE NEIGHBOURING AREA

9.1 It should always be possible to display the ENC 'north-up'. In any other orientation the North direction should be indicated.

9.2 ECDIS should provide at least for true motion mode. If true motion mode is in use, reset and generation of the neighbouring area should take place automatically at a predetermined distance from the border of the display.

9.3 There should be a positive indication of the display mode in use.

9.4 The change of the chart area and the position of own ship on the screen should also be capable of being performed manually.

10   DISPLAYS

10.1 The ECDIS should have the capacity to display information required for:

.1   navigation and route monitoring;

.2   look ahead, route planning and supplementary navigation tasks;

In changing from one function to the other on a display the change should be immediate.

Note: This may require one or two displays depending on the nature of the voyage.

10.2 The effective size of the chart presentation on a display should be at least 350 mm x 270 mm.

10.3 The displays should be capable of meeting colour and resolution requirements of the IHO and IMO.

10.4 The method of presentation should ensure that the displayed data are clearly visible, in general, to more than one observer in the conditions of light normally experienced on the bridge of a ship by day and by night. Facilities to adjust the brightness should be provided.

11   PROVISION AND CORRECTION OF DATA

11.1 The contents of the ENC should be adequate and up to date for the intended voyage to comply with SOLAS, 1974, regulation V/20.

11.2 The ECDIS should be capable of accepting official automatic updates added to the ENC, communicated in standard IHO format. These updates should be automatically applied to the displayed information but, in accordance with 11.7, should be stored separately from, and should not overwrite, the ENC data.

11.3 The ECDIS should also be capable of accepting updates entered manually with simple means for verification prior to the final acceptance of the data. These should be stored separately from the ENC and should on demand be distinguishable on the display from ENC data and their automatic corrections and not affect their legibility.

11.4 The system should keep a record of updates added to the ENC, including time of application. In addition to an alphanumeric listing of these updates, it is necessary that the navigator be able to display updates both for verification and to ascertain the changes which have been made.

11.5 The format in which the ENC and updates to it are originated by HOs, and the data media, should be internationally standardized.

11.6 The ENC data to be used in ECDIS should be that originated by national hydrographic offices.

11.7 It should not be possible to alter the contents of the ENC on board.

12   CONNECTIONS WITH OTHER EQUIPMENT -

12.1 The ECDIS should not degrade the performance of any equipment providing sensor inputs. The connection of the ECDIS to any other equipment should not degrade the performance of that equipment.

13   PERFORMANCE TESTS AND WARNINGS

13.1 The ECDIS should provide suitable warnings of ECDIS malfunction to enable the observer to monitor the proper operation of the system.

14   POWER SUPPLIES

14.1 The ECDIS should normally be powered from the ship's main source of electrical energy. In addition, it should be possible to operate the ECDIS and all equipment necessary for its normal functioning, from an alternative source of energy. Changing from one source of supply to another or any interruption up to 60 s duration of the supply of electrical energy should not require the equipment to be manually re-initialized and should not lose information stored in the memory.

15   BACK-UP ARRANGEMENTS

15.1 Adequate back-up arrangements should be provided to ensure safe navigation in case of ECDIS failure.

APPENDIX 1

DEFINITIONS OF TERMS TO BE USED ONLY IN CONNECTION
WITH ECDIS PERFORMANCE STANDARDS

1   Electronic chart database (ECDB)

An ECDB is a master database of chart information held in digital form by the national hydrographic authority.

2   Electronic navigational chart (ENC)

An ENC is a subset of the ECDB, held on the vessel. It contains useful information for navigation such as coastlines, obstructions, beacons etc.

3   Electronic chart display equipment (ECDIE)

ECDIE is the display equipment which processes and indicates necessary information compiled in ENC and other information to assist in safe navigation.

4   Electronic chart display system (ECDIS)

An ECDIS is a system which displays hydrographic information which may be combined with information provided by electronic position-fixing systems, radar etc., to assist in the safe navigation of a ship.

An ECDIS consists of the electronic navigational chart (ENC) as data file, and the electronic chart display equipment (ECDIE).

APPENDIX 2

NON-ENC DISPLAY SYMBOLS

The following preliminary list of symbols has been identified as being used for navigational routines:

.1   Own ship

.2   Past track

.3   Vector for heading and speed

.4   Vector for course and speed made good

.5   Range rings

.6   Cursor mark

.7   Waypoint

.8   Event

.9   Dead reckoning position (DR)

.10   Estimated position (EP)

.11   Position probability area (PPA)

.12   Fix - visual

        - astronomical

        - radar

        - electronic position fixing system (EPFS)

.13   Position lines

.14   Transferred position lines

.15   Planning track

.16   Current vector

.17   Dangers

.18   Clearing lines

.19   Distance to run

.20   Planned position and time

.21   Visual limits of lights

.22   Position and time of 'Wheel over'

This list is not exhaustive nor does it imply that all ECDIS will contain all these symbols.