ECDIS

What you need to know

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Mandatory ECDIS

What is the IMO resolution?

At its 86th session from May 26 to June 5, 2009, the IMO's Maritime Safety Committee approved new regulations for the mandatory carriage requirement of ECDIS.

The amendment to SOLAS Chapter V regulation 19.2 will require ships engaged on international voyages to be fitted with ECDIS according to the following timetable:

/// TIMETABLE FOR ECDIS CARRIAGE REQUIREMENTS			
Ship type	Size	New ship	Existing ship
Passenger ships	≥500 gross tons	1 July 2012	No later than 1st survey after 1 July 2014
Tankers	≥3,000 gross tons	1 July 2012	No later than 1st survey after 1 July 2015
Dry cargo ships	≥50,000 gross tons	1 July 2013	No later than 1st survey after 1 July 2016
	≥20,000 gross tons (new ships) 20-50,000 gross tons (existing ships)	1 July 2013	No later than 1st survey after 1 July 2017
	≥10,000 gross tons (new ships) 10-20,000 gross tons (existing ships)	1 July 2013	No later than 1st survey after 1 July 2018
	3-10,000 gross tons	1 July 2014	No retrofit requirements to existing ships <10,000 gross tons

NOTE: Ships may be exempt from the requirements if they will be taken permanently out of service within two years after the implementation date specified.

An amendment to the existing Chapter V regulation 19.2.1.4 was also made to reflect that ECDIS is an acceptable alternative to nautical charts and nautical publications. However, it stipulates that it is appropriate to use only nautical charts and publications in a number of cases – for example ships not on international voyages, ships exempt from the carriage requirements because they were to be permanently taken out of service and cargo ships on international voyages but below the agreed tonnage limit.

What is
an
ECDIS?

An Electronic Chart Display and Information System (ECDIS) is a computer-based navigation system that complies with IMO regulations and can be used as an alternative to paper navigation charts. Integrating a variety of real-time information, it is an automated decision aid capable of continuously determining a vessel's position in relation to land, charted objects, navigation aids and unseen hazards.

An ECDIS includes electronic navigational charts (ENC) and integrates position information from the Global Positioning System (GPS) and other navigational sensors, such as radar, fathometer and automatic identification systems (AIS). It may also display additional navigation-related information, such as sailing directions.

ECDIS is defined in the IMO ECDIS Performance Standards, IMO Resolution A.817 (19), as follows:

> Electronic Chart Display and Information System (ECDIS) means a navigation information system which, with adequate back up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/19 & V/27 of the 1974 SOLAS Convention, by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information if required.

How do you know if you have an "official" ECDIS?

To legally comply with IMO regulations, an ECDIS must receive type approval, which is typically conducted by recognized organizations or marine classification societies nominated by flag states.

The test procedures were developed by the International Electrotechnical Commission (IEC) and are based on IMO ECDIS Performance Standards, applying the IHO requirements S-52 and S-57. The performance standards specify many details, such as:

- ECDIS should present the Standard Display at any time by a single operator action.
- It should be possible for the mariner to select a safety depth. ECDIS should emphasize soundings equal to or less than the safety depth whenever spot soundings are selected for display.
- The ENC and all updates to it should be displayed without any degradation of their information content.
- It should not be possible to alter the contents of the ENC.
- ECDIS should also be capable of accepting updates to the ENC data entered manually with simple means for verification prior to the final acceptance of the data. They would be distinguishable on the display from ENC information and its official updates and not affect display legibility.
- It should always be possible to display the SENC in a "north-up" orientation. Other orientations are permitted.

- The effective size of the chart presentation for route monitoring should be at least 270 mm by 270 mm.
- It should be possible to plan an alternate route in addition to the selected route. The selected route should be clearly distinguishable from the alternate route.

For the complete list, please see:
http://www.nauticalcharts.noaa.gov/staff/docs/nRNC_EDISperformstandards.pdf

As with other navigation equipment, compliance with IMO standards is based on the manufacturer's self declaration. European governments are in agreement about recognition of their ECDIS type approval certificates – indicated by the "wheel mark" sign showing conformity with the Maritime Equipment Directive of the European Union. There are no such facilities, organizations or any particular request by a flag state in North America.

Some maritime nations also have type-approval programs within their maritime safety administration or Department of Marine Transportation.

The IHO Check Dataset

The IMO has indicated its concern about reports of operating anomalies identified in some ECDIS and issued IMO MSC Circular 1391. MSC Circular 1391 encourages mariners to report any unexpected ECDIS performance issues to the appropriate authorities. It is believed that some older ECDIS are unable to display important new chart features recently agreed by IMO such as Particularly Sensitive Sea Areas and Archipelagic Sea Lanes as these require ECDIS to use the latest version of the display standards set by the IHO. Some other ECDIS alarms and indications may also not work in certain operating modes in some equipment.

To support further investigation and to collect more information the IHO, which is the intergovernmental organization responsible for the ECDIS chart and display standards, has produced a simple Check Dataset that allows the operation of ECDIS to be checked.

Any anomalies revealed by the checks will alert mariners to the possibility that their ECDIS may require upgrading and will help to identify how the different brands of ECDIS display and handle chart information. Feedback from the checks will be used to inform the IMO, national Hydrographic Offices, ECDIS manufacturers and others, so that they can take any corrective action that may be necessary.

The ENC data needed to conduct the checks is provided to ships through the normal ENC provider network or via the IHO website.

ECDIS manufacturer overview

Manufacturer	Website
Dalian LandSea	http://www.maritech.cn
Danelec Marine	http://www.danelec.dk
DMU China	http://www.dmu-maritech.com
e-MLX	http://www.emlx.co.kr
Furuno	http://www.furuno.fi
GEM	http://www.gemrad.com
Haihua Electronics Enterprise Corporation	http://www.hhee.com.cn/enindex.asp
Headway Marine Technology	http://www.headwaytech.com
Imtech	http://www.imtech.com
JRC	http://www.jrc.co.jp
Kelvin Hughes	http://www.kelvinhughes.com
Kongsberg Maritime	http://www.km.kongsberg.com
L-3 Navigation	http://www.mapps.l-3com.com
Maris	http://www.maris.no
Navico	http://www.simrad-yachting.com
NavMarine	http://www.navmarine.ru
OSI Nav systems	http://www.osi.com
PC-Maritime	http://www.pcmaritime.co.uk
Raytheon Anschütz	http://www.raytheon-anschuetz.com
Rutter Technologies	http://www.rutter.ca
SAM Electronics	http://www.sam-electronics.de
Samsung	http://www.samsungbaha.com
Sea Information Systems	http://www.microplot.co.uk
Sodena	http://www.sodena.net
Sperry Marine	http://www.sperry-marine.com
STX Engine Co., Ltd.	http://www.stxengine.co.kr
Telko AS	http://www.telko.no
Tokyo Keiki	http://www.tokyo-keiki.co.jp
Totem Plus	http://www.totemplus.com
Trancomm Technologies	http://www.trancomm.com.cn
Tresco Engineering	http://www.tresco.be

As this information can change, please refer to
www.jeppesenmarine.com/ecdisecs for the most up-to-date information

Electronic charts and carriage requirements

What does the IMO require onboard?

To support a safe nautical environment for all, IMO requires nautical charts to be carried onboard. Amendments to SOLAS regulations that came into force in July 2002 allow these requirements to be met solely by electronic means provided there is an appropriate back-up.

The carriage requirement for charts and publications can be fulfilled by:

- Carriage of official and up-to-date paper charts, or
- Carriage of a type-approved ECDIS (using up-to-date Electronic Navigational Charts (ENC) supplemented by a suitable back-up arrangement).

The requirements for carriage of nautical charts are outlined in SOLAS Chapter V. The relevant regulations appear on the following pages. They are:

- Regulation 2, defines the nautical chart or publication (commonly called "official charts and publications")
- Regulation 19, specifies the equipment to be carried on different types of ships
- Regulation 27, specifies the requirement to keep charts and publications up to date.

Regulation 2

(IMO SOLAS V/2)

2.2 Nautical chart or nautical publication is a special-purpose map or book, or a specially compiled database from which such a map or book is derived, that is issued officially by or on the authority of a government, authorized Hydrographic Office or other relevant government institution and is designed to meet the requirements of marine navigation.

Regulation 19

(IMO SOLAS V/19)

2.1 All ships irrespective of size shall have:

2.1.4 nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage; an Electronic Chart Display and Information System (ECDIS) may be accepted as meeting the chart carriage requirements of this subparagraph;

2.1.5 back-up arrangements to meet the functional requirements of subparagraph 2.1.4, if this function is partly or fully fulfilled by electronic means; 1

Regulation 27

(IMO SOLAS V/27)

Nautical charts and nautical publications, such as sailing directions, lists of lights, notices to mariners, tide tables and all other nautical publications necessary for the intended voyage, shall be adequate and up to date.

What is an ENC ?

The Electronic Navigational Chart (ENC) is a file containing the official chart data that an ECDIS utilizes. It stores the chart information in the form of geographic objects represented by point, line and area shapes, carrying individual attributes, which make any of these objects unique.

Produced and authorized by national hydrographic authorities such as Hydrographic Offices, ENCs are vector charts that conform to IHO specifications. When used in an ECDIS, the data can be reassembled to display either an entire chart image or a user-selected combination of chart data. ENCs are "intelligent" in that systems using them can be programmed to warn of impending danger in relation to charted information and the vessel's position and movement.

ENCs are vector charts compiled from a database of individual geo-referenced objects from Hydrographic Office's archives including existing paper charts. When used in an ECDIS, the ENC content can be displayed as a seamless pattern in user selected scales presenting user selected chart items. The chart image generated from ENCs is not simply a reproduction of the corresponding paper chart. Its differing appearance is intended to increase visibility and situational awareness and to allow overlays to work without adversely affecting safety, as well as to fit the limited size and resolution of computer monitors. The ENC is a data file: special ECDIS operational functions continuously retrieve the ENC content to give warning of impending danger in relation to the vessel's position and its movement.

> **IMO's definition for the Electronic Navigational Chart – ENC:**
>
> ENC means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government-authorized Hydrographic Offices. The ENC contains all the chart information useful for safe navigation, and may contain supplementary information in addition to that contained in the paper, which may be considered necessary for safe navigation.

What is
the data format
of an ENC ?

The IHO Special Publication S-57 "IHO Transfer Standard for Digital Hydrographic Data" provides the basis for ensuring the worldwide uniformity of ENCs issued by different organizations. It describes the standards for the exchange of digital hydrographic data between national hydrographic offices and for the distribution of digital data and products to manufacturers, mariners and other data users. The World Geodetic System 1984 (WGS 84) is the horizontal datum reference used to measure positions on the surface of the earth for all ENCs.

Further, the IHO has established a standard for encrypting and securing electronic navigational chart (ENC) data. This standard is called S-63, and it is a scheme available to hydrographic offices, third-party suppliers and end-users. The IHO administers S-63, and S-63 encryption is available as a service from the RENCs (IC-ENC and Primar-Stavanger).

Within the next few years the maritime industry will start to adopt the new S-100 standard that has been developed by the IHO to facilitate better marine and hydrographic information exchange than that currently available with the S-57 standard. Essentially, S-100 extends the functionality of the S-57 hydrographic data transfer standard by creating a more flexible and richer data framework. ECDIS manufacturers will adopt and implement support for S-100 in their systems as and when requirements dictate that they do so, and when data becomes available.

What is on the screen when an ENC is displayed ?

An ENC contains an abstract description of geographic entities but does not contain any presentation rules. All rules for the display of ENC content are in a separate ECDIS software component – the "Presentation Library".

The ENC's geo-referenced objects and the appropriate symbolization contained in the Presentation Library are linked to each other in the ECDIS only when called up for display. The resulting image varies depending on the selected sea area, the intended display scale and the mariner's pre-settings, such as ambient light and other operational conditions.

The definition of the Presentation Library for ENCs is contained in Annex A of the IHO Special Publication S-52, Appendix 2 "Colours & Symbols Specifications for ECDIS" (current edition 3.4/2008)— its use is mandatory in all ECDIS.

The ECDIS Presentation Library follows that of the paper chart as much as possible. However, studies and early experience indicate that good visual communication between the ECDIS display and the user requires more flexibility of display than paper charts provide. As a result, alternative display methods are being introduced as options in the Presentation Library.

The lighting on the bridge ranges from bright sunlight, which washes out information on the display, to night, when the light emitted by the display has to be low enough that it does not affect the mariner's night vision.

The color and symbol specifications of S-52 have been designed to meet these difficult requirements rather than less demanding normal day conditions. Because the ECDIS display uses emitted light, compared with reflected light for the paper chart, ECDIS must switch to a negative image of the chart at night, using a dark background in place of the white background of the paper chart, in order not to impair night vision.

Three pre-defined color schemes are therefore provided:

- Day (white background)

- Dusk (black background)

- Night (black background)

Day
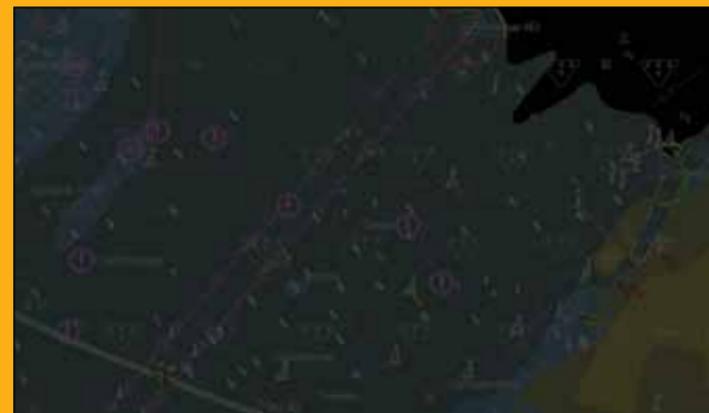
Night

What is a SENC?

An ECDIS does not process the ENC content directly to the screen. In order to display ENC data quickly enough, ECDIS converts each ENC from S-57 ENC format into an internal format called the System Electronic Navigational Chart (SENC), which is optimized for chart image creation.

However, the SENC format may differ between the ECDIS of different manufacturers. In contrast to the common uniform ENC format, the SENC format is dependent upon the choice of each ECDIS manufacturer.

The characteristics of SENC are defined in paragraph 2.3 of the ECDIS Performance Standard. Chart updates, either received electronically or applied manually will be incorporated into the SENC directly.

The IMO definition in the IMO Performance Standards for ECDIS:

2.3 The System Electronic Navigational Chart (SENC) means a database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the Mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions and is the equivalent to an up-to-date paper chart.

SENC delivery

SENC delivery is an alternative method to the standard distribution and use of official ENC data. Developed by IHO's Worldwide Electronic Navigational Chart Database (WEND) system, this method allows an authorized chart data distributor to perform the ENC-to-SENC conversion – that otherwise would have to happen inside the ECDIS – and deliver the resulting SENC to the end user.

It is possible for the ECDIS to determine if the SENC data being displayed is from either an ENC or a private source by use of the Agency Code (a two character combination which is unique for any data producer) embedded in the data. Using this code, the ECDIS is able to inform the mariners that they must navigate with an official up to date paper chart if SENC data from a private source is in use. The ECDIS will show a warning on the ECDIS screen:

«No Official Data -Refer to paper chart »

At the 16th International Hydrographic Conference, (Monaco 14 -19 April 2002), the IHO Member States agreed a "SENC Delivery Option" (decision 17.e of the conference refers) for ECDIS, thus allowing that ENC data could be distributed in proprietary SENC formats as well as in the fundamental IHO S-57 format. This resulted in an amended paragraph 3.3 of S-52 and a new IHO Technical Resolution A3.11

ENC
scale ranges

ENCs are created and designed for different scale ranges (Usage Bands), and the definition of which scale has to be used for which Usage Band is not yet internationally agreed.

The table below, provides an overview of the common scale ranges for each Usage Band:

/// SUGGESTED ASSIGNMENT OF NAVIGATIONAL PURPOSES TO SCALE RANGES	
Navigational purpose	Scale Range
Overview	<1:1 499 999
General	1:350 000 – 1:1 499 999
Coastal	1:90 000 – 1:349 999
Approach	1:22 000 – 1:89 999
Harbor	1:4 000 – 1:21 999
Berthing	1:4 000

To facilitate the display of the radar overlay on ENCs, Hydrographic Offices are encouraged to set the compilation scales of their ENCs to be consistent with the standard radar range scales as shown in the following table:

/// RADAR RANGE / STANDARD SCALE

Navigational purpose	Scale Range
200 NM	1:3 000 000
96 NM	1:1 500 000
48 NM	1:700 000
24NM	1:350 000
12 NM	1:180 000
6 NM	1:90 000
3 NM	1:45 000
1.5 NM	1:22 000
0.75NM	1:12 000
0.5 NM	1:8 000
0.25 NM	1:4 000

Although ENCs with the same Usage Band may overlap, the displayed information must not. ENCs with a different Usage Band could overlap both area and displayed information.

How are ENCs named?

Each ENC is identified by an eight-symbol "name". The first two characters refer to the producer – FR for France or GB for Great Britain, for example. A complete list of producer codes is included in the IHO standard S-62. The third character (a number from 1 to 6) represents the navigational purpose band. The last five are alphanumeric and are unique for each ENC.

How are ENCs updated?

The generation and distribution of regular ENC updates should happen in the same way the ENCs are initially produced and distributed. Normally, this is coordinated with the chart corrections circulated with national Notice to Mariners for the affected sea areas.

Updates may reach the ship in a variety of ways, depending on the capabilities of the service provider and the onboard communication facilities:

- On data distribution media, such as DVD

- As an e-mail attachment via SATCOM

- As a broadcast message via SATCOM plus additional communication hardware

- As an Internet download via GSM, 3G, WiFi or any other Internet channel

How will mandatory ECDIS be enforced?

Port state control and flag state requirements

Though the IMO crafted the resolution that will make ECDIS mandatory on steadily more commercial ships over the next few years, the IMO has no power to enforce compliance to it. The role of enforcement falls upon national governments and/or international or regional governing bodies. Once a government has become a signatory to an IMO convention, the rules in that convention are adopted as national laws and regulations, which impact any ship carrying that nation's flag or any ship visiting that government's ports. These are then enforced during flag state and port state inspections, usually carried out under the auspices of a national maritime administration (such as the United States Coast Guard).

The requirements to ships flying a nation's flag (flag state requirements) and the requirements to ships visiting that same nation's ports (port state control requirements) are usually the same; the requirements from nation to nation, or government to government, however, often differ, even if they are derived from the very same IMO Convention.

Shipowners will of course be familiar with the rules and regulations of their ships' flag state authorities. Regional affiliations of port state authorities (such as the Paris Memorandum of Understanding, a coalition of 27 European and North Atlantic maritime administrations) provide guidelines to owners of ships that will call at ports in their region.

What can I expect from port state control officers?

Port state control inspections will seek to ascertain whether any and every commercial vessel visiting a country's ports is being operated in accordance with national laws and international regulations. In the instance of mandatory ECDIS, the relevant international regulation is IMO's SOLAS Convention.

The Tokyo MoU (Memorandum of Understanding) region, which aligns the port state control functions in Far East Asia, carried out in late 2008 a concentrated inspection campaign on safety of navigation. The most notable deficiency found during this campaign was related to lack of adequate charts and publications (57.39 per cent).

Despite the fact that these inspections all follow the requirements laid out in the IMO's SOLAS Convention, different interpretations of this convention has resulted in different guidelines from country to country, and regime to regime. A port state control officer will refer to the statement from the flag state authority, which is onboard every vessel, and will control the ship according to these requirements.

Port state control officers differ in their expertise, but many have a background from navigation and steadily more will have experience with ECDIS systems. As a result, one should expect the proficiency and rigor of these systems' control to increase over time.

A list of items subject to inspection by the Paris MoU (the European region) is indicative of what port state control authorities will check. These include:

1) Documentation indicating that the ship's navigation system complies with IMO Performance Standards for ECDIS

Port state will either ask for written documentation that attests to the ECDIS system's compliance, or look on the ECDIS system itself for markings that attest to the same. It is the flag state's responsibility to ensure that the ship possesses this documentation.

2) Written procedures onboard the vessel for using the ECDIS system

Port state considers the ECDIS system as critical bridge equipment, and will thus seek readily available instructions for bridge personnel. These procedures should cover incidents such as equipment failure or power failure, and give watch-keepers a quick and clear reference.

3) The master and watch-keeping officers are able to produce appropriate documentation that generic and type-specific ECDIS familiarisation has been undertaken

Port state will seek certification that the bridge team has been trained in its use. This training should generally include a general course including the IMO model course syllabus (a five-day programme), and a course specific to the ECDIS make – a "buttons and knobs" familiarisation course. Port state may also request watch-keepers to demonstrate proficiency (find an ENC, enter a position, enter a bearing line, etc.

4) The ship is equipped with the latest updates and new editions of ENCs

The port state control officer may investigate the data presented on the ECDIS screen to determine if it is an official ENC, if it is updated recently and if it includes the most recent Notices to Mariners.

5) The ship is equipped with correct usage bands for the entire upcoming voyage

The port state control officer may check the voyage planning by seeing if the whole route is available, at the appropriate scales.

6) The ship is equipped with additional nautical publications, as defined by the national carriage requirements

This requirement is one that is familiar to all navigators, with or without ECDIS, and is determined by flag state requirements.

7) There is agreement between sensor data and its presentation on the ECDIS system

Port state will look at the representation on the ECDIS to make sure that the ship appears where it should, that it is pointed in the right direction, that the ship is in the correct position on the ECDIS and that the ship's vector is aligned.

8) The ship is equipped with an approved back-up arrangements to ensure safe navigation of the entire voyage, in the event of an ECDIS failure

Port state will investigate whether the ship's back-up navigation arrangements are in accordance with flag state requirements, and whether these arrange-ments are up to specification and ready to use. If a ship is using dual ECDIS, it does not need two separate power sources, but the port state control officer may examine how the sensors are divided, to ensure the back-up ECDIS is a valid back-up.

9) The ship is equipped with an updated collection of paper charts, if the ECDIS system is being used in RCDS mode (Raster Chart Display System)

Port state will determine whether the appropriate paper charts are onboard, whether they are marked with a course line and whether positions have been noted at regular intervals.

What will my flag state demand of me?

In the context of mandatory ECDIS, requirements from flag state authorities are unfortunately not uniform from government to government. Governments differ on two key points:

- whether an ECDIS using ENCs can qualify as the ships's primary system for navigation, and
- what constitutes an acceptable back-up arrangement.

A very useful compendium of flag state ECDIS requirements was developed by the RENCs, the International Center of ENCs and Primar, in 2007, and is reprinted on the following pages.

This information was compiled as a reference frame to help resolve uncertainties. It does not replace or amend national or international rules and regulations. Ship owners should always refer to their national administration and flag state for the latest information.

Flag state (document reference)	Acceptance of ENCs and ECDIS for primary navigation	Acceptable back-up arrangements mode	Acceptance of the use of RNCs in RCDS	Acceptance of use of private chart data in ECDIS to meet SOLAS carriage requirement
Australia	Y	1, 2, 3	Y	N
Bahamas	Y	1, 3	Y	N
Barbados	Y	1, 3	N/K	N
Brazil	N	N/A	N	N
Bulgaria	Y	1, 2, 3	Y	N
Canada	Y	1, 3	Y	N
Chile	Y	1, 3	N	N
Colombia	N	N/A	N	N
Cyprus*	Y	1, 3	N	N
Denmark*	Y*	1, 3*	N	N
Estonia*	Y	1, 3	Y*	N
Finland*	Y	1, 3	N	N
France*	Y*	3*	Y	N
Germany*	Y	1, 3*	Y	N
Greece	Y	1, 3	Y	N
Japan*	Y*	1, 3	N*	N
Korea	Y	1, 3	N	N
Liberia*	Y*	1, 3	N	N
Lithuania	N	N/A	N	N
Malta	Y	1, 3*	N	N
Marshall Islands	Y*	3	Y	N
Mauritius	N	N/A	N	N
Netherlands*	N	N/A	N	N
New Zealand*	Y	1, 3*	Y	N
Norway*	Y	1, 3*	N	N
Panama*	Y	1, 3	N	N
Poland	N	N/A	N	N
Portugal	N	N/A	N	N
Spain*	Y	1, 3	Y	N
Sweden*	Y	1, 3	Y*	N
Switzerland	N	N/A	Y	N
Ukraine*	Y	1, 3	Y	N
United Kingdom*	Y*	1, 2*, 3	Y*	N
USA*	N	N/A	N	N

Explanation of Columns within the Summary Table:

An asterisk (*) indicates that there is further significant or useful information in Part 2 that should be consulted. A plus (+) indicates that details have been obtained from the Flag State website.

Y = yes   N = no   N/A = not applicable N/K = not known

Column 1:

Flag State: Name of Country. Where the nation has issued documentation either directly, or via IMO, the reference to this is included in brackets.

Column 2:

Acceptance of ENCs and ECDIS for primary navigation "Yes" signifies the Flag State accepts the use of ENCs in ECDIS for primary navigation on all its registered vessels when used in accordance with the provisions set out in A817(19); ie with adequate back up arrangements and using ENCs. An * may indicate that approval is given on a vessel by vessel basis – see part 2 for details.

Column 3:

Back-up arrangements considered acceptable by the authority

1 - a second ECDIS device using ENCs, maintained by an independent power supply

2 - a second ECDIS device using official Raster Navigational Charts (official RNCs), maintained by an independent power supply

3 - sufficient paper charts covering the operational area

4 - other as specified in part 2

Column 4:

Acceptance of the use of RNCs in ECDIS (RCDS mode) "Yes" signifies the flag state accepts the use of RNCs in ECDIS (in RCDS Mode) for primary navigation in areas where there is no ENC coverage at an appropriate scale for navigation and when RCDS operation is supplemented by an appropriate portfolio of up-to-date paper charts.

Column 5:

Acceptance of the use of private chart data (in ECDIS). "No" signifies that the use of private chart data is not accepted as meeting carriage requirements and that if used in ECDIS a full set of official paper charts must be carried and used as the primary means of navigation.

Australia

Acceptance of ECDIS

See Australian Maritime Safety Authority (AMSA) Marine Notice 10-2005 and associated Background Paper.

Backup Arrangements for ECDIS

1. A second fully compliant ECDIS, or
2. A full folio of paper charts, corrected for the latest Notices to Mariners, for the intended voyage.

Acceptance of RCDS

Official RNCs may be used where ENCs are not available noting the requirement for vessels to carry the "appropriate folio" of paper charts when operating in the RCDS mode.

AMSA has provided the IHO with a list of charts which will be the minimum requirement for the "appropriate folio" in Australian waters.

Australian registered ships may dispense with the requirement for the "appropriate folio" in certain circumstances. Reference should be made to AMSA Marine Notice 10 – 2005.

IMO or Flag State Notifications

Marine Notice 10/2005

www.amsa.gov.au/shipping_safety/marine_notices/2005/MN10-2005.asp

Background paper

www.amsa.gov.au/shipping%5Fsafety/marine%5Fnotices/2005/documents/1005%20att.pdf

Website

www.amsa.gov.au

Bahamas

IMO or Flag State Notifications

BMA Information Bulletin 51 July 2003

Website

www.bahamasmaritime.com

Barbados

IMO or Flag State Notifications

Information Bulletin 64 –Electronic Charts and Nautical Publications
SLS14/Circ200

www.imo.org/includes/blastDataOnly.asp/data_id%3D7855/200.pdf

Website

www.barbadosmaritime.com/index3.html

Canada

Acceptance of ECDIS

Full details of the national regulatory requirements for ECDIS including acceptance, training, use of RCDS mode etc are to be found in Canada's Charts and Nautical Publications Regulations, 1995 and section 40 of the Crewing Regulations, made pursuant to the Canada Shipping Act.

IMO or Flag State Notifications

Canada Shipping Act:

www.tc.gc.ca/acts-regulations/GENERAL/C/CSA/menu.htm
or
www.tc.gc.ca/lois-reglements/generale/l/lmmc/menu.htm

Cyprus

IMO or Flag State Notifications

www.shipping.gov.cy/circulars/c2006/circular_2006_26.pdf

Website

www.shipping.gov.cy

Denmark

Backup Arrangements for ECDIS

Danish authorities also accept an electronic back-up arrangement for ECDIS mode of operation (using ENC) type-approved in accordance with relevant international standards, instead of a second ECDIS. (Ref. resolution MSC.64(67), Annex 5).

IMO or Flag State Notifications

SLS14/Circ180

www.imo.org/includes/blastDataOnly.asp/data_id%3D5399/180.pdf

Website

www.dma.dk/

Estonia

Acceptance of RCDS

RNCs in ECDIS are accepted outside the waters of Estonian jurisdiction. Inside the waters under Estonian jurisdiction only ENCs are accepted. All Estonian waters are covered with ENCs and there is no need to use RNCs.

Website

www.vta.ee/atp/?lang=en

Finland

IMO or Flag State Notifications
Regulation 1414/30/2004 - Shipboard Navigational Systems and Equipment (given in Bulletin No8 23.6.2004)
www.fma.fi/e/services/informationservices/publications/bulletin/avaa.php?id=246

Other Comments
Training: When a seafarer changes ship from a vessel not fitted with an ECDIS to another which is fitted with an ECDIS, and the seafarer does not have any training on ECDIS, the owner shall require that the seafarer shall take part to an IMO model course on ECDIS before signing on.

Website
www.fma.fi

France

Acceptance of ECDIS
Applies to all vessels; Maritime Authority provides certification

Backup Arrangements for ECDIS
At present the French Administration only authorises paper charts to be used as a backup to ECDIS. The content of paper chart backup folio will be defined in the near future.

Acceptance of RCDS
Applies to all vessels; Maritime Authority provides certification

IMO or Flag State Notifications
Règlement annexé à l'arrêté du 23/11/1987, division 221

Website
www.mer.gouv.fr/

Germany

Backup Arrangements for ECDIS
BSH accepts Chart Radar as meeting the requirements for back up.

IMO or Flag State Notifications
Full details regarding the acceptance of ECDIS and RCDS and the status of private charts is included in the Week 1 issue of BSH Notice to Mariners each year.
SLS14/Circ190
www.imo.org/includes/blastDataOnly.asp?data_id%3D5557/190.pdf

Website
www.bsh.de

Japan

Acceptance of ECDIS
ECDIS is approved on a ship by ship basis

Acceptance of RCDS
RNCs of Japanese sea areas are not provided. Therefore navigation in these areas by means ECDIS in RCDS mode is impossible

Website
www1.kaiho.mlit.go.jp

Liberia

Acceptance of ECDIS
Permission is given on a vessel by vessel basis; a certificate is issued to the vessel

IMO or Flag State Notifications
Guidance is provided to ship operators through Liberian Marine Operations Note 1-2005.

Website
www.liberianregistry.com/

Malta

Backup Arrangements for ECDIS
A type approved electronic backup arrangement for ECDIS mode of operation (using ENC) is also accepted

IMO or Flag State Notifications
IMO circular SLS.14/Circ.254
www.imo.org/includes/blastDataOnly.asp/data_id%3D13957/254.pdf

Marshall Islands

Acceptance of ECDIS
Even though a ship may be routinely operating in the ECDIS mode with available ENC data, prudence would dictate that an appropriate portfolio of paper charts still be maintained as a back-up in the event that, for whatever reason, the ship loses the use of its ECDIS. Certain ports still require the use of up-to-date charts for the approaches to their harbours. It is strongly recommended that Shipowners consider the practical and legal risks involved and continue to maintain corrected paper charts on board every ship.

Acceptance of RCDS
Because of a number of technical limitations in the RCDS, the mode does not have the full functionality of ECDIS, and therefore should only be used in conjunction with an appropriate portfolio of up-to-date paper charts.

IMO or Flag State Notifications

Marine Guidance note 7-41-1

www.register-iri.com/marineguidelines/mg-7-41-1.doc

Website

www.register-iri.com/content.cfm?catid=98

Netherlands

Acceptance of ECDIS

Upon receiving a documented request a confirmation of the permission to sail without paper charts is provided to the vessel by letter or fax. A note is added to the Safety Certificate indicating the vessel is equipped with an ECDIS compliant with SLS.14/Circ.191, which will also be attached to this Safety Certificate

Backup Arrangements for ECDIS

Use of official RNC's for backup is only acceptable where official ENC's are not available

Acceptance of RCDS

All vessels are permitted to use RCDS mode where no ENCs are available. Guidance on the appropriate paper chart folio is that no paper charts are required. Upon receiving a documented request a confirmation of the permission to sail without paper charts is provided by letter or fax. A note is added to the Safety Certificate indicating the vessel is equipped with an ECDIS compliant with SLS.14/Circ.191, which will also be attached to this Safety Certificate.

IMO or Flag State Notifications

SLS.14/Circ.191

www.imo.org/includes/blastDataOnly.asp/data_id%3D6145/191.pdf

Letter DS-20665/01/SKA, dated 4 October 2001 to the Netherlands' shipowners associations.

Website

www.ivw.nl/en/

New Zealand

IMO or Flag State Notifications

MNZ Maritime Rule 25 does contain reference to use of ECDIS.

Website

www.msa.govt.nz/rules/maritime_rules.asp

Norway

Backup Arrangements for ECDIS

Norwegian Maritime Directorate also accept a Chart Radar as meeting back up arrangements

Other Comments

Training: An amendment to Norwegian Maritime Directorate (NMD) regulation 2003-05-09 no 687 came into effect on 1 January 2005. Navigators on vessels equipped with ARPA, ECDIS, AIS or similar equipment are now required to complete training in the use of this equipment and its limitations.

Website

www.sjofartsdir.no

Pamana*

* Panama Maritime Authority, Merchant Marine Circular MMC-218

Acceptance of ECDIS

Vessels may use an ECDIS to either partly or fully fulfill this chart carriage requirement, provided however, and bearing in mind that a worldwide ECDIS portfolio of ENC coverage has not yet been achieved, the following conditions are met:

Backup Arrangements for ECDIS

1. An appropriate portfolio of back-up paper charts is onboard and ready for use wherever ENC coverage is not available.
2. Other back up arrangements, including a second ECDIS, may be used.

Carriage Requirements

Ships to which Regulation V/19.2.10 of SOLAS 74 applies shall comply with the carriage requirements for ECDIS detailed therein, and sufficient planning should be anticipated to comply with these new regulatory requirements well in advance of the applicable "first survey" date.

Training Requirements

All ship's officers in charge of a navigational watch on board the vessels to which the ECDIS is mandatory must attend, as a minimum, an approved generic ECDIS operator training course based on the IMO standard model.

Website

www.segumar.com

Spain

IMO or Flag State Notifications
SLS14/circ283
www.imo.org/includes/blastDataOnly.asp/data_id%3D18185/283.pdf
FOM/2472/2006

Website
www.fomento.es/MFOM/LANG_EN/DIRECCIONES_GENERALES/MARINA_MERCANTE/

Sweden

Acceptance of RCDS
Use of RCDS mode is allowed in conjunction with appropriate paper charts for areas where no ENCs exist.

IMO or Flag State Notifications
IMO circular SLS.14/Circ.198

Website
www.sjofartsverket.se/default____603.aspx

Ukraine

Acceptance of ECDIS
Permission is granted to all vessels see - "Regulations on the Sea Vessels Equipping"; Ukrainian Register of Shipping, Kyiv, 2003.

United Kingdom

Acceptance of ECDIS
Permission is given on a vessel by vessel basis; a letter of equivalency is issued.

Backup Arrangements for ECDIS
Option 2 is accepted only for areas not covered by ENCs and where supported by an appropriate portfolio of paper charts ascertained following a risk assessment.

Acceptance of RCDS
Acceptance on a ship by ship basis following a risk assessment in accordance with Marine Guidance Note 285

IMO or Flag State Notifications
MCA special publication "Safety of Navigation –Implementing SOLAS Chapter V, 2002. Annex 14 – "Electronic Charts"

Marine Guidance Note (MGN) 285 – Electronic Charts – The use of Risk Assessment when Operating ECDIS in the Raster Chart Display System (RCDS) Mode. February 2005.

Other Comments
Training: As part of the UK process for issuing a Letter of Equivalency, MCA need to be satisfied regarding arrangements for training (generic and type-specific) and familiarisation of electronic charts users.

Website
www.mcga.gov.uk

United States of America

Acceptance of ECDIS
ECDIS has not yet been recognized in US national regulations, however U.S. Coast Guard Navigation and Vessel Inspection Circular (NAVIC) 02 03 outlines the interim acceptance for meeting SOLAS carriage requirements regarding the use of ECDIS for primary means of navigation on board foreign vessels in U.S. waters. NAVIC 02-03 is considered temporary guidance until U.S. navigation regulations are formally amended to also include U.S registered vessels.

Draft regulations are expected to be published for consultation later in 2007

Backup Arrangements for ECDIS
NAVIC 02-03 finds the back up options referenced in SOLAS Chapter V acceptable when foreign vessel utilize a second ECDIS, ECDIS in RCDS mode with an appropriate folio of paper charts with respect to transit areas, and paper charts as the sole means for providing backup.

Website
www.uscg.mil/

What is an adequate back-up system?

This question sums up most of the different interpretations of SOLAS from nation to nation. Since failure of the primary ECDIS navigation system is a very real and appropriate concern, authorities responsible for safe commercial navigation have put extra care and attention into their answers of the question "what then?"

Some countries regard only a fully-updated folio of approved paper charts as adequate back-up. Others permit ships to employ a second ENC-fuelled ECDIS to be used as a back-up, as long as it has an independent power supply. Still others allow a second ECDIS, with an independent power supply, which uses RNCs, or raster nautical charts. Some flag states may allow a non-ECDIS electronic chart system (called an ECS) that uses ENC data as back-up, provided it meets IMO back-up rules. Finally, some flag states may permit the use of a chart radar as back-up.

As practically every country takes a unique stance in respect to this question, the only definitive answer is to refer to the chart on the previous pages, for general guidance, and speak to your flag state authority for specific guidance. The expansion of ENC coverage, increased usage of ECDIS and commercial aspects of navigation technology will all play a role in determining how these guidelines change.

In instances where several back-up arrangements are possible, each operator must weigh the relative advantages of different systems based on their existing systems, lifetime costing of new arrangements, training and safety and operational considerations.

Will I be able to sail without updated paper charts?

Given the amount of time and energy navigation officers spend acquiring and updating paper charts, many shipping companies are keen to see the day when they can answer "yes" to this question.

A ship's master must ensure that his ship is equipped with a portfolio of updated paper charts that cover his intended voyage, unless:

- He uses a type-approved ECDIS as his primary navigation system, AND
- His flag state permits use of ECDIS as a primary navigation system, AND
- He possesses a full complement of updated ENCs for the intended voyage, AND
- He uses a type-approved ECDIS with an independent power source as his back-up navigation arrangement, AND
- His flag state permits use of ECDIS with an independent power source as a back-up navigation arrangement, AND
- He has installed the appropriate ENCs on both his primary and back-up ECDIS systems, AND
- He has ensured that he meets all other requirements, including possession of the correct documentation of ECDIS training, and so forth.

If the master has done all of these things, he should be able to sail without updated paper charts. Nonetheless, he should be aware of the risk of entering ports of nations that do not permit the use of ECDIS as either a primary or back-up navigation system, as this may lead to penalties or detention. Further, he must exercise the usual due care and caution demanded to ensure safe navigation.

Training

Much of the fear stemming from the introduction of mandatory ECDIS has actually been the fear of watchkeepers and masters navigating via an ECDIS without the proper training. Most bridge officers would readily agree that ECDIS seems like a beneficial and helpful tool that increases safety. They would also agree that the prospect of navigating in close quarters with other ships led by officers using an ECDIS that they are not sufficiently trained on, is unsettling.

In 2008, the United Kingdom's Marine Accident Investigation Branch revealed that an accident earlier that year (CFL Performer) resulted from inadequate ECDIS training. In this instance, one bridge team had received general ECDIS training, and ECDIS training specific to the make on board; sadly, another bridge team was navigating that day.

The master had no previous experience or training on ECDIS or any other form of electronic navigation system. None of the officers were aware of the significance of the safety contour, the safety depth, and the shallow and deep contours, and did not know how to establish a watch vector ahead of the vessel, or its significance.

All of these fundamentals are part of any ECDIS training course. Though the idea of an "ECDIS-assisted grounding" has led to some worries, the ECDIS in many cases is not at fault. In fact, it is an "ECDIS Training-assisted grounding".

Maritime authorities have been addressing the issue of ECDIS training for as long as they have been addressing ECDIS. Training requirements, both in the use of ECDIS, in general, and the specific makes and models onboard, are increasing. Basically every school training bridge officers will offer ECDIS training, with simulators. Further, almost every producer of ECDIS offers training in the use of its equipment, or a list of schools that offer ECDIS training with this equipment.

What are the training requirements for ECDIS?

When it is the primary means of navigation onboard, ECDIS training is required by two specific sets of shipping regulations. For as long as the primary means of navigation onboard is paper charts, however, training in the use of ECDIS is purely optional (as is obviously the case on ships not yet equipped with ECDIS).

The IMO's STCW 95 (Standards of Training, Certification & Watchkeeping) Convention requires ECDIS training, by equating electronic and paper charts, per definition. STCW 95 Table A-I I-1 stipulates that "ECDIS systems are considered to be included under the term 'charts'." Thus, the RENC guide to ECDIS concludes that:

1. If ECDIS is used as "chart", the user must demonstrate the same degree of knowledge and competency concerning the use of ECDIS as a user of a conventional chart must demonstrate chart work competency.

2. ECDIS training is as "mandatory" as chart training.

The ISM Code has stricter wording on ECDIS training, as the ship owner or operator must ensure that personnel are given proper familiarisation with their duties. This applies to proficiency in ECDIS, if this is the main means of navigation onboard. Thus, in the event of an accident, ECDIS training may affect liability and insurance.

Further, national authorities may require ECDIS training for vessels in their flag registries, or visiting their ports. Port state controllers in the Paris MoU region are admonished to discover: "Are officers able to produce appropriate documentation that generic and type-specific ECDIS familiarisation has been undertaken?"

It is up to each flag state to define who on board the vessel must have ECDIS training. In general, however, the master, watchkeeping officer, the route planner and any other bridge personnel who use the ECDIS should have completed a training course.

What is
recommended training
for ECDIS?

All bridge officers who will keep watch on a vessel equipped with an ECDIS should have general ECDIS training, as well as specific familiarisation with the ECDIS model on board. Even when the ship's primary form of navigation is paper charts, the officers will often rely on the ECDIS anyway; for this reason, they should be well trained in its use.

The IMO Committee on Standards for Training and Watch-Keeping (STW) has approved a standardised IMO "Model Training Course on the Operational Use of ECDIS" (Model Course 1.27). This course consists of a set number of topics and skills that provide minimum requirements for a candidate to receive an ECDIS certificate. ECDIS training courses are generally developed according to flag state requirements, which give the ECDIS certificates their authority. Government approved courses generally need to meet the IMO Model Course demands.

Even with these rules, ECDIS training courses differ considerably. For example, some ECDIS training courses take five days, while others (nominally covering the same ground) take only two. Most government-approved ECDIS training programmes will fill five full days though. Type-specific ECDIS courses will usually add anywhere from one to three days of training.

The Master, first officer and any watchkeeping bridge personnel should as a minimum take a general and type-specific ECDIS course, as well as yearly refresher courses. They should renew the type-specific ECDIS course each time the ship is refitted.

A debate regarding standardisation of ECDIS would potentially put an end to type-specific ECDIS training, but as this debate shows no signs of ending soon the need to do type-specific training persists.

Who offers ECDIS training, and where?

Flag state	Location	Contact details
Australia	Australian Maritime College Pivot Marine Royal Australian Navy	
Denmark	Furuno Integrated Navigation System Training Center (INSTC), Copenhagen	Complete list of relevant institutions can be found at www.fuldskruefrem.dk/adresseliste.html
Finland	Satakunta University of Applied Sciences	www.samk.fi/english
	Kymenlaakso University of Applied Sciences	www.kyamk.fi
	Yrkeshögskolan Sydväst	www.sydvast.fi
	Högskolan Åland	www.ha.aland.fi
France	École Navale Écoles Nationales de la Marine Marchande (Marseille, Nantes and Le Havre)	www.ecole-navale.fr www.hydro-marseille.com www.hydro-lehavre.fr www.hydro-nantes.org
Germany	Hochschule Wismar	www.sf.hs-wismar.de
	Hochschule Bremen	www.hs-bremen.de
	Fachhochschule Oldenburg – Ostfriesland/Wilhelmshaven	www.fh-wilhelmshaven.de
	Fortbildungszentrum Hafen	www.fzh.de
India	Anglo-Eastern Maritime Training Centre, Mumbai	http://www.maritimetraining.in
Norway	Ålesund University College	www.hials.no
	Kongsberg Maritime, Kongsberg	www.km.kongsberg.com
Portugal	Escola Náutica Infante D. Henrique	www.enautica.pt
Singapore	Integrated Simulation Centre, Maritime and Port Authority of Singapore, Singapore	www.mpa.gov.sz
	Kongsberg Maritime Pte. Ltd. Training Centre, Singapore, Singapore	www.km.kongsberg.com
South Africa	South African Maritime Training Academy	www.samtra.co.za
Sweden	Kalmar and Gothenburg Maritime Agencies	www.hik.se
	Warsash Maritime Centre	www.warsashcentre.co.uk
	South Tyneside	www.stc.ac.uk/marine
United Kingdom	Blackpool and Fylde	www.blackpool.ac.uk
	Glasgow Nautical College	www.glasgow-nautical.ac.uk
	Lairdside Maritime Centre	www.ljmu.ac.uk
USA	MITAGS	www.mitags.org

Available ECDIS training based on IMO model course 1.27. Note that this list is not exhaustive.

ECDIS, much more than a chart machine

Commentators and experts familiar with ECDIS navigation urge shipowners and mariners alike to understand the full impact of mandatory ECDIS. Some, like a technical manager with the Nautical Institute, urge caution and preparedness, as the transition from paper chart-based navigation to ECDIS navigation may lead to danger:

ECDIS is a total change from paper charts, and the transition from paper to electronic charts will pose a challenge for the industry, particularly for those who have no current experience of electronic charts. Mariners should be aware that ECDIS is more than just a digital version of a paper chart. Important bridge procedures are significantly affected, and these require careful analysis and consideration if ECDIS-assisted groundings are to be avoided. It is important that traditional navigation skills are not lost and that navigators become confident, but not overconfident, in the use of ECDIS. There is a danger that bridge watchkeepers will increasingly trust what is displayed without question.

On the other hand, the increased functionality of ECDIS, vis-à-vis conventional paper chart navigation, means that commercial shipping will see greater safety, and improved bridge oversight. The authors of "The Electronic Chart" sum up the new scenario thus:

The electronic chart represents a revolutionary advance in maritime navigation and safety. Since an electronic chart system is capable of continuously displaying own ship's position on the electronic chart, there is increased benefit of having other real-time information available that can be used to increase the safety and efficiency of the voyage.

These two expert opinions agree that ECDIS will, by necessity, forever change the task of navigating, though the core skills and abilities that form the foundation of traditional maritime navigation should not be lost or diminished.

ECDIS' potential to transform navigation is so great that the IMO has adopted a new concept called e-Navigation, which is meant to describe and direct the changes.

e-Navigation is defined thus: The collection, integration and display of maritime information onboard and ashore by electronic means to enhance berth-to-berth navigation and related services, safety and security at sea and protection of the marine environment.

An orientation paper from the UK Department for Transport described in greater detail how e-Navigation will look to users:

Using satellite positioning signals, underpinned by fail-safe supplementary positioning signals (e.g. Loran C) or onboard devices (e.g. inertial navigation computers), displayed in an intelligible and comprehensively integrated format (ECDIS), onboard ship and replicated on shore, with shore-based monitoring and intervention capability.

Further, the paper described the key structural components of such a system:

- Accurate, comprehensive and up-to-date electronic navigational charts (ENCs) to a common format, covering the entire geographical span of a vessel's operation;
- Accurate and reliable electronic positioning signals, with "fail-safe" performance (provided through multiple redundancy, e.g. GPS, Galileo, differential transmitters, Loran C and defaulting receivers onboard inertial navigation devices);
- Information on vessel route, bearing, manoeuvring parameters and other status items (hydrological data, ship identification data, passenger details, cargo type, security status, etc.) in electronic format;
- Transmission of positional and navigational information ship to shore, shore to ship and ship to ship;
- Clear integrated display of the above information on board ship and ashore;
- Information prioritisation and alert capability in risk situations (collision, grounding, etc.) on ship and ashore.

What does it mean to use ECDIS fully?

Perhaps the best way to describe full use of ECDIS would be to list some anticipated benefits of mandatory ECDIS. These include:

1. Automatic chart correction: ECDIS allows mariners to update electronic charts automatically. Specific functions make the updating task rapid and error-free, which will reduce the occurrence of out-of-date chart information.

2. Combined navigational operations: Before ECDIS, the mariner had to consult and combine input from countless sources. The only place one could find a relatively complete picture of the situation was in the navigating officer's head. ECDIS helps improve this visualisation process.

3. Display of ship's position in real time: Automatic, continuous display of the ship's position, heading, course and speed of the vessel can be included in the ECDIS presentation.

4. Central role at the steering station: An ECDIS puts many technologies and sources of information in one central position, so navigators no longer need to shuttle around the bridge to learn what they need to know.

5. Situation-dependent display: Information filters put just what officers need to know in front of them, and spare them unnecessary detail. Monitors and information suit lighting conditions, sea conditions and the specific scenario.

6. Radar overlay: Combining the electronic chart and radar in an ECDIS combines grounding-avoidance and collision-avoidance into one instrument.

7. Automatic route monitoring: The planned route can be examined for potential danger, in terms of water depth, objects and deviation.

8. Automatic track control: In effect, the ship can transit a pre-planned route, following course changes using a planned turning radius.

9. Reduction of human error: Alarms can alert officers if the ship is about to breach pre-set parameters, or if a sensor gives ambiguous signals.

10. Help in special manoeuvres: Man-overboard, anchoring, docking and other specific operations can employ specific pre-programmed operating guidelines in the ECDIS, when the master requests it.

Shipping companies want to realise this level of use, as a 2005 report into barriers to the adoption of ECDIS revealed:

There is clearly a desire by shipping companies to increase efficiency of the seafarer by the introduction of ECDIS. This increased efficiency can be achieved "on watch" by having all the navigational information in a central source. "Off watch" it is increased by reducing the time taken to complete chart updating and passage planning. The MAIB report identifies fatigue of the watchkeeper as one of the main causes of marine incidents. If ECDIS reduces fatigue by improving efficiency both on watch and off watch, the system will directly contribute to safety.

The same report also stated that the hydrographic community should band together to promote ECDIS as a factor to improve both safety and efficiency. In fact, new, ECDIS-enabled procedures may allow many shipping companies to better manage their core operations, from better weather routing to increased voyage optimization and increased integration to other shipboard systems that affect operational efficiency.

What other sources and technology can be integrated to an ECDIS?

The technologies that can be integrated into the ECDIS system fall into two indistinct groups, ranging from those that are fundamental to the operation of the ECDIS to those that are more voluntary and complementary, bringing value-added functionality. ECDIS manufacturers are constantly seeking to create a competitive advantage by incorporating new functionality into their core product offering, and – to varying degrees – enabling third-party suppliers to offer technologies that are compatible with the ECDIS. There is no clear division between the two classes of technologies that can be integrated into an ECDIS, only a spectrum of utility, complexity and value.

Some of the core sensors and instruments that are usually integrated into the ECDIS include ship position (GPS), course (gyro or magnetic compass), speed over ground (speed log), water depth (echo sounder) and wind speed and direction. In addition, the ECDIS is often set up to receive digital and video radar input and AIS (Automatic Identification System) signals. An ECDIS may often connect to the ship's automatic track control (autopilot).

What other navigational sensors can be connected to an ECDIS?

The purpose of integrating an ECDIS with radar input is to improve the navigator's situational oversight. The specific benefits of an ECDIS/radar overlay include collision avoidance, position monitoring, target identficiation, radar performance, shifted objects, false faraway detection, error detection, mutual check, reduced errors, reduced workload and system redundancy.

Integration of the ECDIS and AIS can have the following benefit: "It may be possible to detect, monitor and manage the movement of vessels without having them in visual sight or on radar. As a result, decisions on collision avoidance measures could be made from a remote location."

In fact, the introduction of an ECDIS onboard a commercial vessel often becomes synonymous with the introduction of an integrated bridge system, in which the ECDIS becomes the focal point for a battery of navigational and operational activities. The report cited earlier in the section on full use of ECDIS ("The Hailwood Report – Barriers to the adoption of ECDIS") found that as many as one in five shipping companies considered the real investment decision to be the integrated bridge system, not ECDIS. The latter was seen as a natural and automatic element of the former.

Additional hardware often connected to a ship's ECDIS include the NAVTEX (and potentially other elements in the GMDSS system), and the voyage data recorder (VDR).

What other information and databases can be used with an ECDIS?

With ECDIS, the potential to add and edit new value-added information for bridge officers that can contribute to increased safety and efficiency is practically endless. Countless companies are currently working to develop and market information products for use on an ECDIS. These products may range from weather information to piracy information to hull acceleration information and any other source that may be deemed practical for shipowners and operators.

Met-ocean (Meteorological and Oceanographic) data is one of the most natural add-ons to an ECDIS. Wave heights, wind speed forecasts, tidal and current information are all mathematically modeled to create a realistic prognosis of conditions in the path of a ship. And this realistic forecast can be represented on an ECDIS on the bridge, and perhaps even more usefully at the navigator's planning station. Another kind of data under development for use on ECDIS is ice coverage, which will hopefully allow safer transit of polar regions.

Traffic information can also be integrated into an ECDIS presentation, allowing bridge officers and even fleet managers to plan movements so that they avoid bottlenecks in heavily trafficked channels and ports. Port information, both commercial (supply) and official (inspection), could also become valuable additions to the navigational picture on an ECDIS. Even security may be improved, as updates on pirate activity show officers where to go and where not to (and when) to minimize the likelihood of attack.

In addition to these basic information channels, some companies are working to combine sources of weather and sea-state information with data coming from the ship to provide intelligent feedback about the ship's handling, the ship's optimal routing from origin to destination and the ship's ability to withstand conditions en route. These systems fall under the general rubric of "optimization", as they incorporate new technology to help navigators find the best possible way to make a sea transit.

Also inland navigation creates opportunities to use information on an ECDIS. Obviously, rapid updates of changing bottom conditions in major waterways, and databases concerning barge and tow-boat traffic can assist freshwater navigators consulting an ECDIS.

More than a chart machine /// What other information and databases can be used?

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Jeppesen Marine

From electronic chart standard
to e-Navigation solution

Decades after ECDIS was first introduced and ENCs
began to be produced, a consistent set of standards are
in place. From this foundation, producers and suppliers
can develop and launch a vast array of new products
and solutions. Digital navigation has, one might say,
reached its Windows-moment – on the common
platform of the ECDIS much new value can be built.

Jeppesen Marine:
Making e-Navigation a reality

C-MAP Norway was founded in 1993 to provide the chart data that would fuel an ECDIS. From this modest beginning, the company has evolved into the market's leading supplier of services and data for e-Navigation. Today the company offers market-leading solutions for distribution and updating of private vector chart data and official ENCs, accurate weather data, voyage optimisation services and dynamic licensing. After Jeppesen Marine (a Boeing company, based in Colorado, USA) acquired C-MAP Norway in 2006, the company's ambitions to support the maritime industry were brought up to the same level as the mother company's relationship with the aviation industry. Today Jeppesen Marine has as its goal to be the most attractive partner and supplier of e-Navigation services and data, in order to make shipping operations more efficient and safe.

Co-operation with Hydrographic Offices

Jeppesen Marine works with dozens of hydrographic offices worldwide in two crucial ways. Jeppesen Marine provides software that helps hydrographic offices to convert navigational data into official ENC databases. Secondly, Jeppesen Marine acquires licenses from hydrographic offices to incorporate their ENC data into value-added products.

Jeppesen Marine markets two types of chart data. One is its own private, vector-based electronic charts, known as C-MAP Professional+. The other is the official ENCs produced by hydrographic offices all over the world. Only the latter satisfies the IMO's requirements to mandatory ECDIS. The private C-MAP Professional+ data has, however, played a critical role as a source of high-quality navigational data where ENCs do not yet exist.

Jeppesen Marine maintains a close relationship with the hydrographic community. As a leading private-sector supplier of data from hydrographic offices to the global commercial shipping industry, Jeppesen Marine plays a crucial role in the market.

Products and Services

ENC Service

Jeppesen Piracy Update

Weather

Weather routing

Professional services

Jeppesen T&P Notices Service

Optimization Solutions

Jeppesen Nautical Services

Fleet manager

Dynamic Licensing

Updating Services

C-MAP Update Service CD/DVD

C-MAP Update Service Online

C-MAP Update Service Online+

ENC Service

Jeppesen Marine is an authorised distributor of official ENCs available directly from various national Hydrographic Offices, as well as ENC data distributed by Regional ENC Coordinating Centres in Norway and the UK.

Jeppesen Piracy Update

The Piracy Update service incorporates the most authoritative and expansive sources of up-to-date piracy data worldwide to help mariners identify and avoid high-risk areas.

It also integrates piracy data with detailed chart, weather and tropical cyclone information, to facilitate risk mitigation strategies and ensure safe and efficient navigation.

Weather

Jeppesen Marine is continuously working on refining the Weather Service offered to its professional users.

This work has resulted in a combination of the electronic charts with important weather information. The new functionalities are collectively part of a solution called WeatherNav.

When planning a transit or offshore operations, navigators can use the WeatherNav functionality to assess both the detailed navigational information in the chart and the world's best meteorological data.

WeatherNav functionalities mentioned here are being incorporated into steadily more ECDIS systems.

Weather routing

Jeppesen Marine offers a range of services under the name Vessel and Voyage Optimization Solutions (VVOS). The system is an onboard passage planning tool and a seakeeping expert advisory system.

VVOS software is custom tailored to each vessel class in order to provide accurate predictions of the ship seakeeping and speedkeeping capabilities in any seastate. The VVOS seakeeping advisory module shows the effect of changing heading and speed on vessel roll, pitch, accelerations, slamming, boarding waves, bending moment/shear forces on critical frames -- thus helping officers avoid heavy weather damage. An optimization algorithm can also minimize fuel costs.

Professional services

Jeppesen's Marine Professional Services engage an experienced team of master mariners, naval architects, marine engineers, and business analysts to help customers pinpoint operational inefficiencies and provide solutions to mitigate them.

Our multi-disciplinary team supports customers in business critical processes, from new-builds and deployment planning, to shore-side routing, real-time voyage performance optimization and post voyage analysis.

Jeppesen T&P Notices Service

Jeppesen provides a T&P service that features globally valid T&P notices published by Hydrographic Offices to support safe navigation. The T&P notices are displayed as an overlay on ECDIS/ECS chart data and updated daily through Jeppesen's online updating service via email or the Internet.

Optimization Solutions

Using sophisticated hydrodynamic modeling, computations, and highest resolution ocean forecasts the VVOS guidance system recommends speed and heading changes to manage ship motions to minimize heavy weather damage.

Unlike traditional weather routing services and programs on the market, VVOS includes a detailed model of ships' motion, engine and propeller characteristics. This "virtual" ship accurately estimates speed made good under forecast wind, wave and ocean current conditions for a given engine power and propeller RPM, as well as ship motion limitations defined in the "Safe Operating Envelope".

VVOS includes a real-time monitoring, recording and warning system for excessive motions and accelerations, particularly for Parametric Roll. Once underway the system also monitors ship motion response and engine condition, and provides alarms if safe operating limits are exceeded.

Jeppesen Nautical Services

Numerous tools can assist mariners in accessing and maintaining paper-based data. Few can integrate paper and electronic data and offer decision support for ensuring safe and efficient navigation.

The Jeppesen Nautical Service Suite (JNS), which can be installed on an ordinary PC, incorporates and harmonizes all nautical information needed for safe navigation in a back of bridge solution. Its comprehensive set of tools simplify mariners' duties and reduce time spent managing and maintaining nautical information.

In its initial phase, JNS will incorporate simplified route planning with chart licensing and updating, and input this into the ECDIS on board.

Fleet Manager

Jeppesen Fleet Manager is a comprehensive web-based program that gives shore side managers extensive insight into their fleet status and performance. Based on user defined configurations, Fleet Manager delivers analytics that can be used to manage assets more efficiently and improve strategic decision making. The program is easy to use, and provides critical information when needed. Whether you're monitoring in progress, or past voyages, Fleet Manager provides an integrated set of tools to help you manage your fleet to its full potential.

Dynamic Licensing

Dynamic Licensing is a user-friendly and cost effective method of licensing, using and updating charts in C-MAP SENC format onboard vessels globally.

Dynamic Licensing eases the ordering process for the mariner and makes ENC licenses available in seconds automatically. Usage is reported automatically on the C-MAP Online Updating Service. Hence all the charts, updates and licenses will be onboard and ready for use without a pre-ordering process through a chart supplier. Costs are controlled via pre-set budgets and spending limits, making "pay-as-you-go" a reality.

Updating Services

The C-MAP Update Service makes the latest updated weather and navigational data available wherever you are. For subscribers with access to adequate communications channels, new chart updates are made available on the C-MAP update server every working day. Weather forecast updates are available several times a day. In addition to NtM's, chart updates can now also include new charts and new editions of existing charts.

Depending on the customer's needs, technical outfit and communication capacity, the chart service subscriber can choose between three different options to keep the onboard database updated.

C-MAP Update Service DVD

Updates are distributed on DVD (Professional+ and ENC) every month or three times a year. This option includes all updates issued in NtM booklets, new charts and new editions of charts.

C-MAP Update Service Online

NtM updates can be distributed via the Internet. This service does not include new charts and new edition of charts. Thus, to get access to new charts, it is recommended to receive complete updates on DVD on a regular basis. This service does not support the CM-93/2 product.

C-MAP Update Service Online+

This is the premium option. The service includes NtMs as well as new charts and provides for complete database updating. The service requires bandwidth of high quality and size. This service supports C-MAP Professional, C-MAP Professional+ and C-MAP ENC.

References and abbreviations

AIS: Automatic Identification System. A short range coastal tracking system used on ships and by vessel traffic services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships and VTS stations.

ARPA: Automatic Radar Plotting Aid. A function that creates tracks on the radar display using radar contacts. Such systems can calculate the tracked object's course, speed and closest point of approach.

COG: Course Over Ground. The GPS system's calculation of the ship's heading in relation to the installed chart system

DCDB: Data Center for Digital Bathymetry. Operated by the National Geophysical Data Center in Boulder, Colorado, USA, DCDB is a focal point for digital hydrographic data services for IHO Member Countries.

DGPS: Differential Global Positioning System. An enhancement to GPS that uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the satellite system and the known fixed positions.

DNC: Digital Nautical Charts. A vector-based digital product designed to give navigators an up-to-date seamless database of the world. DNCs are published by the National Geospatial-Intelligence Agency – part of the United States' Department of Defense.

DSCC: Data Supply Chain Certification. A system of handling data intended to ensure that the transmission of data from its source to the point at which it is displayed on the end-user screen does not degrade the data.

EBL: Electronic Bearing Line. A feature in a radar that is used to determine the relative bearing of an object from the observing ship's bearing.

EC: Electronic Chart. A term used to describe the data, the software and hardware system capable of displaying electronic chart information.

ENC: Electronic Navigational Chart. An electronic chart designed to be used in the ECDIS and issued on the authority of government-authorized hydrographic offices

FIG: International Federation of Surveyors. An international, non-governmental organisation whose purpose is to support international collaboration for the progress of suveying in all fields and applications.

GAGAN: GPS and GEO Augmented Navigation System

GEBCO: General Bathymetric Chart of the Oceans. An international group of experts who work on the development of a range of bathymetric data sets and data products.

GLL: Geographic position. Used to send position from the GPS, LORAN C or other satellite receiver to other devices, such as radar or ECDIS

GLONASS: Global Navigation Satellite System. A space-based, radio-positioning, navigation and time-transfer system operated by the Government of the Russian Federation.

GNSS: Global Navigation Satellite System. A world-wide position, time and velocity radio-determination system comprising space, ground and user-segments of which GPS, GLONASS, EGNOS, COMPASS and IRNSS are components.

GPS: Global Positioning System. A US-based global navigation satellite system that provides positioning, navigation and timing services to worldwide users on a continuous basis.

HDT: Heading-True. Used to send heading information from the gyro-compass to other devices including radar and ECDIS

IALA: International Association of Marine Aids to Navigation and Lighthouse Authorities. A non-profit, non-governmental international technical association that gathers marine aids to navigation authorities, manufacturers and consultants from all parts of the world, and facilitates knowledge sharing.

IAPH: International Association of Ports and Harbors. A global alliance of ports representing 230 ports in 90 countries. IAPH is non-profit and non-governmental. Headquartered in Tokyo, Japan.

IBS: Integrated Bridge System. Ship systems that take input from sensors throughout a ship in order to display position and control information electronically for bridge officers. Navigators manage this system, choosing how to set the system, interpreting output and monitoring interactions between controls and the ship.

ICA: International Cartographic Association. The world's authoritative body for cartography, the discipline dealing with the conception, production, dissemination and study of maps.

IFHS: International Federation of Hydrographic Societies. A partnership of national and regional hydrographic societies that promotes the development of hydrography and knowledge exchange in the hydrographic community.

IHO: International Hydrographic Organisation. An intergovernmental organization representing over 80 national hydrographic organizations. Coordinates hydrographic activity between states.

IMSO: International Mobile Satellite Organization. An intergovernmental organization that oversees certain public satellite safety and security communication services provided by the Inmarsat satellites.

IOC: Intergovernmental Oceanographic Commission. A UNESCO commission that coordinates marine research, services, observation systems, hazard mitigation and capacity development in order to better manage the ocean and coastal areas.

QZSS: Quasi-Zenith Satellite System. Is the Japanese regional satellite system that will enhance the GPS in Japan.

RENC: Regional ENC Coordination Centre. Entities set up by the IHO, a RENC validates and distributes ENCs from producing nations to end-users. Each major geographical area of the world is meant to be represented by a RENC, but only two currently exist, in Norway (PRIMAR) and the UK (IC-ENC).

RNC: Raster Nautical Chart. Raster charts that conform to IHO specifications and are produced by digitally scanning and geo-referencing the image of a paper chart.

S-52: An IHO publication developed in conjunction with the IMO's performance standards for ECDIS that provides specifications and guidance regarding the issuing and updating of ENCs, and their display in ECDIS.

S-57: IHO Special Publication 57. Contains the IHO Transfer Standard for Digital Hydrographic Data. The major components of S-57 Edition 3.1 are: Theoretical Data Model , Data Structure, Object Catalogue, ENC product Specification, Use of the Object Catalogue for ENC.

S-63: The IHO recommended standard for the protection of ENC information. It defines security constructs and operating procedures that must be followed to ensure that the IHO Data Protection Scheme is operated correctly.

S-100: Specification from the IHO for the new geospatial standards for hydrographic data. It is purported to be a wider standard catering to other users apart from ECDIS and based on the ISO TC211 standards for contemporary GIS. The ENC product specifications based on S-100 and termed S-101, will in due course replace the S-57.

SBAS: Satellite Based Augmentation System

SENC: A database in the manufacturer's internal ECDIS format produced as a result of transforming the ENC. The conversion from ENC contained in the ASCII form to SENC in a binary form may be carried outside the ECDIS in a lab. This is a preferable way to provide efficient and error-free electronic charts to the end-user.

SOG: Speed Over Ground. The GPS system's approximation of the ship's speed in relation to the installed chart

TCS: Track Control System. Via a connection with the autopilot, TCS in an ECDIS controls that the ship's GPS position follows a pre-planned track.

TTM: Tracked Target Status
Used to send tracked target information from ARPA to ECDIS.

VDR: Voyage Data Recorder. A data recording system designed for all ships, and

required to comply with the IMO's SOLAS Convention, in order to collect data from various sensors on board the vessel. The information is stored in an externally mounted protective storage unit.

VRM: Variable Range Marker. A feature of radar used to determine relative distance to any target seen on the screen.

VTS: Vessel Traffic Services. A marine traffic monitoring system established by harbor or port authorities, similar to air traffic control for aircraft. These use radar, CCTV, VHF radiotelephony and AIS to track vessels.

WAAS: Wide Area Augmentation System. An SBAS system operational in the US region.

WEND: Worldwide Electronic Navigational Chart Data Base. An IHO concept, based on the set of WEND Principles, designed specifically to ensure a world-wide consistent level of high-quality, updated official ENCs through integrated services that support chart carriage requirements of SOLAS and the requirements of IMO PS for ECDIS.