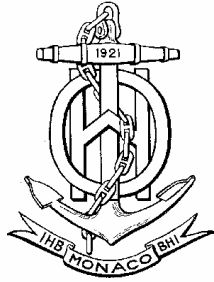
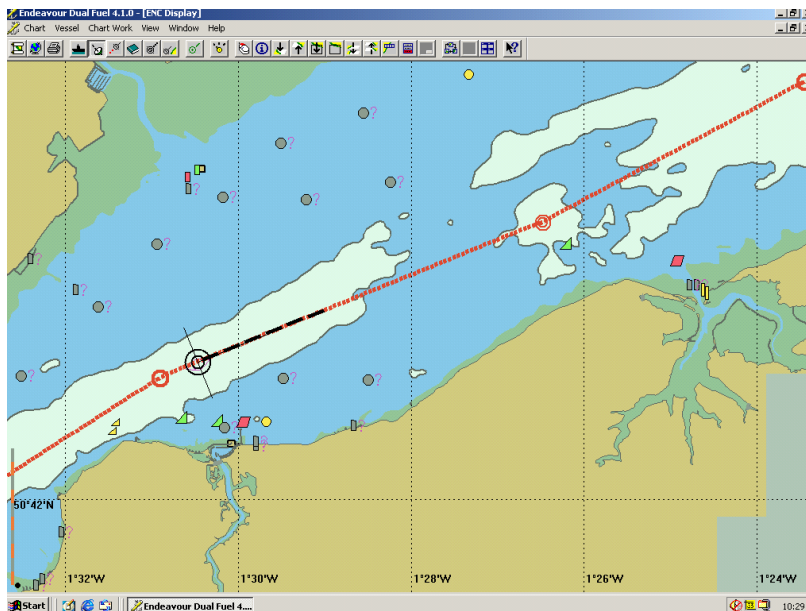


INTERNATIONAL HYDROGRAPHIC ORGANIZATION



ELECTRONIC NAVIGATIONAL CHARTS
(ENCs)

“PRODUCTION, MAINTENANCE AND
DISTRIBUTION GUIDANCE”



A guide to the requirements and processes necessary
to produce, maintain and distribute ENCs

IHO Publication S-65

Edition 2.0 month year



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Introduction

Purpose and Scope

This document provides a high level guide to the production, maintenance and distribution of Electronic Navigational Charts (ENCs).

It offers a framework to inform hydrographic offices of the processes and requirements necessary to produce, maintain and distribute ENCs.

It provides references to documentation which can support each stage of the process. It is not intended to serve as a technical reference manual but to enable hydrographic offices to gain an overview of ENC production processes, and the requirements and procedures that need to be in place to set up an ENC production facility.

References

Standards and Conventions

- A IHO S-52, "Specifications for Chart Content and Display Aspects of ECDIS"
- B IHO S-57, "IHO Transfer Standard for Digital Hydrographic Data"
- C IHO S-58, "Recommended ENC Validation Checks"
- D IHO S-62, "ENC Producer Codes"
- E IHO S-63, "IHO Data Protection Scheme"
- F IHO M-3, "Resolutions of the IHO", Resolution K2.19, Principles of the Worldwide Electronic Navigational Chart Database (WEND).
- G IHO S-4, "Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO"
- H IHO S-8, FIG/IHO/ICA 'Standards of Competence for Nautical Cartographers'
- I IMO Resolutions MSC.232(82) and A.817 (19), as amended by MSC.64 (67) and MSC.86 (70), "Performance Standards for Electronic Chart Display and Information Systems (ECDIS)"
- J IMO Convention on the Safety of Life at Sea (SOLAS), 2009
- K IHO S-66, "Facts about electronic charts and carriage requirements"

Indicative Documentation

- L UKHO ENC Product Specification
- M UKHO ENC Data Capture Specification
- N UKHO ENC Training Documentation and Job Descriptions
- O UKHO Quality Procedures for the production of ENCs
- P Guidelines for the Implementation of the WEND Principles

The UKHO can make References L & M and the overview elements of References N & O available on request; due to their complexity more detailed elements of the latter pair would typically form part of the documentation provided as part of an overall training/support package and would be considered on an individual basis.

In addition, various HOs have established their own specifications; certain of them are available.



Abbreviations

| | |
|-------|---|
| ENC | Electronic Navigational Chart |
| ECDIS | Electronic Chart Display and Information System |
| HO | Hydrographic Office |
| IHO | International Hydrographic Organization |
| IMO | International Maritime Organization |
| QMS | Quality Management System |
| RENC | Regional ENC Coordinating Centre |
| SOLAS | Convention on the Safety of Life at Sea |
| WEND | Worldwide ENC Database |



What is an ENC?

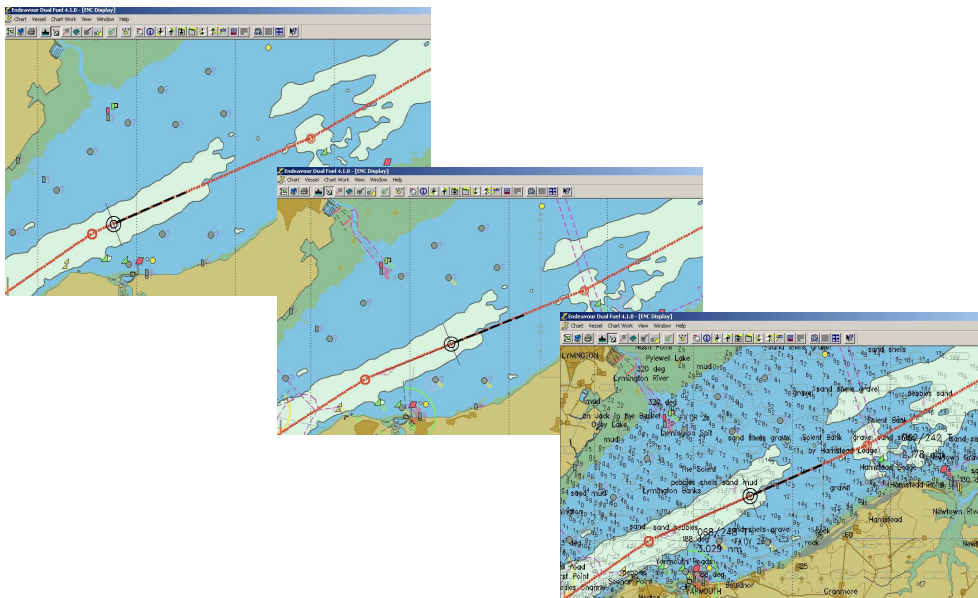
Digitised Data

Electronic Navigational Charts (ENCs) consist of digitised data conforming to the IHO's S-57 ENC Product Specification that records all the relevant charted features necessary for safe navigation, such as coastlines, bathymetry, buoys, lights, etc. The basic unit of geographic coverage (analogous to a paper chart) is termed a cell.

An Electronic Chart Display and Information System (ECDIS) will convert the ENC **and its updates** into a System ENC (SENC) in an internal format optimised for efficient display.

Commentaire : Improvement from EUWG

Within the ECDIS, the features and their attributes (e.g. position, colour, shape) can be selectively displayed and queried, creating the potential to manipulate the chart image displayed on screen. The figures below show various levels of detail displayed from the same cell:



This not only provides ENC users with control over what level and type of detail they wish to see, but can also be linked to other onboard systems to provide additional features such as automatic warning alarms and indications.

S-52 Display Standard

While S-57 defines what information can be encoded and how it is to be structured, it says nothing about how that data can be displayed. When ENC data is used in an ECDIS, this is defined within S-52. This specifies not only the symbology to be used but also the full range of conditional rules that govern their use.



Official Vector Charts

ENCs are official vector-based electronic charts designed to meet the relevant chart carriage requirements of the Safety of Life At Sea (SOLAS) convention.

When displayed within certain parameters, and using a type approved ECDIS, ENCs fully satisfy SOLAS chart carriage requirements, and so can be used as the primary means of navigation.

Relevant Regulations

The SOLAS convention of the International Maritime Organization (IMO) includes a number of pertinent requirements:

- ❑ That nations publish nautical information necessary for safe navigation; this includes systematic updating with all necessary safety-critical information
- ❑ That ships shall carry nautical charts and that use of an ECDIS meets this requirement. It also notes that such charts (paper or electronic) shall be “issued by or on behalf of a Government authorized hydrographic office or other relevant government institution”; in other words they must be ‘official charts’.

The IMO’s ECDIS Performance Standard further mandates that “The chart information to be used in ECDIS should be the latest edition of that originated by a government authorized hydrographic office, and conform to IHO standards.”

In order to be a legal equivalent of paper charts, the ECDIS must be type-approved in accordance with Standard 61174 of the International Electrotechnical Commission (IEC).

Hydrographic Office Responsibilities For Producing ENCs

The responsibilities of Hydrographic Offices (HOs) for the production and distribution of ENCs are defined in the WEND (Worldwide Electronic Navigational Chart Database) principles. (M-3, Resolutions of the IHO). These note that :

“The purpose of WEND is to ensure a world-wide consistent level of high-quality, updated official ENCs through integrated services that support chart carriage requirements of SOLAS Chapter V, and the requirements of the IMO Performance Standards for ECDIS.”

HOs are responsible for:

- ❑ The preparation and provision of digital data and its subsequent updating for waters of national jurisdiction.
- ❑ Ensuring that, mariners, anywhere in the world, can obtain fully updated ENCs for all shipping routes and ports across the world and that their ENC data are available to users through integrated services.
- ❑ Assuring the high quality of its ENC services through the use of a Quality Management System that is certified by a relevant body as conforming to a suitable recognised standard; typically this will be ISO 9001:2000.

Commentaire : Mandatory carriage of ECDIS for Solas class vessels is covered at page 10 (IHO WEND principles, first bullet)



- ❑ Ensuring compliance with all relevant IHO and IMO standards and criteria (including IHO S-57, IHO S-52, or their replacements).
- ❑ Providing timely updates to the ENC for the mariner; these should be at least as frequent as those provided by the nation for correction of paper charting.

Reference is made throughout this document to the relevant WEND principles that support some of the stages of the ENC production processes.

For full details of the WEND principles refer to M-3 - Resolutions of the IHO, Resolution K2.19, Principles of the Worldwide Electronic Navigational Chart Database (WEND).

Note should also be taken of the 'Guidelines for the Implementation of the WEND Principles'¹ agreed by the WEND Committee in 2008 and available on the IHO Website.

Useful References: S-66 - Facts about electronic charts and carriage requirements²; (Plus those documents listed above).

Flow Chart

A flow chart detailing each stage of the process is shown overleaf.

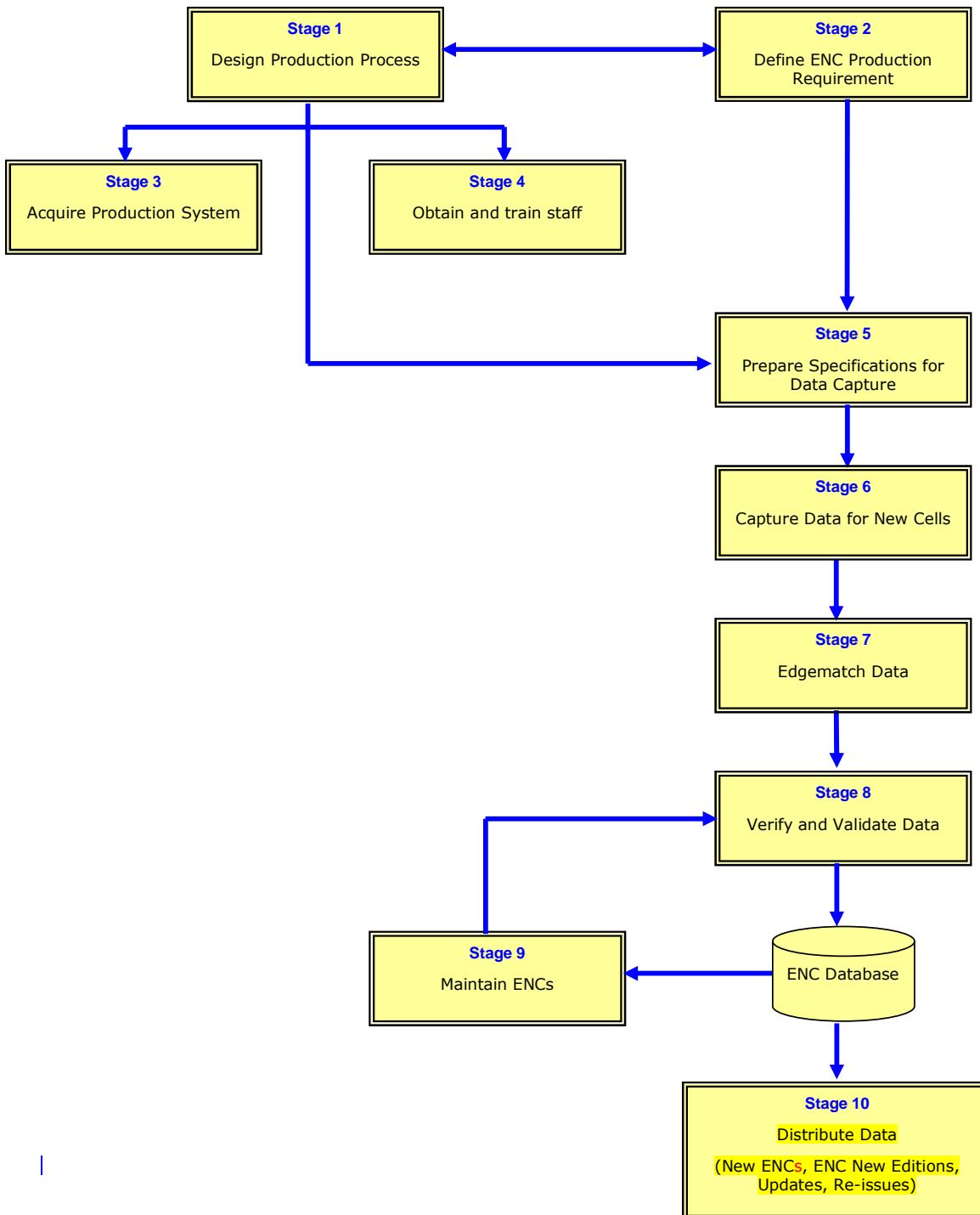
¹ Reference P

² Reference K



Key Stages in the Production of ENC

Commentaire : Diagram modified (end) to be more in accordance with diagram page 21.





ENC PRODUCTION AND DISTRIBUTION GUIDANCE

STAGE 1 – Design Production Process

STEP 1 – Production Method

- Before the production process can be designed, it has to be decided which source material will be used for the ENCs.

ENCs can be encoded directly from original survey material, databased information, from existing paper charts or a combination of each.

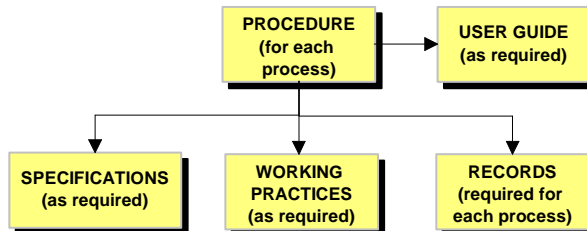
The decision as to which source material will be used will depend on several factors:

- The quality and format (i.e. digital or analogue) of existing survey data. For example it may be more efficient and prudent to produce ENCs only from surveys completed to modern surveying standards.
 - The availability of accurate transformations for existing information to WGS-84 where required.
 - The existence of, or facilities to produce, rectified raster images of existing charts.
- Once it has been decided which source material will be used, a production process needs to be designed and a Quality Management System (QMS) for ENC developed to interface with existing production processes.
 - Any production process will be dependent on whether the Data Capture is to be carried out 'in house' or under contract – see Stages 5 & 6. This decision must be based on the in house production capacity, number of cells to be captured, required timescales, available staff and IT resources, and funding. Each has its own advantages and disadvantages. These include:
 - In house capture should provide a more flexible solution but may require a longer lead time for staff training and may have resourcing issues where a large team is needed for initial capture and a much smaller team to maintain the service thereafter.
 - Contracting out the work should reduce the costs of basic capture, however the time necessary to put the contract in place should not be underestimated nor the effort required to support it; also final validation needs to be carried out by the HO taking responsibility for the product.
 - Options such as using external resources to provide an initial 'bulk load' - see Stage 2 - with all further capture and maintenance carried out in-house should be considered.
 - Consideration should be given to ensure that the publication of ENCs and updates is co-incident with the publication of the equivalent paper chart information.



STEP 2 – A Quality System

- Procedures should be put in place to ensure that each stage of the production process is carried out correctly and consistently. These should be approved by a relevant body as conforming to a suitable recognised standard; typically this will be ISO 9001:2000.



ENC PROCESS DOCUMENTATION

- The production of ENCs demands a high level of quality control and quality assurance. It is important to bear in mind the difference between these two concepts:
 - Quality Control – those checks made on a product after production;
 - Quality Assurance – the overall set of processes, of which Quality Control forms a part, designed to ensure that a product is produced correctly and without errors.

The IHO WEND principles state the following with reference to Standards and Quality Management:

- ❖ A Quality Management System should be considered to assure high quality of ENC services. When implemented, this should be certified by a relevant body as conforming to a suitable recognised standard; typically this will be ISO 9001:2000.
- ❖ There must be conformance with all relevant IHO and IMO standards.

Useful References: UKHO Quality Procedures



STAGE 2 – Define ENC Production Requirement

STEP 1 – Identify Requirements

■ While each nation has the responsibility for ENCs in its own waters, many aspects of the overall service to the mariner will be improved through their working within the relevant Regional Hydrographic Commission (RHC). This will expedite the completion of small scale coverage and the agreement of cell boundaries between nations. The WEND Task Group recommended that RHCs should:

- Identify key shipping routes and ports within their regions
- Identify charts covering these routes and ports to be captured as ENCs
- Identify producer nations for the ENCs
- Arrange for their production

Wherever possible ENCs should be based on INT charts and the producer nations for the ENCs should be the same as the producer nations for the corresponding INT charts.

If ENCs are to display correctly in an ECDIS it is especially important that there is no overlap of data within the same navigational purpose band. The ENC Product Specification³ makes it clear that such overlap must not occur. See also S-57 Appendix B.1, Annex A – Use of the Object Catalogue for ENC (Edition 3.0.0 (2011)), clause 2.1.8.

In addition to the agreement of boundaries, it is important that neighbouring countries agree, where possible, factors contributing to consistent ENC data encoding such as assignment of ENCs to navigational purpose, use of SCAMIN, and contour interval to provide a seamless depiction. The final assignment of ENCs to navigational purposes and the values used for individual SCAMIN attribution should preferably be done in a regional consultation with all nations within a Regional Hydrographic Commission as appropriate, in order to maintain consistency across national or regional boundaries.

Commentaire : Proposed change if UOC 3.0.0 is adopted (transfer of preliminary note of S-65 Annex A). Suggested by LV.

STEP 2 – Produce Production Plan

- A national production plan then needs to be compiled to define:
 - which geographic areas are to be captured – note that this relates to actual areas of data coverage rather than the rectangular cell limits.
 - which navigational purposes are to be populated for each area
 - how the areas are to be divided into cells for each navigational purpose
 - the order of capture; e.g. larger scale cells first
- The production plan will be dependent on some of the following factors:
 - The reason for the requirement – Defence / SOLAS

³ Reference B, Appendix B.1



- Priority given to major ports and traffic routes, based on volumes of goods and number of passengers
- Liaison with bordering countries to maximise production, improve efficiency and coverage, and to ensure cross-border consistency
- Design considerations outlined below.



The IHO WEND principles also state the following with reference to responsibility and ownership.

- ❖ SOLAS Chapter V, Regulation 9, requires Contracting Governments to ensure that hydrographic data are available in a suitable manner in order to satisfy the needs of safe navigation. Once the carriage of ECDIS becomes mandatory, there will be a consequential requirement to ensure that such data, as agreed by IMO, are available in a form suitable for use in ECDIS.
 - ❖ It is expected that Member States, for waters of national jurisdiction, will have mature supply systems for ENCs and their subsequent updating in place by the earliest date for mandatory carriage of ECDIS.
 - ❖ By the dates established by IMO, Member States will strive to either:
 - a Provide the necessary ENC coverage, or
 - b Agree with other States to produce the necessary ENC coverage on their behalf.
- IHO will address overall coverage on a regional basis through Regional Hydrographic Commissions.
- ❖ The INT chart system is a useful basis for initial area selection for producing ENCs.
 - ❖ Responsibilities for providing digital data outside areas of national jurisdictions must be established.
 - ❖ In producing ENCs, Member States are to take due account of the rights of the owners of source data and if paper chart coverage has been published by another Member State, the rights of that State.
 - ❖ Responsibility for the production of ENCs can be delegated in whole or in part by a country to another country, which then becomes the producing country in the considered area.
 - ❖ When the limits of waters of national jurisdiction between two neighbouring countries are not established, or it is more convenient to establish boundaries other than established national boundaries, producing countries are to define the boundaries for ENC production within a technical arrangement. These limits would be for cartographic convenience only and shall not be construed as having any significance or status regarding political or other jurisdictional boundaries.
 - ❖ In international waters, the INT chart producer nation shall be assumed to be the producer of the corresponding ENC. Where the offshore limits of waters under national jurisdiction have not yet been established, the clause above should apply.
 - ❖ In areas where the paper INT charts overlap, neighbouring producer nations should agree a common limit of ENC production in the overlapping areas. Cartographic boundaries should be as simple as possible, for example: a succession of straight segments and turning points corresponding to such things as meridians, parallels, or chart limits. Where different producer nations are responsible for INT coverage of the same area at different scales, those nations should agree on a suitable set of boundaries so as to provide the user with the most coherent service possible.

Useful Reference: Guidelines for the Implementation of the WEND Principles



Cell Schema Design Considerations

Limits of ENC Cells

- The HO has to decide how the limits of the planned ENC cells should be defined. The limits can be based on the existing limits of paper charts, or be defined by a rectangular grid.
- The ENC Production Specification, S-57 Appendix B.1, states that *"the geographic extent of the cell must be chosen by the ENC producer to ensure that the resulting dataset file contains no more than 5 megabytes of data. Subject to this consideration, the cell size must not be too small in order to avoid the creation of an excessive number of cells."*

It also states that "cells must be rectangular". Within this, the actual data coverage can be any shape.

Compilation Scales

- It is recommended that the compilation scales for ENCs are based upon standard radar ranges.

| Selectable Range | Standard scale (rounded) |
|------------------|--------------------------|
| 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 |
| 0.75 NM | 1:12,000 |
| 0.5 NM | 1:8,000 |
| 0.25 NM | 1:4,000 |

- Normally, the nearest larger standard scale should be used, e.g. an ENC produced from a 1:25,000 paper chart should have a compilation scale of 1:22,000
- Exceptionally, if source material permits, the next larger scale may be used.
- Where the source scale is larger than 1:4,000 or smaller than 1:3,000,000 then the actual scale should be used.

Commentaire : Suggest this be removed and replaced with a reference to Reference B, Appendix B.1, Annex A. (This has been included in UOC Edition 3.0.0 at clause 2.2.6).



Navigational Purposes

- Dependent on its intended navigational purpose an ENC is assigned to one of the 6 navigational purposes defined in S-57:
 - Overview
 - General
 - Coastal
 - Approach
 - Harbour
 - Berthing
- S-57 Edition 3.1 does not define minimum and maximum **compilation** scales for each navigational purpose.



STAGE 3 – Acquire Production System

STEP 1 – Identify Requirement

- The capacity and capability of the production system required will depend on the production plan (see Stage 2) and on the extent to which data capture will be contracted out.
- In the broadest terms there are two types of production software:
 - Those which populate and maintain a database of ENC objects, attributes and attribute values in a format which is compatible with IHO Transfer Standard for Digital Hydrographic Data, S-57 (ENC Product Specification);
 - Those which create individual flat files each forming a single ENC cell.
- A Statement of Requirement (SOR) should be written to set out clearly the requirements of any contract. The SOR should include Key User Requirements, capability of the system, the number of workstations required, any support requirements, and any interfaces with other existing production systems. The contract could include hardware as well as software or just the latter for installation on existing infrastructure. See also Stage 4 regarding the potential for including training provision as part of this contract

STEP 2 – Invitation to Tender

- Once the required production capacity is known (see Stage 2) then an invitation to tender should be sent out to those companies identified as being capable of supplying a suitable system.
- The tenders rendered can then be evaluated against the criteria defined in the initial invitation.
- The contract can then be awarded to the selected company following the evaluation.

STEP 3 – System Installation and Testing

- Before acceptance, the system needs to be installed and tested to ensure that all contractual requirements have been met.

STEP 4 – Live Running

- When the supplier has demonstrated that the system performs in accordance with the specifications it can be contractually accepted and transferred to live running.



STAGE 4 – Obtain and Train Staff

STEP 1 – Staffing Levels

- Staffing levels need to be defined for the production of new ENC cells and the maintenance of existing cells. The staff requirement will be based on whether the decision is to contract out the data capture or capture data in-house, on the number of cells planned, and the proposed targets to achieve those plans.
- To assist with this planning the following provide some guidelines on the approximate timescales (based on UKHO ENC production) for the production and maintenance of cells, from initial preparation to final publication. These are based on production of ENC from paper charts with updates matching the paper chart Notice to Mariners service:
 - Production of New Cells = approximately 5 weeks of an operator's time for a full paper chart equivalent.
 - Production of New Editions = approximately 5 weeks.
 - Production of Updates = approximately 1 hour per update.

Information from other HOs indicates that these figures may vary considerably depending on the complexity of the area, the verification and validation processes adopted and the experience of the staff involved.

Australia's experience is that if highly detailed ENCs are compiled from source material such as hydrographic data, rather than from existing paper charts, substantial additional time will need to be allowed. This will depend on the extents of the cells, area of data coverage, depth contour interval adopted and how complex the source data is. As an example, one degree square ENC cells in the Great Barrier Reef where the seabed is quite complex, compiled from source surveys showing **one** metre depth contours and depth areas, with a navigational purpose of 4, took about 26 weeks to produce, including checking and validation. Such cells often approach the maximum size of 5 MB after optimisation and grouping of soundings has been carried out.

STEP 2 – Determine Skill Levels

- The training needs depend on whether existing staff are to be re-trained or new staff recruited for ENC production.
- A Skills Analysis and Training Needs Analysis should be employed to determine the skills required for the job and the skill levels of the staff. Commercial companies can assist with this task. Where appropriate, reference should be made to Publication S-8; FIG/IHO/ICA 'Standards of Competence for Nautical Cartographers'.

The following training may be required:

- Chart Awareness Training, especially regarding navigational marks
- ENC/S-57 Awareness training
- Quality Assurance training, including quality control aspects



- Production System Training
- ECDIS training – for displaying ENC's to assess portrayal

STEP 3 – Identify Training Provider

- Once the requirement for training has been identified, the training provider needs to be determined. For Production System training, the system provider in most cases will provide the initial training and this needs to be specified within that contract. For Chart Awareness, QA and ENC/S-57 training, this could be provided internally by existing staff, or externally. Courses that are available internationally are listed in IHO Publication C-47, "Training Courses in Hydrography and Nautical Cartography".

The IHO WEND principles state that:

- ❖ Member States' HOs are strongly recommended to provide, upon request, training and advice to HOs that require it to develop their own national ENC provision.

Useful References:

- S-8 FIG/IHO/ICA 'Standards of Competence for Nautical Cartographers'
- UKHO ENC Training Documentation;
- UKHO Job Descriptions;
- C-47 IHO Training Courses;
- Guidelines for the Implementation of the WEND Principles



STAGE 5 – Prepare Specifications for Data Capture

STEP 1 – Published Specifications

- The IHO Transfer Standard for Digital Hydrographic Data, S-57, defines the content, structure and format of the data for ENC. Appendix B1 of the standard contains the Product Specification for ENC.
- Reference should be made to Appendix A (Object Catalogue) and Annex A to Appendix B1 (Use of the Object Catalogue for ENC), of S-57, which define how charted objects should be encoded for ENCs together with the "Recommendations for Consistent ENC Data Encoding" (Annex A).
- It should also be noted that S-57 is maintained by Maintenance Documents and any clarifications within these documents apply to ENCs complying with S-57 Edition 3.1 together with any Supplements that are extant. TSMAD, the IHO group responsible for maintaining and developing S-57, also produces ENC Encoding Bulletins and Frequently Asked Questions (FAQ) about ENC encoding issues. These are all available on the IHO website. TSMAD welcomes additional queries from member states or HOs about ENC encoding issues.

All of these sources need to be searched when collating specifications relating to ENC data capture.

STEP 2 – Data Capture and Product Specifications

- The S-57 standard, although comprehensive, leaves it to HOs to decide what should be the content of the ENCs, what the limits of the cells should be, and which navigational purposes the cells should belong to.
- Supplementary Data Capture and Product Specifications should be produced to clarify the content and construction of ENC cells and the capture of ENC data, in addition to the recommended and mandatory requirements of S-57. As well as clarifications regarding content, these should include elements such as accuracy requirements and file naming conventions for cells and associated text and picture files.
- Size of data sets should be optimized and only necessary data should be included. This will facilitate remote distribution services.
- Ensure consistency with neighbours wherever possible.

Commentaire : Suggest this wording be removed (dependant on decision to remove Annex A from S-65 as it is now included in Edition 3.0.0 of the UOC).

Commentaire : Recommendation from EUWG

The IHO WEND Principles state that:

- ❖ There must be conformance with all relevant IHO and IMO standards.

Useful References: UKHO Data Capture Specification;
UKHO ENC Product Specification;
(Plus those documents listed above).



STAGE 6 – Capture Data for New Cells

STEP 1 – Optionally, place external capture contract

- If it has been decided that new cells are to be captured externally, a suitable contract needs to be agreed. This requires:
 - Definition of a suitable Statement of Requirements.
 - Identification of companies able to carry out the work; this can include a requirement that they be ISO9001:2000 certified.
 - Issuing of Invitations to Tender, including possible production of sample cell.
 - Evaluation of Tenders.
 - Selection of the contractor.
- Alternatively, other Hydrographic Offices may be able to offer production capacity, either on a commercial basis or as part of a wider bilateral agreement.

STEP 2 – Capture data

- In order to facilitate capture, a 'package' should be created for each cell containing all the necessary source information (For example, where capture is from paper charts: Raster Files; List of Lights; Overlays for clarification etc) for populating the cell.
- Depending on form of data capture used:
 - The package will be sent (via a secure route) to external contractor or HO; for facilitating this aspect, consideration should be given to sending such data in batches.
 - A suitably trained in-house operator will be tasked.
- The data must be captured in compliance with the recommended and mandatory requirements of S-57 and in accordance with any HO clarification or Data Capture Specifications.

Useful References: UKHO Data Capture Specifications;
UKHO Quality Procedures



STAGE 7 – Edge Match Data

STEP 1 – National data

- Once a New Cell has been captured, or a New Edition of an ENC produced, it is important that the data on the cell border is aligned and matched with the corresponding data in any adjoining cells particularly of the same navigational purpose.
- When editing data on the border of cells to match adjoining data, it is important that the data is edited so that depth contours, depth areas etc. are adjusted on the side of safety.
- Editing should also only be done within a specific tolerance so that the accuracy of the data is not impaired to too great a degree.

STEP 2 – Between Nations

- In areas which include neighbouring producer nations, HOs should cooperate to agree on cell boundaries. It is recommended that where advantageous, nations agree data boundaries within a technical arrangement based on cartographic convenience and benefit to the mariner.
- Suitable communications with neighbouring nations should be put in place to ensure data consistency across cell boundaries. These will include exchange mechanisms to allow access each other's ENCs.

Commentaire : Most of this has been included in UOC Edition 3.0 at clause 2.1.8. Consider that as this is important information for administrators as well as compilers that this guidance be retained in S-65.

The IHO WEND principles state:

- ❖ Member States are encouraged to work together on data capture and data management.
- ❖ ENC duplication should be avoided. A single ENC producing country should exist in any given area.
- ❖ Responsibility for the production of ENC can be delegated in whole or in part by a country to another country, which then becomes the producing country in the considered area.
- ❖ When the limits of waters of national jurisdiction between two neighbouring countries are not established, or it is more convenient to establish boundaries other than established national boundaries, producing countries are to define the boundaries for ENC production within a technical arrangement. These limits would be for cartographic convenience only and shall not be construed as having any significance or status regarding political or other jurisdictional boundaries.
- ❖ In areas where the paper INT charts overlap, neighbouring producer nations should agree a common limit of ENC production in the overlapping areas. Cartographic boundaries should be as simple as possible, for example: a succession of straight segments and turning points corresponding to such things as meridians, parallels, or chart limits. Where different producer nations are responsible for INT coverage of the same area at different scales, those nations should agree on a suitable set of boundaries so as to provide the user with the most coherent service possible.

Useful Reference:

Guidelines for the Implementation of the WEND Principles



STAGE 8 – Verify and Validate Data

STEP 1 – Production Systems and Procedures

- Thorough verification and validation procedures need to be in place to verify and validate ENC cells for content and accuracy, ensuring consistency with the IHO Data Transfer Standard S-57 Edition 3.1 together with any Supplements that are extant.

STEP 2 – Verification

- Cells need to be checked for content and capture accuracy. Typically this will take the form of a 100% check of the vector data against the source information so as to ensure that no charted objects or attributes have been omitted from the cell or captured in an incorrect position.

STEP 3 – Validation

- Validation software should be used to perform checks on the completed ENC cell. This is to ensure that an ENC is compliant with the S-57 ENC Product Specification. The minimum checks are defined within S-58.
- The validation process used should include software provided by a different supplier to that used for production. Some HOs use more than one validation software package as each tends to pick up different warnings and errors.

The IHO WEND principles state:

- ❖ The Member State responsible for originating the data is also responsible for its validation in terms of content, conformance to standards and consistency across cell boundaries.
- ❖ Member States should recognize their potential exposure to legal liability for ENCs.

A list of companies supplying ENC Validation Tools is maintained on the IHO website (www.iho.int > External Liaisons > External Links > Industry Links > Search on 'ENC validation').

Useful Reference: Guidelines for the Implementation of the WEND Principles



STAGE 9 – Maintain ENCs

STEP 1 – Establish mechanism for ENC updating

- Once an ENC cell has been produced and made available to the end user, then that data has to be maintained.
- The overall Quality Management System must include mechanisms for ENC updating designed to meet the needs of the mariner regarding safety of navigation.
- The processes for updating the paper chart are described in Part B-600 of S-4. The general principles of these processes apply equally to paper and electronic charts. The processes for updating the paper chart will need to have its equivalent in any updating process for the ENC.
- The processes for updating the paper chart and its equivalent for the ENC should be synchronised; however, if paper chart production cycles are lengthy, the option of issuing ENC Updates and New Editions earlier should be considered together with any wider implications.

Commentaire : Transfert from S-52 app 1 §1.2.1 and annex B

The **IHO WEND principles** state:

- ❖ It is expected that Member States, for waters of national jurisdiction, will have mature supply systems for ENC and their subsequent updating in place by the earliest date for mandatory carriage of ECDIS.

STEP 2 – Notice to Mariners (Updates)

- ENC Cells require updating to include details published in paper chart Notices to Mariners. These are in two forms: Chart Correcting Notice to Mariners (NM), and Temporary and Preliminary Notice to Mariners (T&P NM – see Annex See S-4, clauses B-631, B-633 and B-634; and S-57 Appendix B.1, Annex A – Use of the Object Catalogue for ENC (Edition 3.0.0), clause 2.6). Updating must to be completed within a rigid timescale for cells that have been issued to customers.
- ENC Updates must be produced to provide the ECDIS user with an updated SENC. As a guide, an ENC Update should not exceed 50 Kilobytes in size as legacy ECDIS have issues with loading larger update files.
- ENC Updates must be produced so as to replicate the corrections on the equivalent paper chart, and be produced at the same time whether that is weekly, fortnightly or monthly.

Commentaire : Proposed change if UOC 3.0.0 is adopted. Annex B from S-65 as it is now included in Edition 3.0 of the UOC

Commentaire : This has been included in UOC Edition 3.0 at clause 2.6. Consider that as this is important information for administrators as well as compilers that this guidance be retained in S-65.

Commentaire : EB n°31 and EUWG recommendation

STEP 3 – New Editions or Notice to Mariners (NM) Blocks

- New Editions of the equivalent paper charts or paper chart NM blocks will require an ENC New Edition or an ENC Update. To optimize data transmission, updates are preferred where practical. Note: If it is reported from users that it is not possible to load an ENC Update properly, a New Edition should be created.



STEP 4 – ENC Re-issues

- Where it is considered that the number of updates to be applied to a base cell becomes too large, it is recommended that a Re-issue of the ENC be produced. A Re-issue of an ENC will optimise data transmission and avoid the machine intensive task of installing an overly large number of updates for new users of ENC services. It is at the data producer's discretion as to what constitutes a large number of updates, but as a guide this may be considered to be between 20 and 50, and other factors, e.g the size of the updates, should also be considered. Existing users will not be effected by the publication of a Re-issue (i.e. will not be required to load the Re-issue), and both new and existing users will update their SENC from the time of the Re-issue through subsequent updates or New Editions.

Commentaire : Recommendation from EUWG

STEP 5 – Distribution of ENC Data

- The timely distribution of the ENC data can be on CD-ROM, through the Internet, over INMARSAT, or by landline communication. However, see Stage 10 regarding wider distribution principles.

Commentaire : To highlight the constraint of time for distributing.

The IHO WEND principles also state the following with reference to Updating of ENCs:

- ❖ Technically and economically effective solutions for updating are to be established conforming to the relevant IHO standards. The updating of ENCs should be at least as frequent as that provided by the nation for correction of paper charting.
- ❖ National HOs providing source data are responsible for advising the issuing HO of update information in a timely manner.



STAGE 10 – Distribute ENC Data

STEP 1 – Identify Distribution Mechanism

- The distribution mechanism must provide the user with up to date ENC data, from the issuing HO to the user, in a timely manner to support safe navigation. A considerable reduction of time should be possible by taking advantage of digital and telecommunication technologies. These technologies must not compromise the service continuity and the data integrity.
- The distribution mechanism must ensure data integrity and data protection. IHO S-57 Appendix B.1 (ENC Product Specification) identifies the file integrity checks that must be carried with the exchange of unencrypted ENCs. The IHO Data Protection Scheme (S-63) should be used for ENC distribution to end users. See also step 3 Distribution Format.
- A Quality Management System should be established for the overall distribution process.
- The distribution mechanism must provide new users with the latest ENC base cells (New Cell, New Edition or Re-issue) together with all updates applying to them.
- The distribution mechanism must provide existing users with regular updates, e.g. ENC New Editions, Re-issues or Updates, to ensure that the ECDIS SENC is maintained up to date. In case of remote supply, data transmission can be optimized by providing only the required data.
- The distribution mechanism should issue information about the current status of all ENCs in service (latest edition and update number), ENCs cancelled, and where appropriate, replaced ENCs.
- The distribution mechanism may use various methods of delivering ENC data, depending on the media and channels as well as validation procedures required to secure correctness. The methods should provide the update information to the SENC in the most effective way.
- Methods of delivering may use physical media or telecom (on line), on land or at sea.
- The distribution mechanism must make Updates available to users at regular intervals adequate to support safe navigation and known in advance by end users, e.g. Thursday every week.
- As a minimum, all ENC data must be made available on CDROM. On-demand and remote services via telecom should also be made available and a nil message should be used if no update information exists. These services should ensure that service continuity and data integrity is not in conflict with data installed using conventional methods, e.g. CDROM.
- Fully-automatic updating (i.e. the update data reaches the EDCIS directly without any human intervention) may exist. To ensure the integrity of the broadcast update, effective safe transmission mechanisms and/or error detection methods should be employed.
- Updating of the ENC should be accomplished in a user-friendly way by the mariner without the need for assistance of the distributor or manufacturer.

Commentaire : Ref: S-52 Appendix 1, §3.3.2

Commentaire : Ref: Appendix 1 §3.1 b, §3.2.d, §3.3.1.b

Commentaire : Ref: K2.19 on behalf the objectives of S63 (see 3. k) and at K2.19 2.b note 3.

Commentaire : Ref : S52 Appendix 1, §3.2.e

Commentaire : Ref: K2.19 §3.k

Commentaire : Ref appendix 1 § 3.1 b and 3.3.1 c

Commentaire : Ref: S52 Appendix 1 § 3.3.3 d (extend to new editions) and interest of re-issues highlighted.

Commentaire : Ref: S52 Appendix 1 § 3.3.3 d (extend to new editions) and interest of re-issues highlighted.

Commentaire : Ref: S52 Appendix 1 § 2.2 b. 3 and 4

Commentaire : S-52 Appendix 1 globally

Commentaire : Ref: S52 Appendix1, §3.3.1.b

Commentaire : Ref: S52 Appendix 1 § 2.4, §3.2.d.

Commentaire : Ref: S52 Appendix 1, § 3.2.d and § 3.3.3.a – IEC61174 §5.10.3

Commentaire : Ref: S52 Appendix1, §3.2.d, §3.2.k, §3.3.3.b

Commentaire : Ref: S-52 appendix 1 § 3.2.d

Commentaire : Ref: S52 appendix 1, § 3.3.2.a

Commentaire : Ref: S-52 Appendix 1, § 3.3.3.e and M3 K2.19 §2.g



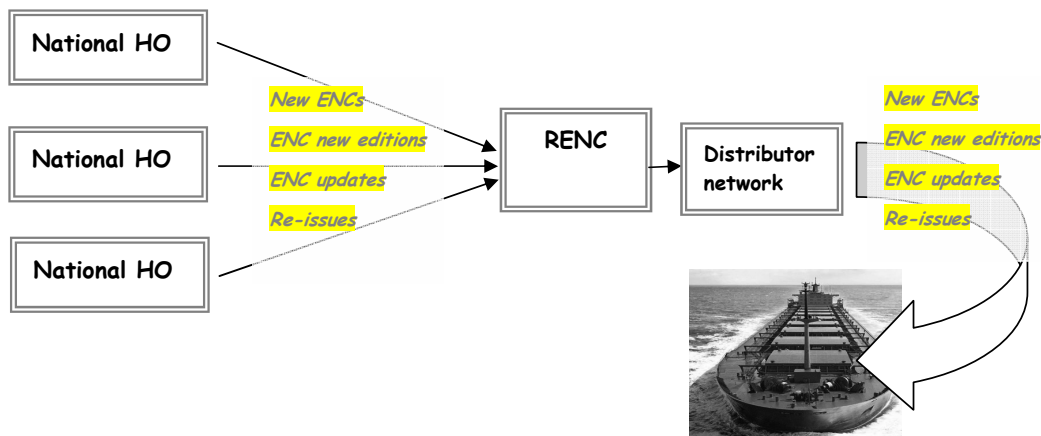
- It is recommended that all ENC data (New ENCs, New Editions, Updates and Re-issues) is distributed through a Regional ENC Co-ordinating Centre (RENC).
- It is the responsibility of the RENC to establish a distribution network for ENC data. The RENC and its distributors are entities of the distribution process.

Commentaire : Ref: S52 Appendix 1 § 3.2.c

The IHO WEND principles state:

- ❖ Member States are encouraged to distribute their ENCs through a RENC in order to share in common experience and reduce expenditure, and to ensure the greatest possible standardization, consistency, reliability and availability of ENCs.
- ❖ Member States should strive for harmonization between RENCs in respect of data standards and service practices in order to ensure the provision of integrated ENC services to users.

Commentaire : Diagram modified to transfer parts of S-52 app 1 fig1 page 4. Note that is no direct link with other RENC in accordance WEND principles K.19. Previous WEND principles (CL 2/94 and S-52 appendix 1) shown a explicit link.



- The supply of data through RENCs reduces the overall cost of ENCs by centralising the distribution of the data, thus avoiding the need for each individual HO to invest in developing their own service and distribution network, thus simplifying the purchasing of ENC data. RENCs also act as 'one stop shops'.
- RENCs can also ensure that data is of uniform quality (in terms of its validation against S-58) and that there are no gaps, or overlaps or inconsistencies between adjacent cells.
- RENCs help promote the production of ENCs around the world, and thus help to ensure that developments in electronic charting are coordinated and meet the requirements of the market.



STEP 2 – Sign Agreement

- Whatever distribution mechanism is adopted, where an outside organisation such as a RENC is involved, the rights and responsibilities of each partner should be detailed in a signed agreement.

STEP 3 – Distribution Format

- Distribution through a RENC is not mandatory. If data is not distributed through a RENC, a security system should be applied to protect the integrity of the data, prove authenticity, and prevent unauthorised copying. Reference should be made to S-63 (IHO Data Protection Scheme).

- In addition to standard S-57 (either S-63 encrypted or unencrypted) ENC_s can also be distributed directly in the SENC format proprietary to an ECDIS manufacturer. The SENC update mechanism should not be inferior to the ENC - ECDIS update mechanism.

Commentaire : Ref: M3 - A3.13.3

Commentaire : Ref : M3 A3.11.d

The IHO WEND principles also state that:

- ❖ Member States will strive to ensure that, mariners, anywhere in the world, can obtain fully updated ENC_s for all shipping routes and ports across the world.
- ❖ Member States will strive to ensure that their ENC data are available to users through integrated services, each accessible to any ECDIS user (i.e., providing data in S-57 form), in addition to any national distribution or system-specific SENC delivery.
- ❖ A Member State responsible for any subsequent integration of a country's data into a wider service is responsible for validating the results of that integration.
- ❖ Methods to be adopted should ensure that data bear a stamp or seal of approval of the issuing HO.
- ❖ Member States should work together so that the IHO Data Protection Scheme (S-63) is used for ENC distribution to end users, to ensure data integrity, to safeguard national copyright in ENC data, to protect the mariner from falsified products, and to ensure traceability.
- ❖ When an encryption mechanism is employed to protect data, a failure of contractual obligations by the user should not result in a complete termination of the service. This is to assure that the safety of the vessel is not compromised.
- ❖ In order to promote the use of ENC_s in ECDIS, Member States are to strive for the greatest possible user-friendliness of their services, and facilitate integrated services to the mariner.

In addition, the **WEND Committee** endorsed the following definition of integrated services:

- ❖ “A variety of end-user services where each service is selling all its ENC data, regardless of source, to the end user within a single service proposition embracing format, data protection scheme and updating mechanism, packaged in a single exchange set.”



Useful Reference: Guidelines for the Implementation of the WEND Principles



Glossary of Terms

Terms and Abbreviations relating to ENC/ECDIS

The following definitions have been principally taken from the Glossary of ECDIS related terms (IHO S-32, Appendix 1, 2007). Reference has also been made to 'The Electronic Chart', Chapter 16, Glossary (Hecht, Berking, Büttgenbach, Jonas, Alexander).

AIS

An automatic communication and identification system intended to improve the safety of navigation by assisting in the efficient operation of vessel traffic services (VTS), ship reporting, ship-to-ship and ship-to-shore operations.

A transponder is an example of an AIS. AIS information may be displayed on an ECDIS.

area

The 2-dimensional geometric primitive of an object that specifies location.

ARPA (Automatic Radar Plotting Aid)

A system wherein radar targets are automatically acquired and tracked and collision situations computer assessed and warnings given.

attribute

A characteristic of an object. Attributes are either qualitative or quantitative. Attributes required for ECDIS are defined in Appendix A of S-57, IHO Object Catalogue.

C-47

IHO Capacity Building Publication 47, titled "Training Courses in Hydrography and Nautical Cartography"

cartographic object

Feature object which contains information about the cartographic representation (including text of real world entities).

The ENC Product Specification prohibits the use of cartographic objects in ENCs.

cell

The basic unit for the distribution of ENC data covering a defined geographical area bounded by two meridians and two parallels, the content of which must not exceed 5 Mbytes, and which is intended for a particular navigational purpose.

chain

A sequence of one or more edges.

chain node

Data structure in which the geometry is described in terms of edges, isolated nodes and connected nodes. Edges and connected nodes are topologically linked. Nodes are explicitly coded in the data structure. Areas are defined by the sequence of edges that comprise their boundaries. Lines are comprised of edges. Point feature objects may only reference isolated nodes.



CHRIS (Committee on Hydrographic Requirements for Information Systems)

A Committee of the IHO tasked with promoting and coordinating the development of official digital products and services. CHRIS has now been superseded by the Hydrographic Services and Standards Committee (HSSC).

collection object

A feature object which describes the relationship between other objects. An example of a collection object in S-57 is "aggregation" which is used, for example, to group together the different objects which together constitute a Traffic Separation Scheme.

compilation

In cartography, the selection, assembly, and graphic presentation of all relevant information required for the preparation of a new map/chart or a new edition thereof. Such information may be derived from other maps/charts, aerial photographs, surveys, new data, and other sources.

compilation scale

The scale at which the ENC data was compiled.

Note that the consistency recommendations (Ref I) indicate that compilation scale should be considered as the optimal scale for display for that ENC.

connected node

A node referred to as a beginning and/or end node by one or more edge. Connected nodes are defined only in the chain-node, planar graph and full topology data structures.

data model

A conceptual specification of the sets of components and the relationships among the components pertaining to the specific phenomena defined by the model reality. A data model is independent of specific systems or data structures. The S-57 data model defines real world entities as a combination of descriptive and spatial characteristics. These characteristics are defined in terms of feature objects and spatial objects and the relationship between them.

data set

A logical grouping of S-57 data to which the S-57 data set descriptive records apply. The data set descriptive records contain meta data. The use of data set descriptive records is product specific and is, therefore, defined by a product specification. If the data set descriptive records are repeated for each file in an exchange set, an instance of a file containing the data set descriptive records is called a data set. If the data set descriptive records are encoded generally for the whole exchange set, the exchange set is referred to as a data set.

data structure

A computer interpretable format used for storing, accessing, transferring and archiving data.

datum (vertical)

Any level surface (e.g. mean sea level) taken as a surface of reference from which to reckon elevations.



display category

The ECDIS Performance Standards establish three categories for SENC objects:

- display base:** The level of information which cannot be removed from the display. It consists of information that is required at all times in all geographic areas and all circumstances.
- standard display:** The level of SENC information that is shown when a chart is first displayed on ECDIS. It is the recommended minimum level of display for safe navigation.
- all other information:** displayed individually (by class) on demand.

edge

A one-dimensional spatial object, located by two or more coordinate pairs (or two connected nodes). An edge must reference a connected node at both ends and must not reference any other nodes.

electronic chart

Very broad term to describe the data, the software, and the electronic system, capable of displaying chart information. An electronic chart may or may not be equivalent to the paper chart required by SOLAS.

Electronic Chart Display and Information System (ECDIS)

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/20 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 if required display additional navigation-related information.

Electronic Chart Systems (ECS)

Generic term for equipment which displays chart data but which is not intended to comply with the IMO Performance Standards for ECDIS, and is not intended to satisfy the SOLAS Chapter V requirement to carry a navigational chart.

Electronic Navigational Chart (ENC)

The data base, 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 necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (eg sailing directions) which may be considered necessary for safe navigation.

ENC Product Specification

Appendix B1 of S-57 which specifies the content, structure and other mandatory aspects of an ENC.

exchange set

The set of files representing a complete, single purpose (i.e. product specific) data transfer. The ENC Product Specification defines an exchange set which contains one Catalogue file and at least one data set file.

**face**

A two dimensional spatial object. A face is a continuous area defined by a loop of one or more edges which bound it. A face may contain interior holes, defined by closing loops of edges. These interior boundaries must be within the outer boundary. No boundary may cross itself or touch itself other than at the beginning/end node. None of the boundaries may touch or cross any other boundary. Faces are defined only in the full topology data structure.

feature

Representation of a real world phenomenon. For example, a particular cardinal buoy represented through a symbol on a chart.

feature object

An object which contains the non-locational information about real world entities. Feature objects are defined in Appendix A of S-57, IHO Object Catalogue.

feature record

A feature record is the implemented term used in the S-57 data structure for a feature object (i.e. a feature object as defined in the data model is encoded as a feature record in the data structure). There are four types of feature records: geo, meta, collection and cartographic.

geo object

A feature object which carries the descriptive characteristics of a real world entity. The positional information is provided through the spatial object.

Geographic Information System (GIS)

A computer based system for handling and integrating data from a variety of sources which is directly or indirectly spatially referenced to Earth.

geometric primitive

One of the three basic geometric units of representation: point, line and area.

Global Maritime Distress and Safety System (GMDSS)

A global communications service based upon automated systems, both satellite based and terrestrial, to provide distress alerting and promulgation of maritime safety information to mariners. This system has been developed by IMO through the SOLAS Convention.

Global Navigation Satellite System (GNSS)

A world-wide position, time and velocity radio determination system comprising space, ground and user segments of which GPS and GLONASS are components.

GLONASS (Global Navigation Satellite System)

A space-based, radio-positioning, navigation and time-transfer system operated by the Government of the Russian Federation. GLONASS to which differential corrections have been applied is known as Differential GLONASS (DGLONASS).

**GPS (Global Positioning System)**

A space-based, radio-positioning, navigation and time-transfer system operated by the United States Government. GPS to which differential corrections have been applied is known as Differential GPS (DGPS).

HSSC (Hydrographic Services and Standards Committee)

The technical steering committee of the IHO tasked, among other things, with promoting and coordinating the development of official digital products and services.

International Electrotechnical Commission (IEC)

A worldwide non-governmental organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. Committee 80, Working Group 7 of IEC is responsible for developing the Performance Requirements for ECDIS to be published as document IEC 61174.

International Hydrographic Organization (IHO)

The IHO is an intergovernmental consultative and technical organization that was established in 1921 to support the safety of navigation and the protection of the marine environment. The object of the organization is to bring about:

- (a) The co-ordination of the activities of national hydrographic offices;
- (b) The greatest possible uniformity in nautical charts and documents;
- (c) The adoption of reliable and efficient methods of carrying out and exploiting hydrographic surveys;
- (d) The development of the sciences in the field of hydrography and the techniques employed in descriptive oceanography.

International Maritime Organization (IMO)

The specialized agency of the United Nations responsible for measures to improve the safety of international shipping and to prevent marine pollution from ships.

isolated node

An isolated zero-dimensional spatial object that represents the geometric location of a point feature. An isolated node is never used as a beginning or end *node*.

line

The one-dimensional geometric primitive of an object that specifies location.

meta object

A feature object which contains information about other *objects*. For example compilation scale or vertical datum.

navigational purpose

The specific purpose for which a cell has been compiled. There are six such purposes, namely berthing, harbour, approach, coastal, general and overview.

**node**

A zero-dimensional spatial object, located by a coordinate pair. A node is either isolated or connected.

Notice to Mariners (NtM)

A periodical notice issued by maritime administrations, or other competent authorities, regarding changes in aids to navigation, dangers to navigation, important new soundings, and, in general, all such information as affects nautical charts, sailing directions, light lists and other nautical publications.

object

An identifiable set of information. An object may have *attributes* and may be related to other objects. Also see spatial object and feature object.

Object Catalogue

The Object Catalogue is the feature schema for S-57. Its primary function is to provide a description of real world entities. It contains a list of feature object classes (each relating to a real world entity), attributes and allowable attribute values.

object class

A generic description of objects which have the same characteristics.

Examples of object classes in S-57 are "buoy, cardinal" and "caution area".

own ship's safety contour

The contour related to the own ship selected by the mariner from the contours provided for in the SENC, to be used by ECDIS to distinguish on the display between the safe and the unsafe water, and for generating anti-grounding alarms.

Performance Standards for ECDIS

Minimum performance requirements for ECDIS, adopted by IMO 5 December 2006 as MSC resolution and published as Annex to IMO Resolution MSC.232(82).

planar graph

A 2-dimensional data structure in which the geometry is described in terms of *nodes* and edges which are topologically linked. A special case of a chain-node data structure in which edges must not cross. Connected nodes are formed at all points where edges meet.

point

The 0-dimensional geometric primitive of an object that specifies location.

polygon

A non-self intersecting, closed chain defining the boundary of an *area*.

product specification

A defined subset of the entire specification combined with rules, tailored to the intended usage of the transfer data. See ENC product specification.



Presentation Library

A set of mostly digital specifications, composed of symbol libraries, colour schemes, look-up tables and rules, linking every object class and attribute of the SENC to the appropriate presentation of the ECDIS display. Published by IHO as Annex A to S-52.

raster

A regular array with information pertaining to each element (pixel) or group of elements.

Regional ENC Coordinating Centre (RENC)

An organizational entity where IHO Member States have established cooperation amongst each other to guarantee a world-wide consistent level of high quality data, and for bringing about coordinated services with official ENC's and updates to them

Regional Hydrographic Commission (RHC)

A body created under IHO Resolution T 1.3 composed of representatives from member states' hydrographic services within a defined geographic area (typically an INT charting area), meeting at regular intervals to discuss mutual hydrographic and chart production issues.

Re-issue

A re-issue of an ENC includes all the updates applied to the ENC up to the date of the reissue. A re-issue does not contain any new information additional to that previously issued by updates. The update sequence is not interrupted by a re-issue. After a re-issue, subsequent updates may be incorporated into the SENC created from this reissue or to the SENC created from the original ENC and kept continuously updated.

S-4

IHO Special Publication 4, titled "Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO".

S-8

IHO Special Publication 8, titled "FIG/IHO/ICA Standards of Competence for Nautical Cartographers".

S-52

IHO Special Publication 52, titled "Specifications for chart content and display aspects of ECDIS".

S-57

IHO Special Publication 57, titled "IHO Transfer Standard for Digital Hydrographic Data". S-57 is The international 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-58

IHO Special Publication S-58, titled "IHO Recommended ENC Validation Checks". S-58 specifies the checks that, as a minimum, producers of ENC validation tools should include in their validation software.

**S-62**

IHO Special Publication S-62, titled "ENC Producer Codes". S-62 provides a list of Agency Codes for all producers of ENCs, in particular Hydrographic Offices.

S-63

IHO Special Publication S-63, titled "IHO Data Protection Scheme". S-63 describes the IHO ENC security scheme and provides test data. It is intended for use by all those ECDIS manufacturers and data distributors participating in an ENC service with data encrypted.

S-66

IHO Special Publication S-66, titled "Facts about electronic charts and carriage requirements". S-66 provides a high level guide to the production, maintenance and distribution of Electronic Navigational Charts (ENCs).

S-100

IHO Special Publication S-100, titled "IHO Universal Hydrographic Data Model". S-100 is a new standard that will eventually supersede S-57. It complies with the ISO 19100 series of geographic standards and will support a greater variety of hydrographic-related digital data sources, products, and customers than S-57.

safety depth

The depth defined by the mariner, e.g. the ship's draft plus underkeel clearance, to be used by the ECDIS to emphasize soundings on the display equal to or less than this value.

SOLAS (Safety Of Life At Sea)

International Convention for the Safety of Life at Sea developed by IMO. The contracting governments undertake to promulgate all laws, decrees, orders and regulations and to take all other steps which may be necessary to give the present Convention full and complete effect, so as to ensure that, from the point of view of safety of life, a ship is fit for the service for which it is intended.

spaghetti data

A *data* structure in which all lines and points are unrelated to each other (i.e. no topological relationships exist in the data structure). This data structure is not permitted for ENC.

spatial object

An object which contains locational information about real world *entities*. For example, in S-57 the location of a buoy or the boundary of a caution area.

System Electronic Navigational Chart (SENC)

A data base 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 data base that is actually accessed by ECDIS for the display generation and other navigational functions, and is equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

**topology**

The set of properties of geometric forms (such as connectivity, neighbourhood) which is defined with the data model remaining invariant when subject to a continuous transformation.

The level of topology chosen for the ENC allows for colour fill, activation of area warnings, e.g. depth area warnings, cautionary areas. The different levels of topology are described in the S-57 Data Model.

Transfer Standard Maintenance and Application Development Working Group (TSMAD)

An HSSC working group that is responsible for the maintenance of digital data standards including S-57 and S-100 to satisfy new hydrographic requirements.

update

Either short for update information or, as a verb, applying the update mechanism. An ENC Update (official update) is a data set produced for changing an existing ENC in the ECDIS SENC (automatic updating). An ENC Update must conform to the ER application profile of S-57.

Use of the Object Catalogue

Annex A of S-57 Appendix B.1 describing how to encode information relevant to a specific navigational purpose. Must be used in conjunction with the ENC Product Specification.

Use of the Object Catalogue is maintained by means of new editions, published as required by the Transfer Standard Maintenance and Applications Development Working Group. The contents of a new edition do not invalidate the contents of the previous edition.

vector

Direct connection between two points, either given as two sets of coordinates (points), or by direction and distance from one given set of coordinates, or a point in a vector space defined by one set of coordinates relative to the origin of a coordinate system.

WEND (World-wide Electronic Navigational chart Database)

A common, worldwide network of ENC datasets based on IHO standards designed specifically to meet the needs of international maritime traffic using ECDIS which conform to the IHO Performance Standards for ECDIS.

World Geodetic System (WGS)

A global geodetic reference system developed by the USA for satellite position fixing and recommended by IHO for hydrographic and cartographic use.

World-Wide Navigational Warning System (WWNWS)

A service established for the purpose of coordinating the transmission of radio navigational warnings in geographical areas using coastal and satellite communication services.



ANNEX A

Commentaire : Suggest this Annex be removed from S-65 as all information is now included in UOC Edition 3.0.0, which is the encoding guide in S-57. See comments below for UOC references.

RECOMMENDATIONS FOR CONSISTENT ENC DATA ENCODING

Note: The final assignment of ENCs to navigational purposes and the values used for individual SCAMIN attribution should preferably be done in consultation with neighbouring HOs, with all nations within a RENC, or with all nations within a Regional Hydrographic Commission, as appropriate; in order to maintain consistency across national or regional boundaries.

Commentaire : Transferred in STAGE 2/ step1

- 1 The compilation scale¹ (CSCL sub-field of the DSPM field of the ENC header and the attribute CSCALE on the object M_CSCL) should be considered as the optimum display scale of an ENC and as such should be set based upon the standard radar range scales in the following table (see also 3 below):

Commentaire : UOC Ed 3.0 clause 2.2.6.

| Selectable Range | Standard radar scale (rounded) |
|------------------|--------------------------------|
| 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 |
| 0.75 NM | 1:12,000 |
| 0.5 NM | 1:8000 |
| 0.25 NM | 1:4000 |

Table 1 - Radar range / standard scale table

- 1.1 Normally, the nearest larger standard radar scale should be used, e.g. an ENC produced from a 1:25,000 paper chart should have a compilation scale of 22,000. However the selected scale may take into account the density of data when displayed at the chosen standard scale in addition to the quality and scale of the original source material.
- 1.2 Where the source material used to produce the ENC is of a scale larger than 1:4000 or smaller than 1:3,000,000 then the actual paper chart / source material scale may be used as the compilation scale for the ENC.

¹ CSCALE is defined in S-57 as *The scale at which the data was originally compiled*. This has proved to be misguided and supports too strong an association with the paper chart compilation scale. Paper charts are designed at a scale which enables a designated area to fit on a specific size of paper. Vector data should be scaled to optimize the viewing capabilities in a digital environment, usually a 21 inch monitor.



1.3 The use of too many M_CSCL objects within the same cell should be avoided. The values of any M_CSCL CSCALE attributes should be set using the same criteria as those used for setting 'compilation scale' described above.

2 SCAMIN should be used for all ENCs.

Commentaire : UOC Ed 3.0 clause 2.2.7.1.

2.1 SCAMIN values used should be selected from the following list:-

| |
|--------------|
| 1:19,999,999 |
| 1:9,999,999 |
| 1:4,999,999 |
| 1:2,999,999 |
| 1:1,499,999 |
| 1:699,999 |
| 1:499,999 |
| 1:349,999 |
| 1:259,999 |
| 1:179,999 |
| 1:119,999 |
| 1:89,999 |
| 1:59,999 |
| 1:44,999 |
| 1:29,999 |
| 1:21,999 |
| 1:17,999 |
| 1:11,999 |
| 1:7,999 |
| 1:3,999 |
| 1:1,999 |
| 1:999 |

Table 2 – SCAMIN values

2.2 SCAMIN values for features within an ENC should be set to either 1, 2, 3 or 4 steps smaller scale than the compilation scale of the ENC.

2.3 Appendix 1 lists the step values (i.e. 1, 2, 3 or 4) that should be applied for specific object classes together with any relevant conditions and additional flexibilities.

Following these three rules, offers an automated approach to setting SCAMIN which takes account of the relative importance of different object classes and will achieve sufficient de-cluttering even where there are large gaps in the scales of coverage available.

Unless the step values outlined in Appendix 1 have been manually adjusted, this approach takes no direct account of the relative importance of individual occurrences of an object, and may still result in the unsettling situation where an object disappears and then reappears as the user zooms out. To address these remaining issues, the following additional rules may be applied:-



- 2.4 Linear and area objects (excluding those objects subject to extensive generalisation e.g. DEPCNT) that extend beyond the coverage of a cell and exist in a smaller navigational purpose cell must be assigned a SCAMIN value based on the compilation scale of the smaller scale cell.
- 2.5 The SCAMIN value of an individual occurrence of an object should be set to either 1, 2, 3 or 4 steps smaller scale than the compilation scale of the smallest scale ENC that the object would appear on.
- 3 Inconsistent depiction of the same localities in different navigational purposes should be avoided. For example, outlines of rivers, ports etc. in smaller scale cells should be shown but may be in a simplified outline form.
- 4 In addition to setting the compilation scale and encoding SCAMIN, there should be close liaison between neighbouring HOs when creating ENCs in their border areas, in order to resolve any issues of inconsistent depiction and to avoid gaps and overlaps in data coverage (consult the WEND Principles in IHO TR K 2.19). In particular, the following issues should be investigated and resolved:
- common data limits
 - COMF value used (*see 9 below*)
 - overlaps / gaps - buffer zone (*see 10 and 11 below*)
 - content / data alignment
 - depth contour intervals (*see 6 below*)
 - truncated limits and boundaries (areas that cross the cell boundaries)
- 5 Misalignment and inconsistent depiction of data at cell, source and international boundaries should be investigated and rectified.
- 6 HOs should, as a minimum, use standardised depth contour intervals (refer S-4, B-411). Additional depth contours may be added, where required.
- 7 HOs should not leave holes in smaller scale coverage, assuming that the user will have larger scale data available.
- 8 Wherever possible, meaningful and useful values of CATZOC should be used, i.e. values other than CATZOC 6 (data not assessed) for areas of bathymetry (refer S-57 Appendix B.1 – Annex A, clause 2.2.3.1). For areas of unstable seafloors, the M_QUAL attribute SUREND may be used to indicate the date of the survey of the underlying bathymetric data.
- 9 Coordinates should be held in ENC production systems at a resolution of 0.0000001 (10^{-7}) and the COMF value should be set to 10000000 (10^7) for all cells.
- 10 There must be no gaps in data between adjoining cells of the same navigational purpose.
- 11 There must be no overlapping data between cells of the same navigational purpose (see S-57, Appendix B.1 clause 2.2), except at the agreed adjoining national data limits, where, if it is difficult to achieve a perfect join, a 5 metre overlapping buffer zone may be used.

Commentaire : UOC Ed 3.0
clause 2.1.8

Commentaire : UOC Ed 3.0
clause 2.1.8

Commentaire : UOC Ed 3.0
clause 5.2

Commentaire : UOC Ed 3.0
clause 2.8.1

Commentaire : UOC Ed 3.0
clause 2.2.3.1

Commentaire : UOC Ed 3.0
clause 2.1.7

Commentaire : UOC Ed 3.0
clause 2.1.8

Commentaire : UOC Ed 3.0
clause 2.1.8



APPENDIX 1

Commentaire : Suggest this Appendix be removed from S-65 as all information is now included in UOC Edition 3.0, which is the encoding guide in S-57, at clause 2.2.7.1. EUWG chair agrees.

SPECIFIC SCAMIN STEP VALUES FOR OBJECT AND ATTRIBUTE COMBINATIONS

Preliminary Note: This appendix presents a standardised approach to SCAMIN step values for object and attribute combinations. It is acknowledged that more detailed recommendations than those contained in this appendix may be agreed for use in some charting regions.

The final column **SCAMIN STEPS** indicates the number of steps above (smaller scale) the compilation scale that SCAMIN values should be set to.

Notes

1. Producers should be prepared to deviate from the step values specified when the significance of the feature dictates, e.g. the recommended number of steps for a LIGHTS object is 4, but there will be circumstances where a LIGHTS object is so important that no SCAMIN value be applied; alternatively, the light could be so minor that a step value of 1 can be applied.
2. SCAMIN should only be applied to navigational aids where they contribute to "screen clutter" and where their removal from the display does not constitute a risk to safe navigation.
3. It is generally accepted that objects making up a NAVAID will have the same attributes, and therefore those with Master/Slave relationships should be assigned the same SCAMIN value.

| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|--------|-----------------|-------------------------------------|---------------------------|
| ACHARE | Point/ Area | | 2 |
| ACHARE | Point/Area | If RESTRN defined | 3 |
| ACHBRT | Point/Area | | 1 |
| ADMARE | Area | | 3 |
| AIRARE | Point/Area | If CONVIS = 1(visually conspicuous) | 3 |
| AIRARE | Point/Area | | 1 |
| ARCSLN | Line/Area | | 4 |
| BCNCAR | Point | | 3 (see Notes 2 & 3 above) |
| BCNISD | Point | | 4 (see Notes 2 & 3 above) |
| BCNLAT | Point | | 3 (see Notes 2 & 3 above) |
| BCNSAW | Point | | 3 (see Notes 2 & 3 above) |
| BCNSPP | Point | | 3 (see Notes 2 & 3 above) |
| BERTHS | Point/Line/Area | | 1 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------------|
| BOYCAR | Point | | 3 (see Notes 2 & 3 above) |
| BOYINB | Point | | 3 (see Notes 2 & 3 above) |
| BOYISD | Point | | 4 (see Notes 2 & 3 above) |
| BOYLAT | Point | | 3 (see Notes 2 & 3 above) |
| BOYSAW | Point | | 3 (see Notes 2 & 3 above) |
| BOYSPP | Point | | 3 (see Notes 2 & 3 above) |
| BRIDGE | Point/Line/Area | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| BUAARE | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| BRIDGE | Point/Line/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) and covered by an area LNDARE | 3 |
| BRIDGE | Point/Line/Area | Covered by an area LNDARE | 1 |
| BUAARE | Point/Area | | 1 |
| BUISGL | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33 | 3 |
| BUISGL | Point/Area | | 1 |
| C_AGGR | N/A | | NOT SET |
| C_ASSO | N/A | | NOT SET |
| CANALS | Line | | 1 |
| CANALS | Area | | 4 |
| CAUSWY | Line/Area | | 2 |
| CBLARE | Area | If RESTRN defined | 3 |
| CBLARE | Area | | 2 |
| CBLOHD | Line | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| CBLOHD | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| CBLOHD | Line | | 1 |
| CBLSUB | Line | | 3 |
| CGUSTA | Point | | 1 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------|
| CHKPNT | Point/Area | | 1 |
| COALNE | Line | | NOT SET |
| CONVYR | Line/Area | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| CONVYR | Line/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| CONVYR | Line/Area | | 1 |
| CONZNE | Area | | 3 |
| COSARE | Area | | 3 |
| CRANES | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| CRANES | Point/Area | | 1 |
| CTNARE | Point/Area | | 4 |
| CTRPNT | Point | | 1 |
| CTSARE | Point/Area | | 1 |
| CURENT | Point | | 3 |
| CUSZNE | Area | | 2 |
| DAMCON | Point/Line/Area | | 1 |
| DAMCON | Line/Area | If sharing geometry with area LNDARE & (DEPARE or DRGARE) objects | NOT SET |
| DAMCON | Line/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| DAYMAR | Point | If Slave SCAMIN must match that of Master | 3 |
| DEPARE | Area | | NOT SET |
| DEPCNT | Line | If VALDCO = 0 (drying line) or 30 (default safety contour ref S-52) | 4 |
| DEPCNT | Line | | 2 |
| DISMAR | Point | | 2 |
| DMPGRD | Point/Area | If RESTRN defined | 3 |
| DMPGRD | Point/Area | | 2 |
| DOCARE | Area | | 1 |
| DRGARE | Area | | NOT SET |
| DRYDOC | Area | | 1 |
| DWRTCL | Line | | NOT SET |
| DWRTPT | Area | | NOT SET |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------|
| DYKCON | Line/Area | If sharing geometry with area LNDARE & (DEPARE or DRGARE) objects | NOT SET |
| DYKCON | Line | | 1 |
| EXEZNE | Area | | 3 |
| FAIRWY | Area | | 3 |
| FERYRT | Line/Area | | 3 |
| FLODOC | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| FLODOC | Area | | NOT SET |
| FNCLNE | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| FNCLNE | Line | | 1 |
| FOGSIG | Point | If Slave SCAMIN must match that of Master | 3 |
| FORSTC | Point/Line/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| FORSTC | Point/Line/Area | | 1 |
| FRPARE | Area | | 2 |
| FSHFAC | Point/Line/Area | | 2 |
| FSHGRD | Area | | 1 |
| FSHZNE | Area | | 3 |
| GATCON | Point/Line/Area | | 2 |
| GATCON | Line/Area | If sharing geometry with area LNDARE & (DEPARE or DRGARE) objects | NOT SET |
| GRIDRN | Point/Area | | 1 |
| HRBARE | Area | | 3 |
| HRBFAC | Point/Area | | 1 |
| HULKES | Point | | 1 |
| HULKES | Point | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| HULKES | Area | | NOT SET |
| ICEARE | Area | | 3 |
| ICNARE | Point/Area | | 1 |
| ICNARE | Point/Area | If RESTRN defined | 3 |
| ISTZNE | Area | | NOT SET |
| LAKARE | Area | | 1 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------------|
| LIGHTS | Point | If Slave SCAMIN must match that of Master | 4 (see Notes 2 & 3 above) |
| LITFLT | Point | | 4 (see Notes 2 & 3 above) |
| LITVES | Point | | 4 (see Notes 2 & 3 above) |
| LNDARE | Point/Line/Area | | NOT SET |
| LNDELV | Point | If CONVIS = 1 (visually conspicuous) | 3 |
| LNDELV | Point/Line | | 1 |
| LNDMRK | Point/Line/Area | If CONVIS = 1 (visually conspicuous) or CONRAD = 1 (radar conspicuous) or FUNCTN = 33 | 3 |
| LNDMRK | Point/Line/Area | | 1 |
| LNDRGN | Point/Area | | 1 |
| LOCMAG | Point/Line/Area | | 3 |
| LOGPON | Point/Area | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| LOGPON | Point/Area | | 1 |
| LOKBSN | Area | | 1 |
| M_ACCY | Area | | NOT SET |
| M_COVR | Area | | NOT SET |
| M_CSCL | Area | | NOT SET |
| M_HOPA | Area | | NOT SET |
| M_NPUB | Area | | NOT SET |
| M_NSYS | Area | | NOT SET |
| M_QUAL | Area | | NOT SET |
| M_SDAT | Area | | NOT SET |
| M_SREL | Area | | NOT SET |
| M_VDAT | Area | | NOT SET |
| MAGVAR | Point/Line/Area | | 1 |
| MARCUL | Point/Line/Area | If EXPSOU = 2 (shoaler than range of the surrounding depth area) & VALSOU ≤ 30m | 4 |
| MARCUL | Point/Line/Area | If RESTRN defined | 3 |
| MARCUL | Point/Line/Area | | 1 |
| MIPARE | Point/Area | | 3 |
| MORFAC | Point/Line/Area | If CONVIS = 1 (visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|---------------------|---|---------------------|
| MORFAC | Point/Line/Area | | 2 |
| NAVLNE | Line | | 3 |
| NEWOBJ | Point/line/Area | | 4 |
| OBSTRN | Point/Line/Area | | NOT SET |
| OBSTRN | Point/ Line/Area | If VALSOU > 30m and EXPSOU <> 2 | 4 |
| OFSPLF | Point | Not covered by an area OSPARE | 4 |
| OFSPLF | Point/Area | | 3 |
| OFSPLF | Area | | 4 |
| OILBAR | Line | | 4 |
| OSPARE | Area | | 4 |
| PILBOP | Point/Area | | 3 |
| PILPNT | Point | Where used to mark position of LIGHTS object in water | 4 |
| PILPNT | Point | If CONVIS = 1(visually conspicuous) | 3 |
| PILPNT | Point | | 2 |
| PIPARE | Point/Area | | 3 |
| PIPOHD | Line | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| PIPOHD | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| PIPOHD | Line | | 1 |
| PIPSOL | Point/Line | Covered by an area DEPARE, DRGARE, or UNSARE object | 3 |
| PIPSOL | Point | Covered by an area LNDARE object | 1 |
| PONTON | Line | | 2 |
| PONTON | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| PONTON | Area | | NOT SET |
| PRCARE | Point/Area | | 3 |
| PRCARE | Point/Area | Sharing geometry with either DWRTCL, DWRTPT, ISTZNE, TSELNE, TSEZNE, TSSCRS, TSSLPT or TSSRON objects | NOT SET |
| PRDARE | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| PRDARE | Point/Area | | 1 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------|
| PYLONS | Point/Area | Covered by an area DEPARE, DRGARE, or UNSARE object | NOT SET |
| PYLONS | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| PYLONS | Point/Area | | 1 |
| RADLNE | Line | | 3 |
| RADRFL | Point | If Slave SCAMIN must match that of Master | 3 |
| RADRNG | Area | | 3 |
| RADSTA | Point | If Slave SCAMIN must match that of Master | 2 |
| RAILWY | Line | | 1 |
| RAPIDS | Point/Line/Area | | 1 |
| RCRTCL | Line | | 3 |
| RCTLPT | Point/Area | | 3 |
| RDOCAL | Point/Line | | 3 |
| RDOSTA | Point | If Slave SCAMIN must match that of Master | 1 |
| RECTRC | Line/Area | | 3 |
| RESARE | Area | | 3 |
| RETRFL | Point | If Slave SCAMIN must match that of Master | 3 |
| RIVERS | Line | | 1 |
| RIVERS | Area | | 4 |
| ROADWY | Point/Line/Area | | 1 |
| RSCSTA | Point | | 3 |
| RTPBCN | Point | If Slave SCAMIN must match that of Master | 3 |
| RUNWAY | Point/Line/Area | If CONVIS = 1(visually conspicuous) | 3 |
| RUNWAY | Point/Line/Area | | 1 |
| SBDARE | Point/Line/Area | | 1 |
| SEAARE | Point/Area | | 1 |
| SILTNK | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1(radar conspicuous) | 3 |
| SILTNK | Point/Area | | 1 |
| SISTAT | Point | If Slave SCAMIN must match that of Master | 1 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|---------------|------------------|---|---------------------|
| SISTAW | Point | If Slave SCAMIN must match that of Master | 1 |
| SLCONS | Point/Line/Area | | NOT SET |
| SLOGRD | Point/Area | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| SLOGRD | Point/Area | | 1 |
| SLOTOP | Line | If CONVIS = 1(visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |
| SLOTOP | Line | | 1 |
| SMCFAC | Point/Area | | 1 |
| SNDWAV | Point/Line/Area | | 3 |
| SOUNDG | Point | | 1 |
| SPLARE | Point/Area | If RESTRN defined | 3 |
| SPLARE | Point/Area | | 1 |
| SPRING | Point | | 1 |
| STSLNE | Line | | 3 |
| SUBTLN | Area | | 3 |
| SWPARE | Area | | 3 |
| T_HMON | Point/Area | | 1 |
| T_NHMN | Point/Area | | 1 |
| T_TIMS | Point/Area | | 1 |
| TESARE | Area | | 3 |
| TIDEWY | Line/Area | | 1 |
| TOPMAR | Point | If Slave SCAMIN must match that of Master | 3 |
| TS_FEB | Point/Area | | 3 |
| TS_PAD | Point/Area | | 2 |
| TS_PNH | Point/Area | | 2 |
| TS_PRH | Point/Area | | 2 |
| TSELNE | Line/Area | | NOT SET |
| TSEZNE | AREA | | NOT SET |
| TSSBND | Line | | NOT SET |
| TSSCRS | Area | | NOT SET |
| TSSLPT | Area | | NOT SET |
| TSSRON | Area | | NOT SET |
| TS-TIS | Point/Area | | 2 |



| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|--------|-----------------|---|--------------|
| TUNNEL | Line/Area | Covered by an area DEPARE, DRGARE, or UNSARE object | 4 |
| TUNNEL | Line/Area | Covered by a LNDARE object | 1 |
| TWRTPT | Area | | NOT SET |
| UNSARE | Area | | NOT SET |
| UWTROC | Point | | NOT SET |
| UWTROC | Point | If VALSOU > 30m and EXPSOU <> 2 | 4 |
| UWTROC | Point | Covered by an area OBSTRN object | 2 |
| VEGATN | Point/Line/Area | If CONVIS = 1(visually conspicuous) | 3 |
| VEGATN | Point/Line/Area | | 1 |
| WATFAL | Point/Line | If CONVIS = 1(visually conspicuous) | 3 |
| WATFAL | Point/Line | | 1 |
| WATTUR | Point/Line/Area | | 3 |
| WEDKLP | Point/Area | | 3 |
| WRECKS | Point/Area | | NOT SET |
| WRECKS | Point/Area | If CATWRK = 1 or (VALSOU > 30m and EXPSOU <> 2) | 3 |
| WRECKS | Point/Area | CONVIS = 1 (visually conspicuous) or CONRAD = 1 (radar conspicuous) | 3 |

Commentaire : This value is missing. From JP comment.

Optional additional rules that can be manually applied to fine tune the application of SCAMIN after the above values have been automatically applied.

| OBJECT | PRIMITIVE | CONDITION | SCAMIN STEPS |
|--------|-----------|--|--------------|
| OBSTRN | Point | The most significant OBSTRN of a group of OBSTRNs within close proximity | NOT SET |
| OBSTRN | Point | For groups of OBSTRNs in close proximity, or within an OBSTRN area | 2 |
| SOUNDG | Point | SCAMIN should be applied so that the least significant soundings are set to 1 step progressing to 4 steps for the most significant, above the compilation scale in order to achieve a gradual reduction in the sounding displayed as the user zooms out. | 1, 2, 3, 4 |
| UWTROC | Point | The most significant UWTROC of a group of UWTROCs within close proximity and not within an OBSTRN area | NOT SET |



| WRECKS | Point/Area | For groups of WRECKSs in close proximity (the most significant should not have SCAMIN) | 2 |
|--------|------------|--|---|
|--------|------------|--|---|



ANNEX B

Commentaire : Suggest this Appendix be removed from S-65 as all information is now included in UOC Edition 3.0, which is the encoding guide in S-57, at clause 2.6.2. EUWG chair agrees

GUIDELINES for ENCODING TEMPORARY and PRELIMINARY ENC UPDATES

INTRODUCTION

At its 20th meeting held in Brazil in November 2008, the Committee on Hydrographic Requirements for Information Systems (CHRIS) – replaced by the Hydrographic Services and Standards Committee (HSSC) in January 2009, drew attention to inconsistencies in the promulgation and distribution of Temporary (T) and Preliminary (P) Notices to Mariners (NMs) intended for use in ECDIS. It was identified that:

- about half of all ENC Producer States promulgate the equivalent of paper chart (T) and/or (P) NMs via ENC updates, whereas the other half invite mariners to refer to Notices to Mariners booklets or websites;
- not all paper chart (T) and (P) NMs which relate also to ENCs are in English;
- translation of (T) and (P) NMs intended for paper charts into ENC updates is sometimes difficult and may introduce an additional time delay for the distribution of navigationally significant information;
- it is very difficult for ENC users to comprehend the (T) and (P) NM network and get rapid and seamless information from one region to the other.

The CHRIS agreed that the situation has implications for safety of navigation and consistency between ENC services and therefore requires urgent study and resolution. As a result, the CHRIS decided to form a Working Group (ENC Updating Working Group - EUWG) tasked with developing contemporary guidance on standardised processes for the delivery and implementation of updates to ENCs. More specifically the EUWG was asked to develop and propose a pragmatic approach to overcome any current shortcomings in the updating mechanisms for (T) and (P) NMs in ENCs.

The following guidance is the result of the work of the EUWG. It was developed through an iterative process of correspondence with all the members of the WG. It provides high level guidance for the promulgation of the equivalent of paper chart (T) and/or (P) NMs via ENC updates (ER application profile). Through a set of recommendations, it provides keys to compile the appropriate ENC updates. The guidance conforms with the current IHO standard (S-57 Edition 3.1). It allows for some latitude in its application and is dependant on the assessment of each particular case, and as such relies ultimately on the judgement of each ENC producer.



PART A - Temporary Notices to Mariners

GENERAL

1. Temporary Notices to Mariners, (T) NMs, for paper charts are defined in S-4, Section B-600, in particular § B-633. A (T) NM promulgates navigationally significant information that will remain valid only for a limited period of time.

For the paper chart, the convention is for the mariner to insert the update on the chart in pencil, and erase it when the (T) NM is cancelled.

S-57 provides mechanisms which allow ENC(s) to be automatically updated (ER application profile¹). This allows the affected ENC(s) to be continually updated in a timely manner for the duration of the NM without additional workload for the mariner.

Hydrographic Offices (HOs) should promulgate temporary navigationally significant information by ENC update to provide the ECDIS user with an updated SENC. This service corresponds to the service that (T) NMs offer to the paper chart user.

2. ER encoding for an ENC and (T) NM for the paper chart are two completely different communication processes for promulgating information to the mariner. Since these processes are different (but not supposed to be independent), and the products to which they apply are also different, it is recommended that ENC updates be derived from the source information rather than the paper chart (T) NM. Often the (T) NM for paper chart does not provide enough detail to perform the relevant ENC update.
3. If possible the information should be encoded with the relevant S-57 objects. However, HOs should consider the following:
 - An ENC update must not be initiated if the information will no longer be valid by the time it is received by the mariner; this will depend upon the timescales relating to the producer nation's ENC updating regime. Shorter time periods may be covered by Radio Navigational Warnings (RNW). If known, the ENC update should include an indication of how long the temporary change will remain in force.
 - If it is unlikely that the HO will be notified when a temporary change will revert to its original charted state, the HO should consider an alternative method such as a general note or by issuing an ENC update explaining, for example, that the aids to navigation within an area are reported to be unreliable.

It is important that HOs should consider constraints of time when identifying the encoding method. Time consuming and unnecessarily complex methods of encoding should be avoided.

4. The overuse of CTNARE objects (especially CTNARE of type area) for temporary information should be avoided. The CTNARE object is used when it is relevant for the situation and/or when a particular change needs a special warning. CTNARE² may be used when the relevant objects cannot be encoded, e.g. information cannot be displayed clearly or cannot be easily promulgated due to time constraints.

¹ The ER application profile only applies to ENC update cell files. S-57 Appendix B.1 - ENC Product Specifications refers

² An implementation of "New Object" may be approved in the future (see S-57 supplement no. 2 – June 2009). The use of such objects may be more appropriate than the use of CTNARE in this or in other cases.



5. To correctly encode an ENC update the source information is essential in determining which elements of the update are reliable, which are permanent and which are temporary. The STATUS attribute value 7 (temporary) should only be used in an update when it is certain that the status of an object is confirmed as temporary.

6. Use of DATSTA – DATEND:

The earliest date on which an object will be present (DATSTA) and the latest date on which an object will be present (DATEND) must only be encoded when known. When these dates are encoded for navigational aids, DATSTA and DATEND must be populated on each component of the aid (for FOGSIG, RETRFL and TOPMAR, refer to S-57 Edition 3.1 Supplement No. 2 - June 2009).

The ENC update should be issued as close as possible to the earliest date of the change (DATSTA), unless it is appropriate to provide the information well in advance. An object no longer present should be removed by issuing a further update as soon as possible after the return to the original charted state (DATEND). The timing of the issue of these updates will depend upon the producer nation's ENC Updating regime and its corresponding timescales.

When an ENC update promulgates information well in advance and uses DATSTA and DATEND, a CTNARE object may be used in order to inform mariners that temporal information exists at some future point in time.

NOTE: some older legacy ECDIS's may not have the functionality to manage temporal information correctly or may have implemented it incorrectly. Some ENC producers may wish to include additional encoding to safeguard against this. For example, insert a CTNARE describing the changes and timings.

7. The INFORM attribute should be used to provide supplementary or contextual information when encoding temporary (or preliminary) information. When the text is too long to be encoded with INFORM (the INFORM/NINFOM text should not be over 300 characters - see S-57 MAINTENANCE DOCUMENT, clarification 8.Cl.1), the attribute TXTDSC should be used. Encoders using INFORM/TXTDSC to provide positional information must express the coordinate values in WGS 84 and in accordance with S-4 §B-131. If it is deemed necessary a picture file (PICREP) may be added. If the relevant object class (e.g. CTNARE) does not have PICREP as an allowable attribute then this may be attributed against a M_NPUB object which shares the same geometry as the relevant object.
8. ENC updates issued for temporary information should be carefully managed and reviewed regularly to consider whether further action is necessary. New information may have been received that necessitates the issuing of a new update to modify or cancel the previous one. HOs should make it easy to recover the original charted state before the temporary changes came into effect.
9. Further verification is recommended to make sure that the encoded ENC update is consistent with the corresponding paper chart NM.



GUIDELINES FOR TYPICAL CASES

- a. Individual new physical objects (e.g. wreck, buoy) with no associated explicit or implicit area associated (e.g. restricted area):

Encode the relevant S-57 object.

In this instance a CTNARE would not normally be used.

- b. Individual new physical objects with an associated explicit area around it:

Encode the relevant S-57 area object (e.g. RESARE). The relevant object is created for the new physical object. However, when the area is an "entry prohibited area" or a CTNARE the new physical object may be omitted to simplify encoding unless it is navigationally significant.

- c. Individual new physical object with a notification of caution, e.g. "Mariners are advised to navigate with caution...":

Encode the relevant S-57 object. Additional clarification and advice may, if required, be provided in INFORM or TXTDSC. Exceptionally, a CTNARE may be created to highlight the caution if considered necessary.

- d. Obstructions (including wrecks) reported to exist within an area:

Encode an OBSTRN area or WRECKS area.

- e. New simple area object (military practice area, dredged area):

Encode the relevant S-57 area object.

Supplementary information is provided in INFORM or TXTDSC.

Normally, a CTNARE is not added.

- f. Complex information within an area (e.g. works in progress where the changes are numerous or involve complex changes to the topology):

Encode the area object. It should be encoded with the relevant S-57 object or, if more suitable or by default, a CTNARE. Supplementary or contextual information is provided in INFORM or TXTDSC. When the available information is sufficiently detailed, navigationally significant objects (e.g. navigational aids, obstructions) are created or modified within the area. When the available information does not permit this, a CTNARE defining the area is preferred.

- g. Changes to an existing object (e.g. navigational aid):

In these instances it is usually only necessary to change the attributes values. A CTNARE may be used to warn the mariner if it is considered necessary.

- h. Buoy temporarily moved:

When a buoy is temporarily moved, then it, and any associated objects, are "moved" to the new position and the STATUS attribute value 7 (temporary) is used. Alternative encodings are possible, for example, if the move is for a fixed period of time. In these cases the object, and any associated components, can be created in the temporary position with DATEND attributed to it and populated with the date corresponding to



the end of the fixed period of time. The currently charted object, and any associated components, can be attributed with DATSTA populated also with the date corresponding to the end of the fixed period of time. A Cautionary Area may, if considered necessary, be added. Data producers may wish to consider the NOTE in section 6 under the "General" heading above.

i. Light temporarily extinguished:

The STATUS attribute of the LIGHTS object is encoded with the values 11 (extinguished) and 7 (temporary).

j. Change to a maintained depth in a dredged area:

When information is received from an official or recognised survey authority relating to a dredged area where the dredged depth has changed, the attribute value of DRVAL1 for the DRGARE object should be changed to the value provided by the survey.

When a depth within a dredged area is reported shoaler than the stated maintained depth, then a CTNARE is created covering the shoaler depth area concerned. The depth information is provided in the CTNARE attribute INFORM. Additionally a **SOUNDG** object with attribute EXPSOU = 2 (shoaler than the range of depth of the surrounding depth area) may be created (but see clause 5.3 Note). The value of the shoaler depth may also be populated using the attribute DRVAL1 for the **DRGARE**, with the original dredged depth populated using the attribute DRVAL2. See also S-4. B-414.5.



Part B - Preliminary Notices to Mariners

GENERAL

1. Preliminary Notices to Mariners, (P) NMs, for paper chart are defined in S-4, Section B-600, in particular § B-634. A (P) NM promulgates navigationally significant information early to the mariner e.g. when a paper chart new edition cannot be issued in due time.

For the paper chart, the convention is for the mariner to insert the update on the chart in pencil, and erase it when the (P) NM is cancelled.

S-57 provides mechanisms which allow ENC(s) to be automatically updated (ER application profile). This allows the affected ENC(s) to be continually updated in a timely manner for the duration of the NM without additional workload for the mariner.

HOs should promulgate preliminary navigationally significant information by ENC update to provide the ECDIS user with an updated SENC. This method of delivery corresponds to the service that (P) NMs offer to the paper chart user.

2. ER encoding for ENC and (P) NM for paper chart are two completely different communication processes for promulgating information to the mariner.

For example, there are instances when the paper chart needs updating using a NM block (also known as a chartlet or patch) or by issuing a new edition due to the complexity or volume of changes. This could clutter the paper chart unacceptably if amended by hand and/or overburden the chart corrector. The lead time for a NM block correction or a new edition can be lengthy, sometimes several months. In these cases a (P) NM may be issued as an interim measure. The ENC updating mechanisms are more flexible and may allow for ENC updates to be issued in quicker time. However, experience has shown that large updates can cause the ECDIS processing issues and in particular inordinately long loading times. Producing an ENC new edition may be the better option in some cases.

There may be other instances, when new information is received, where it is not possible to fully update both the ENC and paper chart promptly. For example, not all the information required to produce a chart-updating NM is received by the HO in the first notification (for instance notification of works in progress or projected) or extensive new information requires significant compilation work. In these cases it is still necessary to provide notification of navigationally significant changes to the mariner in a timely manner.

Since the paper chart and ENC processes are different (but not supposed to be independent), and also the products to which they apply are different, it is recommended that ENC updates be derived from the source information rather than from the paper chart (P) NM. It is often the case that the paper chart (P) NM does not provide enough detail to encode the ENC update exactly as it should be.

3. Simple or more complex encoding methods are possible but it is important that HOs should consider carefully which encoding method is appropriate when creating an ENC update with due consideration for time.
4. Often, information received is too complex, extensive and/or imprecise to be encoded with the relevant S-57 objects. In these instances the use of the CTNARE object and its attribute INFORM is preferred to give a précis of the overall changes together with detailed navigationally significant information. For complex or extensive changes the



CTNARE should have an associated TXTDSC file containing precise details of the preliminary information. See also Part A, § 7 above. If the information is less precise then the INFORM attribute should be used to inform users of this fact.

It is noted that the mariner, if it is considered necessary, has the facility in the ECDIS to add "Mariner Objects" and annotate them. These can be saved in the SENC based on information provided in textual form by the TXTDSC or INFORM attributes. It is envisaged that these objects would be created at the "Route Planning" stage and act as a prompt during the "Route Monitoring" phase.

When information is issued as advance notification for an ENC it is necessary to provide as soon as possible to the mariner the final and full charted information encoded with the relevant S-57 objects. An ENC update or a new edition of the ENC cell should therefore be issued at a later date when the HO can carry out full encoding of the changes. The period of time will depend on the following:

- the time needed by the HO to undertake the full encoding with relevant objects;
 - the time needed to obtain confirmation of details; and
 - the date at which the real world situation is stabilized and any forecast changes have been completed.
5. Source Information received may contain some navigationally significant elements that are simple to encode with the relevant objects in a timely manner. In these instances these elements may be encoded with the relevant objects provided that they reflect the 'real world' situation after the ENC update is made available to the user. However, if the changes are subject to continual change these objects should be amended as a consequence and will represent additional work for the HO. In such cases, the ENC update should also warn users that the situation is subject to change. For temporary information, see part A.
 6. Use of DATSTA – DATEND: see part A, § 6. For new or amended routeing measures, see ENC Encoding Bulletin number 25.
 7. Use of INFORM: see part A, § 7.
 8. Diagrams are sometimes very useful to the mariner, e.g. for indicating changes to complex routeing measures or the introduction of new ones. A picture file may be referenced using the attribute PICREP in such cases. As the CTNARE object does not allow PICREP attribution, the picture file may be referenced by a M_NPUB object which shares the same geometry as the CTNARE.
 9. ENC updates issued for Preliminary information should be managed and reviewed regularly. For example further source information may have been acquired requiring a further ENC update. This may add, modify or cancel information previously promulgated.
 10. Further verification is recommended to make sure that the encoded ENC update is consistent with the corresponding paper notice.



GUIDELINES FOR TYPICAL CASES

a. Traffic separation schemes:

Encoding bulletin E25 – April 2009 and following versions should be applied. For the use of the attributes DATSTA and DATEND, see also, part A, § 6.

b. Complex information within an area of change (e.g. works in progress):

A CTNARE object is created to cover the area. Information is provided in either INFORM, e.g. under construction, or TXTDSC when it is necessary to give more detailed information. If sufficiently detailed information is available, then navigationally significant information such as navigational aids, fairways, regulated areas, etc. can be created or modified within the CTNARE if time permits.

As the CTNARE object does not allow PICREP attribution, the picture file may be referenced by a M_NPUB object which shares the same geometry as the CTNARE.

Alternatively and if considered appropriate a RESARE – “entry prohibited area” object can be used instead the CTNARE object.

c. Simple information which does not need an additional notification of caution:

The relevant object(s) and the appropriate attributes are encoded with any additional contextual information provided in INFORM or TXTDSC. In this case it is not necessary to use a CTNARE object. This could apply, for example, to submarine cables or pipelines being laid (CBLSUB, PIPSOL) or area under reclamation (LNDARE with CONDTN = 3 “under reclamation”). If necessary the encoding should reflect, if appropriate, that positions are approximate.

d. Depths less than those charted within a defined area:

If the depth values and their positions are known, SOUNDG objects may be created or modified. Any affected depth contours and depth areas should also be amended as necessary. The source of the information should be encoded using the attribute SORIND. However, HOs should carefully consider the time needed to update ENC depth information and the complexity of changes to the topology that may be required. The encoding of amended SOUNDG, DEPARE and associated objects could be inappropriate for promulgating this navigationally significant information within acceptable time scales. In this case a CNTARE is the preferred option. In such cases, only the most significant amendments to depth information should be provided in the attribute INFORM or TXTDSC. This method should also be used if the depth values and/or the exact positions are unknown, or if the HO only has information relating to a limited number of depth values.

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