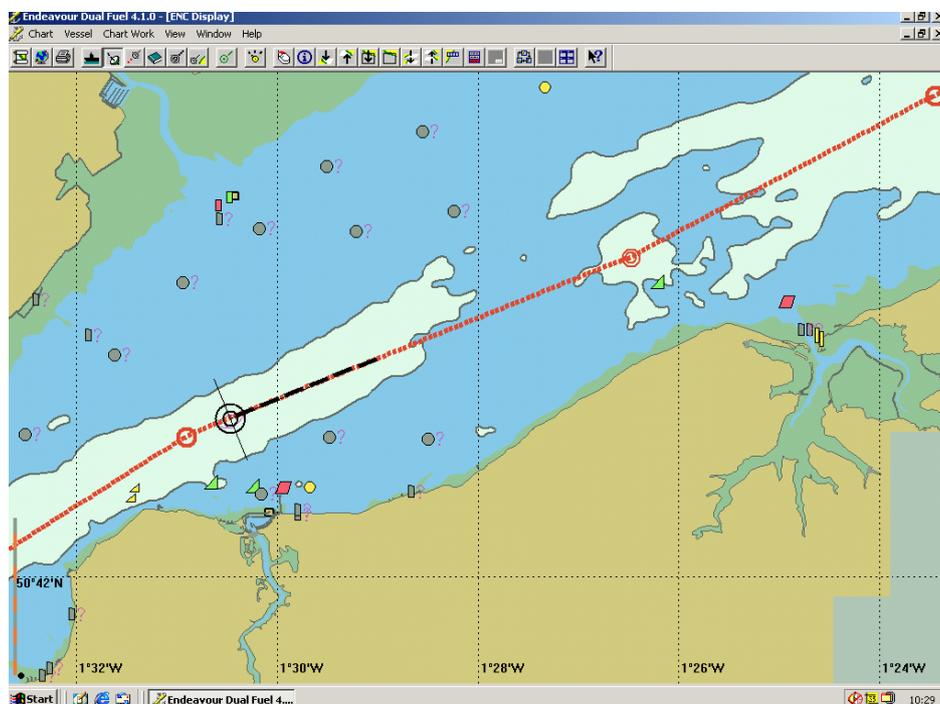


INTERNATIONAL HYDROGRAPHIC ORGANIZATION



## ELECTRONIC NAVIGATIONAL CHARTS (ENCs)

### “PRODUCTION, MAINTENANCE AND DISTRIBUTION GUIDANCE”



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

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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, "ENC Validation Checks"
- D IHO S-62, "List of Data Producer Codes"
- E IHO S-63, "IHO Data Protection Scheme"
- F IHO M-3, "Resolutions of the IHO", Resolution 1/1997 (as amended), 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-11 Part A, Section 200, "Guidance on the Preparation and Maintenance of ENC Schemes"
- I IHO S-8, FIG/IHO/ICA "Standards of Competence for Nautical Cartographers"
- J 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)"
- K International Convention for the Safety of Life at Sea (SOLAS) (as amended)
- L IHO S-66, "Facts about Electronic Charts and Carriage Requirements"
- M IHO C-47, "Training Courses in Hydrography and Nautical Cartography"

#### Indicative Documentation

- N UKHO ENC Product Specification
- O UKHO ENC Data Capture Specification
- P UKHO ENC Training Documentation and Job Descriptions



- Q UKHO Quality Procedures for the production of ENCs  
R Guidelines for the Implementation of the WEND Principles

The UKHO can make References N & O and the overview elements of References P & Q 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
QA	Quality Assurance
QMS	Quality Management System
RENC	Regional ENC Coordinating Centre
SOLAS	International Convention for the Safety of Life at Sea
SOR	Statement of Requirement
WEND	Worldwide ENC Database



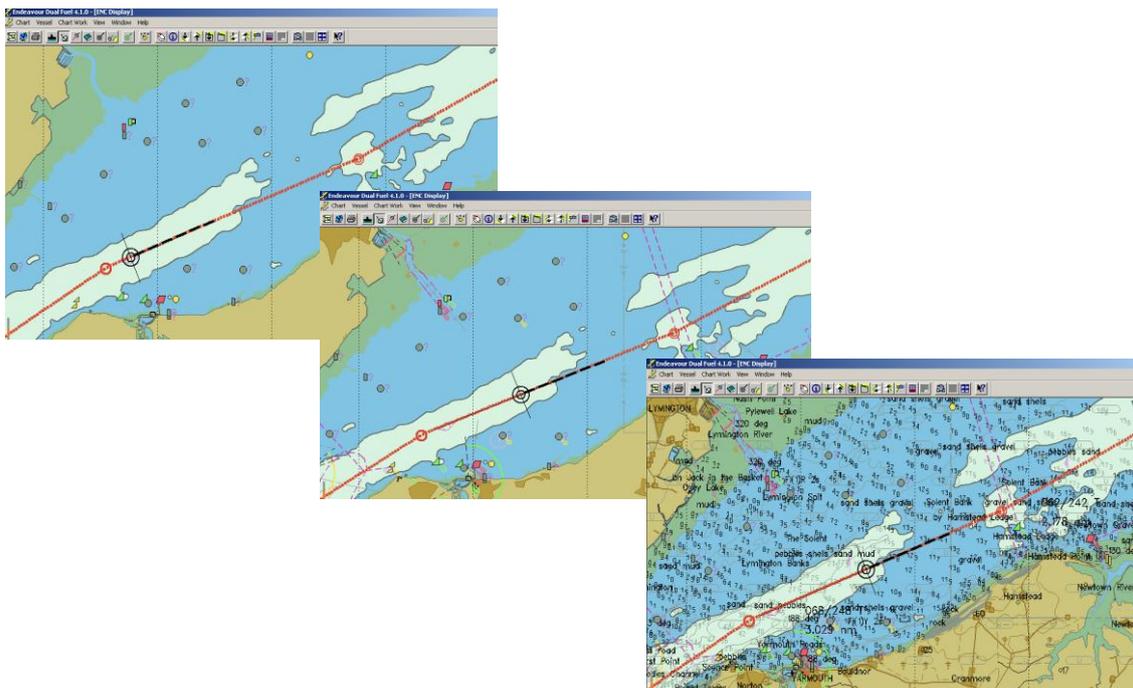
## What is an ENC?

### 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 its own native System ENC (SENC) format. The SENC format is optimised by the ECDIS manufacturer for the correct and efficient display of the ENC information.

Within the ECDIS, the features and their attributes (for example position, colour, shape) can be selectively displayed and queried, creating the potential to customize 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 on-board 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 Contracting Governments 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 – Resolution 1/1997 (as amended)). 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.



- ❑ 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 and timely as those provided by the Contracting Government for the correction of paper charts.

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 1/1997 (as amended), Principles of the Worldwide Electronic Navigational Chart Database (WEND).

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

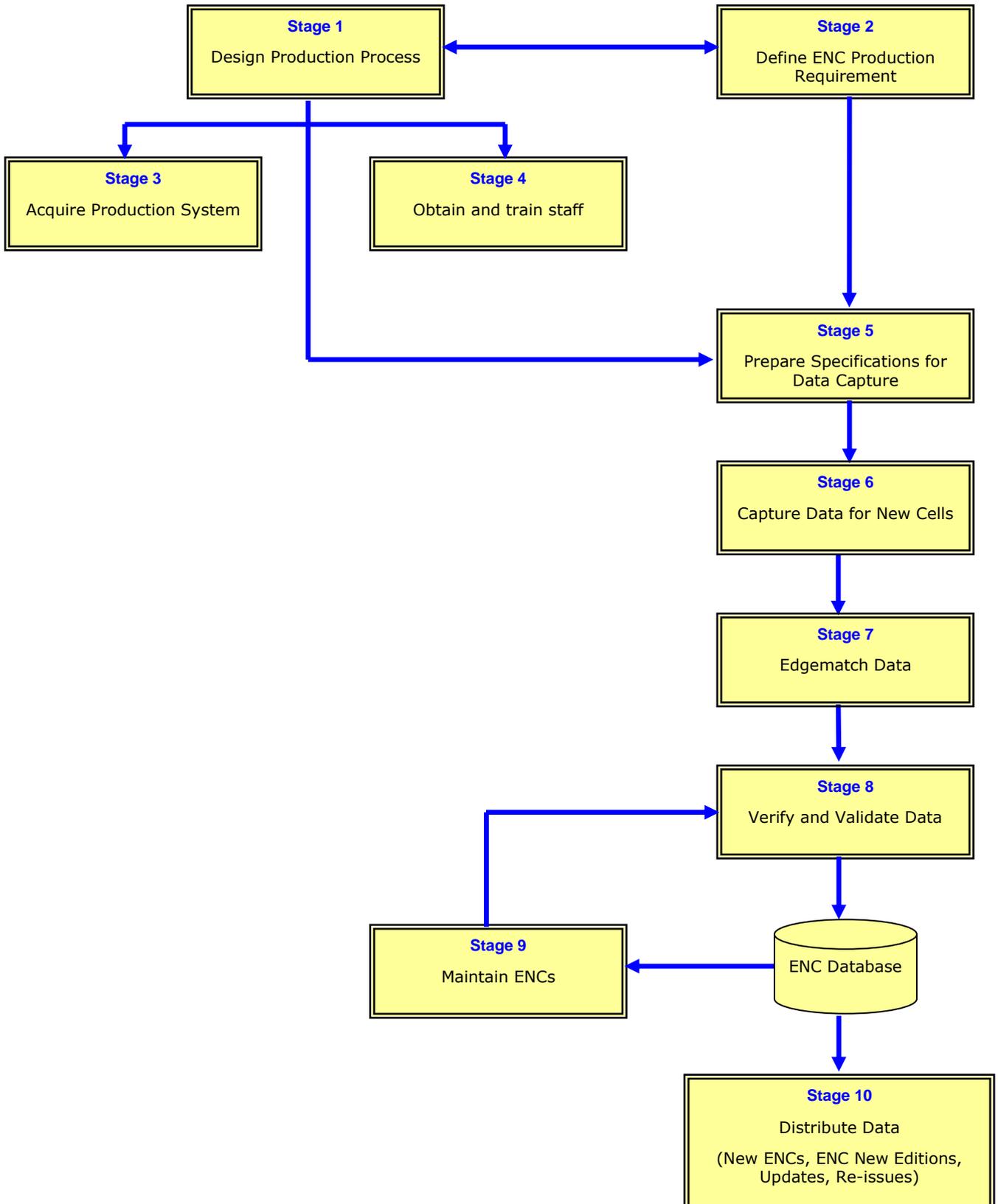
- Useful References:**
- S-66 - Facts about Electronic Charts and Carriage Requirements;
  - M-3 - Resolutions of the IHO, Resolution 1/1997 (as amended), Principles of the Worldwide Electronic Navigational Chart Database (WEND);
  - S-11 Part A – Section 200, Guidance for the Preparation and Maintenance of ENC Schemes;
  - Guidelines for the Implementation of the WEND Principles. (See [www.iho.int](http://www.iho.int) > Committees & WG > WENDWG).

## **Flow Chart**

A flow chart detailing each stage of the process is shown on the next page.



## Key Stages in the Production of ENC





## ENC PRODUCTION AND DISTRIBUTION GUIDANCE

### STAGE 1 – Design Production Process

#### **STEP 1 – Production Method**

- Before starting the ENC production process, the source material to be used should be selected.

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

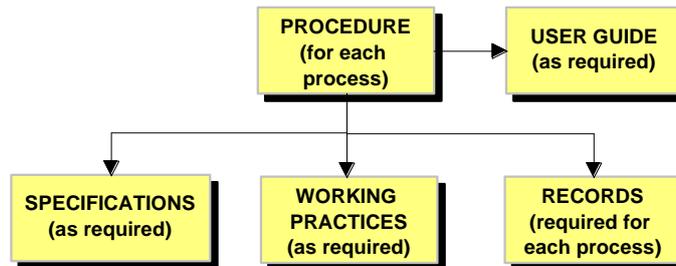
The decision as to which source material will be used will depend on several factors:

- The quality and format (that is, 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 task 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, information technology (IT) resources, and available funding. Each option 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.



### **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 during/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.
- ❖ 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 recommends 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 the INT chart scheme and the ENC producer nations 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. The ENC Product Specification 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, clause 2.1.8.

In addition to the agreement of boundaries, neighbouring producer nations are encouraged to harmonise the design of their adjacent ENC cells in order to provide a seamless depiction in ECDIS. To achieve this, matching Navigational Purposes, SCAMIN values and contour interval should be chosen where possible. (See Stage 7, Step 2). The final assignment of ENCs to Navigational Purposes and the values used for individual SCAMIN attribution should preferably be done through consultation with all ENC Producer States within a Regional Hydrographic Commission as appropriate, in order to maintain consistency across national or regional boundaries. See also S-11 Part A, Section 200.

### **STEP 2 – Produce Production Plan**

- A national production plan then needs to be compiled to define:
  - The geographic areas that are to be captured – note that this relates to actual areas of data coverage rather than the rectangular cell limits.
  - The Navigational Purposes that are to be populated for each area.
  - How the areas are to be divided into cells for each Navigational Purpose.
  - The priority in which ENC cells will be produced; for example larger scale cells first.
- The production plan will be dependent on some of the following factors:
  - The reason for the requirement – Defence / SOLAS.



- Priority given to major ports and traffic routes, based on factors such as volumes of vessel traffic, etc.
- Cooperation with bordering countries to maximise production, improve efficiency and coverage, and to ensure cross-border consistency.
- Design considerations as 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. The introduction from 2012 of an IMO mandatory carriage requirement for ECDIS imposes a requirement on Contracting Governments to ensure that such data are available in a form suitable for use in ECDIS.
- ❖ It is expected that Member States will have mature arrangements in place for the issue of ENCs and their subsequent updating for waters of national jurisdiction in order to support the IMO requirement for the 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. Guidelines on the implementation of the WEND Principles are published separately. These should be employed to facilitate the provision of appropriate ENC coverage within a suitable timeframe.

- ❖ 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 cartographic boundaries for ENC production within a technical arrangement.
- ❖ A cartographic boundary is defined as an agreed limit to clip overlapping nautical charts or related data between two or more neighbouring countries, or between two adjacent charting Regions. The boundary is established for cartographic convenience and technical purposes only and shall not be construed as having any significance, legal effect or status regarding political or other jurisdictional boundary. It should be as simple as possible (for example: a succession of straight segments and turning points corresponding preferably to meridians and parallels) so as to provide data compilers with clarity as to the limits of their charting responsibilities and data users with the most coherent service possible.



- ❖ In international waters, the paper INT chart producer nation is assumed to be the producer of the corresponding ENC. Where the offshore limits of waters under national jurisdiction have not yet been established, or where paper INT charts overlap, the clause above should apply.
- ❖ In areas where the paper INT charts overlap, neighbouring producer nations should agree on a cartographic boundary for ENC production. 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 cartographic boundaries for ENC production.
- ❖ In areas of national jurisdiction for which there is no recognized ENC producer nation, the Regional Hydrographic Commission (or similar body) should determine the ENC producer nation. ENCs produced under such arrangements should be offered for transfer to the Coastal State in the event that the Coastal State subsequently develops the capacity to maintain the ENCs. Such transfer should respect the moral rights of the Coastal State and the commercial rights of the producer nation.
- ❖ When the production limits are the official limits for national jurisdiction waters, commercial rights shall belong to the ENC producing country.
- ❖ When the production limits are cartographic boundaries as opposed to national boundaries, the commercial rights shall normally belong to the ENC producing country but may possibly be encumbered by the payment of royalties to the relevant country through a technical arrangement.

**Useful References:** S-11 Part A – Section 200, Guidance for the Preparation and Maintenance of ENC Schemes;

Guidelines for the Implementation of the WEND Principles. (See [www.iho.int](http://www.iho.int) > Committees & WG > WENDWG).

## Cell Schema Design Considerations

### **Limits of ENC Cells**

- The HO has to decide how the limits of the planned ENC cells should be defined. For instance, 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	1:3000000
96 NM	1:1500000
48 NM	1:700000
24NM	1:350000
12 NM	1:180000
6 NM	1:90000
3 NM	1:45000
1.5 NM	1:22000
0.75 NM	1:12000
0.5 NM	1:8000
0.25 NM	1:4000

For more information on setting compilation scale please refer to S-57 Appendix B.1, Annex A – Use of the Object Catalogue for ENC, clause 2.2.6.

### **Navigation 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. However, the following table is an example of how scale ranges may be assigned to Navigational Purposes:

Navigation Purpose	Name	Scale Range
1	Overview	<1:1 499 999
2	General	1:350 000 – 1:1 499 999
3	Coastal	1:90 000 – 1:349 999
4	Approach	1:22 000 – 1:89 999
5	Harbour	1:4 000 – 1:21 999
6	Berthing	> 1:4 000



## **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 mainly 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 the IHO Transfer Standard for Digital Hydrographic Data, S-57 (ENC Product Specification), or its replacement;
  - 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, testing and implementation requirements, 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, 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, port ENC cells in the Navigational Purpose 5 usage, compiled from source surveys and comprising areas of **one** metre depth contours and depth areas in the main navigational channels, may take up to 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 Training Courses in Hydrography and Nautical Cartography;  
Guidelines for the Implementation of the WEND Principles. (See [www.iho.int](http://www.iho.int) > Committees & WG > WENDWG).



## **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 B.1 of the standard contains the Product Specification for ENC.
- Reference should be made to Appendix A (Object Catalogue) and Annex A to Appendix B.1 (Use of the Object Catalogue for ENC) of S-57, which define how charted objects should be encoded for ENCs.

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. The IHO ENC Standards Maintenance Working Group (ENCWG) is responsible for maintaining the S-57 standard. The ENCWG also maintains online lists of ENC Encoding Bulletins and Frequently Asked Questions (FAQ) about ENC encoding issues. These are available on the IHO website. ENC data producers are invited to submit queries or encoding anomalies to the ENCWG for discussion and possible inclusion in this online resource.

- 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 their ENCs, what the limits of the cells should be, and which Navigational Purposes the cells should belong to. However IHO Publication S-4 “Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO” must be used in determining the appropriate content of ENCs. IHO S-58 “ENC Validation Checks” defines a minimum check standard for ENC data compliance.
- 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.
- The size of data sets should be optimized and only necessary data should be included. This will facilitate remote distribution services.
- ENC producers must ensure consistency with neighbouring ENCs wherever possible.

**The IHO WEND Principles** state that:

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



- Useful References:**
- S-57 IHO Transfer Standard for Digital Hydrographic Data;
  - S-58 ENC Validation Checks;
  - S-4 Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO;
  - UKHO Data Capture Specification;
  - UKHO ENC Product Specification.



## **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:
  - The definition of a suitable Statement of Requirements.
  - Assuring a high quality of its ENC services. This could be through the use of a Quality Management System that is certified by a relevant body conforming to a suitably recognised standard such as ISO 9001.
  - The issuing of Invitations to Tender, including possible production of a sample cell.
  - The evaluation of Tenders.
  - The selection of a contractor.
- Alternatively, other HOs may be able to offer production capacity, either on a commercial basis or as part of a wider bilateral agreement that supports broad distribution and availability of ENCs to end users.

### **STEP 2 – Capture data**

- In order to facilitate data 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 the form of data capture used, it is recommended that:
  - The package should be sent in batches (via a secure route) to the external contractor or HO.
  - A suitably trained in-house operator will be tasked to receive the package and compile the ENC.
- The data must be captured in compliance with the recommended and mandatory requirements of S-57, S-58 and S-4; and in accordance with any HO clarification or Data Capture Specifications.

**Useful References:** S-57 IHO Transfer Standard for Digital Hydrographic Data;  
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 along the cell borders are aligned and continuous across any adjoining cells, particularly cells of the same Navigational Purpose. It may be necessary to include these adjoining cells in the same project to ensure consistency across cell borders.
- 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 co-operate to agree on a homogenous ENC scheme, including responsibility for data coverage within each Navigational Purpose. It is recommended that where advantageous, producers should agree on data boundaries which may be subject to technical arrangements based on cartographic convenience and navigational safety.
- Neighbouring producer states should establish exchange mechanisms to allow access to each other's ENCs. ENC harmonization across cell boundaries should address the following issues:
  - ENC cell compilation scales and application of the SCAMIN attribute.
  - COMF value used.
  - Overlaps and gaps between data limits (buffer zone).
  - Data content (including depth contour interval) and alignment.
  - Truncated areas and boundary limits.

For further information, refer to S-57 Appendix B.1, Annex A – Use of the Object Catalogue for ENC.

#### **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 cartographic boundaries for ENC production within a technical arrangement.



- ❖ A cartographic boundary is defined as an agreed limit to clip overlapping nautical charts or related data between two or more neighbouring countries, or between two adjacent charting Regions. The boundary is established for cartographic convenience and technical purposes only and shall not be construed as having any significance, legal effect or status regarding political or other jurisdictional boundary. It should be as simple as possible (for example: a succession of straight segments and turning points corresponding preferably to meridians and parallels) so as to provide data compilers with clarity as to the limits of their charting responsibilities and data users with the most coherent service possible.
- ❖ In areas where the paper INT charts overlap, neighbouring producer nations should agree on a cartographic boundary for ENC production. 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 cartographic boundaries for ENC production.

**Useful References:** S-11 Part A – Section 200, Guidance for the Preparation and Maintenance of ENC Schemes;  
Guidelines for the Implementation of the WEND Principles. (See [www.ihoint.org](http://www.ihoint.org) > Committees & WG > WENDWG).



## **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 data 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 to which validation software is developed are defined within S-58 “ENC Validation Checks”.
- 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.
- It is recommended that, as a last validation step, ENC cells are loaded into an ECDIS to check for any anomalies in loading and viewing the data.

#### **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](http://www.iho.int) > External Liaisons (top) > External Stakeholders (left) > Download the External Stakeholders' contact list **here**).

**Useful References:** S-58 ENC Validation Checks;

Guidelines for the Implementation of the WEND Principles. (See [www.iho.int](http://www.iho.int) > Committees & WG > WENDWG).



## **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, it must 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 charts 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.

*The IHO WEND principles* state:

- ❖ It is expected that Member States will have mature arrangements in place for the issue of ENC's and their subsequent updating for waters of national jurisdiction in order to support the IMO requirement for the 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 Notices to Mariners (NM), and Temporary and Preliminary Notices to Mariners (T&P NM – 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, clause 2.6). Updating must be completed within a rigid timescale for ENC 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 may have issues with loading larger update files.
- ENC Updates should fully replicate their paper chart equivalent updates, and both should be distributed at the same frequency, for example weekly.

### **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 users report 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 updates. Other factors such as the size of the updates should also be taken into consideration. Existing users will not be effected by the publication of a Re-issue (that is, 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.

#### **STEP 5 – Distribution of ENC Data**

- ENC data can be distributed on CD-ROM, via Internet transmission, over SATCOM, by landline communication or by other means. See Stage 10 regarding wider distribution principles.

**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.

**Useful References:** S-57 IHO Transfer Standard for Digital Hydrographic Data;  
S-4 Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO.



## **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 in the distribution of ENC data 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) or SENC distribution 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, comprising ENC New Editions, Re-issues and Updates, to ensure that the ECDIS SENC is maintained up to date. In the case of remote supply, data transmission can be optimized by sending only the additional ENC data necessary to bring the SENC up to date.
- The distribution mechanism should issue information about the current status of all ENCs in service (latest edition and update number), cancelled ENCs, and where appropriate, replaced ENCs.
- The distribution mechanism may use various methods of delivering ENC data, depending on the media and channels available as well as validation procedures required to ensure correctness. The methods should provide update information to the SENC in the most efficient and effective way.
- Methods of delivery may include the use of physical media or remotely using 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, for example 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 supplied if no additional update information is available. These services should ensure that service continuity and data integrity is not in conflict with data installed using conventional methods, for example CDROM.
- Fully-automatic updating (**that is**, the update data reaches the EDCIS directly without any human intervention) may exist. To ensure the integrity

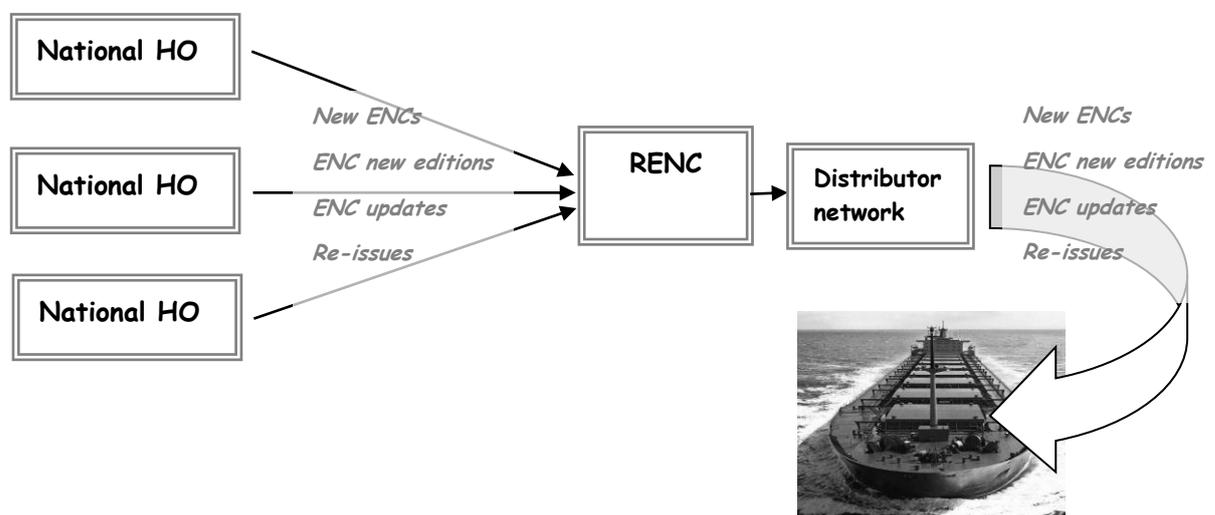


of the broadcast update, effective safe transmission mechanisms and/or error detection methods should be employed.

- Updating of the ENC should be accomplished in a user-friendly way by the mariner without the need for assistance from the distributor or manufacturer.
- 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.

**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.



- 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, and simplifying the purchasing of ENC data. RENCs also act as 'one stop shops'.
- RENCs are able to assist with ENC validation and quality checks (in terms of its validation against S-58) and provide valuable guidance on quality enhancements and data harmonization.



- RENCs help promote the production of ENC's 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 organization 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.

**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. [Integrated services are 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.]
- ❖ 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.
- ❖ Member States are to strive for the greatest possible user-friendliness of their ENC services and to facilitate integrated services to the mariner in order to maximise the use of ENC's.



**Useful Reference:**

S-63 IHO Data Protection Scheme;

Guidelines for the Implementation of the WEND Principles. (See [www.iho.int](http://www.iho.int) > Committees & WG > WENDWG).



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## **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 (Automatic Identification System)**

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 reference isolated nodes or connected nodes.

**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 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 display categories for SENC objects:

**display base:** The chart content which must be permanently shown on the ECDIS display and cannot be removed from the display. It is not intended to be sufficient for safe navigation.

**standard display:** The display mode intended to be used as a minimum during route planning and route monitoring.

**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 regulations V/19 and V/20 of the 1974 SOLAS Convention, as amended, 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 a Government, authorized Hydrographic Office or other relevant government institution, and conform to IHO standards. 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 (e.g. sailing directions) which may be considered necessary for safe navigation.

**ENC Product Specification**

Appendix B.1 of S-57 which specifies the content, structure and other mandatory aspects of an ENC.



### **ENC Standards Maintenance Working Group (ENCWG)**

An HSSC working group that is responsible for the maintenance of digital data standards including S-52, S-57 and S-58 to satisfy new hydrographic requirements.

### **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 (see the IHO web site for additional information <http://www.iho.int>).

### **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 zero-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 ENCs 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-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)**

The former HSSC working group responsible for the maintenance of digital data standards including *S-57* and *S-100* to satisfy new hydrographic requirements. TSMAD has now been superseded by the *S-100* Working Group (*S-100WG*) and *ENC* Standards Maintenance Working Group (*ENCWG*).

**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 for ENC**

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 *ENC* Standards Maintenance Working Group (*ENCWG*). 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.



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**Annex A**

# **High Density (HD) ENC Production and Maintenance Guidance**

**Edition 1.0.0 – January 2020**

**IHO**



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**Document History**

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0.0.1	May 2019	ENCWG	Draft document for discussion (S-101PT4)
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0.0.3	November 2019	ENCWG	Revised draft document for WG review
0.0.4	January 2020	ENCWG	Final draft for WG approval
1.0.0	January 2020	ENCWG	Publication of Edition 1.0.0

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# 1 Overview

## 1.1 Introduction

When Electronic Navigational Charts (ENCs) were first introduced most HOs used their paper chart series as the source for this new vector product. Unfortunately, while enabling the relatively quick creation of ENC data, it has also led to some more unforeseen issues. One of the principle advantages of using ECDIS for navigation is that the system enables the setting of a safety contour, differentiating the safe and unsafe water. This can only accurately be achieved if the data within the ECDIS includes higher density contour intervals than those traditionally shown on the paper chart. Many of our ENCs today only contain the standard series of contour lines mirroring the paper chart as specified in IHO Publication S-4 - *Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO*, section B-411. This results in some vessels having to navigate in waters indicated on the ECDIS as dangerous, when in reality the vessel is still safe and has not reached the maximum permitted water depth.

There is also an emerging requirement for ENC covering commercial ports to include significantly larger scale and higher bathymetric content levels than included in the corresponding paper chart portfolio. This requirement is driven by:

- The increasing size of vessels in relation to ports, and their channels and confined waters;
- Reduced under-keel depth margins as more vessel sailings are required within each tidal window;
- A fundamental shift in the way these vessels are navigated and a change in user expectations.

The preference is to meet these requirements through official S-57/S-63 ENC rather than unofficial 'closed' proprietary formats. There is a concern that use of a proprietary format creates a situation whereby the ship's Pilot has a considerably different view of the navigation situation compared to the vessel's Master, leading to ineffective Bridge Resource Management, confusion and increased safety risk. In contrast, exclusive use of S-57/S-63 ENC allows for access and use of the same information by all parties.

With advances in the processing of high-resolution bathymetry it is now possible to automatically create sets of supplementary contours that can directly feed into the creation of high density (HD) ENCs. This Annex will provide HOs with survey capture, processing and production guidance to enable the effective creation of HD ENCs.

## 1.2 References

IHO S-4	Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO, Edition 4.8.0, October/November 2018
IHO S-44	Standards for Hydrographic Surveys, 5th Edition, February 2008
IHO S-57	Transfer Standard for Digital Hydrographic Data – Appendix B.1 – ENC Product Specification, November 2000.
IHO S-58	ENC Validation Checks, Edition 6.1.0, September 2018

## 1.3 Definitions

### High Density ENC (HD ENC)

An ENC product that includes bathymetry depicted with depth area intervals of 1 metre or closer within the depth range of relevance, focussed on a physically constrained waterway. The additional bathymetric information is incorporated in the base ENC dataset. The product may also include more detailed port infrastructure. Under the current IMO ECDIS Performance Standards, this product is suitable to be displayed and operated on any type-approved ECDIS and consequently it can be used to fulfil the IMO's chart carriage requirements.

## 2 Bathymetric Surveys for HD ENCs

HD ENCs are considered to be of maximum benefit to the Mariner in areas where there are areas of minimal under-keel clearance and/or vessel manoeuvrability is restricted.

Careful consideration must be given when planning surveys, so that the resulting data can be used to compile areas of HD bathymetry where a requirement is identified. Hydrographic offices should consult with ports, pilots etc. regarding surveys, maintenance, accuracy of infrastructure, target vessel type(s) and any other characteristics of the area of interest that may influence the structure and content of a HD ENC.

Hydrographic surveys to be used in the compilation of HD bathymetric areas will in the majority of cases need to meet IHO S-44 Special Order survey requirements:

**Table 2.1 – S-44 Special Order survey requirements**

Maximum allowable Total Horizontal Uncertainty (95% confidence):	+/- 2 m
Maximum allowable Total Vertical Uncertainty (TVU) (95% confidence)*: a = +/- 0.25m b = 0.0075	Examples: TVU for 10m depths = +/- 0.26m TVU for 20m depths = +/- 0.29m
Feature Detection:	Full seafloor search (able to detect features greater than 1 cubic metre in size)

\* Recognizing that there are both depth independent and depth dependent error sources that affect the measurements of depths, the formula below is used to compute an acceptance interval for vertical measurement uncertainties. The interval of the *total vertical uncertainties* of depth measurements calculated with a 95 % confidence level must comply with this acceptance interval.

The parameters “a” and “b”, together with the depth “d”, have to be introduced into the formula below in order to calculate the acceptance interval  $A_{TVU}(d)$ :

$$A_{TVU}(d) = \left[ -\sqrt{a^2 + (b \times d)^2} ; +\sqrt{a^2 + (b \times d)^2} \right]$$

Where:

- a represents that portion of the uncertainty that does not vary with depth
- b is a coefficient which represents that portion of the uncertainty that varies with depth. It is given in percent format and must be divided by 100 when used in the equation above (i.e. for 0.75% of depth, use b = 0.0075)
- d is the depth
- b x d represents that portion of the uncertainty that varies with depth<sup>1</sup>

The bathymetry supplied must be referenced to:

- WGS84. This is what ships, pilots, and ENC use. Transformation to other reference systems, and back again, increases the Total Horizontal Uncertainty.
- A specified port tidal datum (such as “zero of the port tide gauge”, “x.xx metres below [named] benchmark” or similar). Where multiple tidal stations or nodes have been used, each should be listed to ensure accuracy is maintained through to the ENC. Simply stating “LAT” (Lowest Astronomical Tide) does not necessarily provide sufficient detail to replicate the tidal reference plane. LAT within ports is frequently insufficiently defined for levels of accuracy to be maintained through to the HD ENC.

In cartographic terms, HD bathymetric data should only be depicted in areas categorized as CATZOC A1 or A2.

<sup>1</sup> IHO Publication S-44 – *IHO Standards for Hydrographic Surveys* – Draft<sup>h</sup> Edition 6.0.0 (January 2020), clause 3.2.3

The exception to the above is where the bottom quality is mud/silt and the water column is holding significant amounts of sediment. Given these environmental conditions multibeam as a survey technique is not suited when acquiring depth information. In this situation other survey techniques may be used.

It is recommended that charting authorities consider the following criteria when developing HD ENCs:

- a. Ability for larger vessels to access the port.
- b. Improvement to routes to avoid areas of environmental risk.
- c. Improvement to routes to improve traffic flow.
- d. Is it practical to maintain the cells once produced?

### 3 HD ENC Cell Creation

There are two options for creating HD ENCs:

- Incorporating HD ENC information in existing published ENC cells.
- Creation of dedicated new HD ENC datasets.

In order for RENCs or other service providers to identify a HD ENC for catalogue service purposes, the text string "HD ENC" should be included in the "Comment" [COMT] subfield of the "Data Set Identification" [DSID] field of the ENC Data Set General Information record.

#### 3.1 Existing cells

HD bathymetric data can be included in any navigational purpose so long as the product is the largest scale ENC available in the area. The area of the data coverage of the ENC cell to be covered by HD ENC information should, for reasons of economy and maintenance, be restricted to the area of interest for the target vessel classes for the HD ENC information; with the remainder of the area of data coverage containing the more "traditional" level of bathymetric detail. In general, the area of interest for HD ENC data coverage will include (but is not restricted to) shipping channels (including dredged areas), anchorages, emergency escape channels, waiting areas, vessel manoeuvring areas (for example turning basins) and berths. In most cases these areas will require a larger compilation scale (using the S-57 meta object M\_CSCL) to support the extra detail provided and the way the end user will use the ENC.



**Standard ENC**



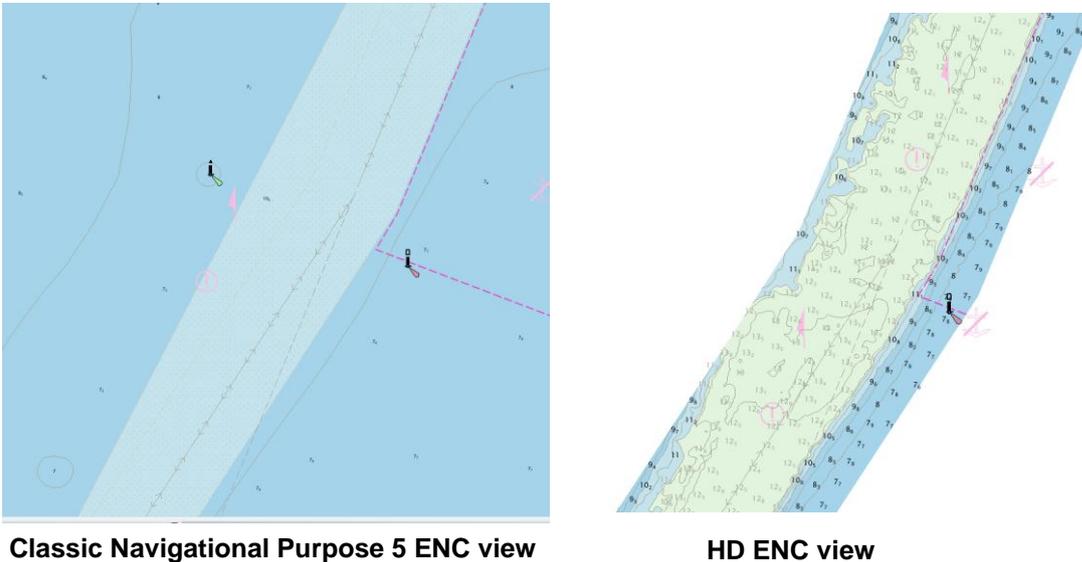
**ENC containing HD bathymetric data**

**Figure 3.1 – Standard ENC and ENC containing HD information – comparison**

The images above show the impact on the available safe water when additional contours are included.

### 3.2 New cells

New ENC cells containing only HD ENC data must be the largest Navigational Purpose ENC data covering the area. Where ENC data already exists at the Harbour (Navigational Purpose 5) band, the Navigational Purpose band 6 (Berthing) may be used. It is expected that the majority of HD bathymetric data will be included in new cells created in the Berthing Navigational Purpose. This approach is preferred as it simplifies the updating process.



**Figure 3.2 – Standard ENC and new HD ENC cell – comparison**

## 4 Cell Size

An ENC dataset containing HD bathymetric data should contain no more than 5 Megabytes of data. Appropriate scheming of the area of interest, for instance consideration of multiple cells in lieu of a single large sized cell, should be considered; particularly if it is considered important that the 5 Megabyte data limit is to be retained.

## 5 Quality of Bathymetric Data

To ensure the mariner has access to all the metadata related to the bathymetric survey the meta object M\_QUAL must be used, in accordance with S-57 Appendix B.1, Annex A – *Use of the Object Catalogue for ENC*. However for HD bathymetric data the use of the attribute value CATZOC = 6 (Unassessed) is prohibited.

It is strongly recommended that the attributes POSACC, SOUACC, SUREND and TECSOU are used on the M\_QUAL where possible to relay important information about the quantitative accuracy of the source surveys and the survey technique of sounding measurement, taking into account the guidance on the use of these attributes as included in S-57 Appendix B.1, Annex A, clause 2.2.3.1.

The quality of source surveys used to compile HD bathymetric data should be the equivalent to ENC data CATZOC values A1 or A2 (see clause 2).

### 5.1 HD ENC validation checks

ENC cells containing HD bathymetric data must conform to S-58 – *ENC Validation Checks*, noting however the allowance to exceed to 5 Megabyte data content limit (see clause 4 above).

## 6 Automatic Generation of Depth Contours and Sounding Selection

Hydrographic Offices are free to determine density of contours. It is recommended that a contour interval of 1m is used as this represents the most useful contour interval for the end user, although there has been HD bathymetry data produced with a 0.1m contour interval.

For use in ECDIS HD bathymetric data does not need to extend in the whole 0m – 50m depth range; the most useful depth range for surface navigation is between 5m to 30m. Hydrographic offices should consider factors such as the nature of the topography, area to be covered and classes of vessels for which the data is intended when determining the depth range within which to compile HD bathymetry.

For reasons of economy, it is considered that the cartographic quality of contours auto-generated and smoothed by modern production software tools is sufficient for use of HD bathymetry in ECDIS. Cartographic intervention should only be applied when matching the “standard” depth contours to adjoining data and in the depiction of isolated shoals and deeps (see clause 8).

The use of denser sounding patterns (50-100m ground spacing) may be beneficial to support the navigation of large vessels that may still require higher accuracy than the recommended 1m contour interval. In these cases, an evenly spaced sounding pattern (production software automated sounding suppression/selection (shoal biased) routine) is preferred. With modern production software, such an automated process is very quick and reliable taking into account the additional contours to be supported, noting that with such higher density data there is no expectation that the mariner may sail ‘from sounding to sounding’ as is common practice when navigating on traditional charts. It is important to remember that soundings are not part of the S-52 ‘Standard’ display and they can be turned off at any moment.

Note: When dredged areas (S-57 object class DRGARE) exist within the area of HD bathymetry the use of ‘supplementary’ contours matching the design depth of the dredged area is highly recommended (for example 7.6m). HO’s may decide to replace dredged areas with full bathymetry, in which case the limit of the dredged area and the dredged depth should be indicated using a fairway (S-57 object class FAIRWY).

## 7 Application of SCAMIN

### 7.1 SCAMIN on contours

SCAMIN must be applied to the “standard” contours (0, 2, 5, 10, ...) such that they match the SCAMIN values of the corresponding contours outside and adjoining the area of HD bathymetry. This ensures that the “standard” depth contours will appear and disappear at the same time irrespective of whether they sit within or outside the HD bathymetry area.

To avoid excess clutter within the ECDIS it is recommended that SCAMIN is applied to the intermediate (non-standard) contours within the HD bathymetry area so they are either not visible or only visible at the compilation scale of the HD bathymetry. The decision depends on the sea bottom topography and on how close together the contours are at compilation scale. Related S-58 checks (1553) can be ignored where the decision is to apply SCAMIN such that the intermediate contours disappear from ECDIS display at the compilation scale.

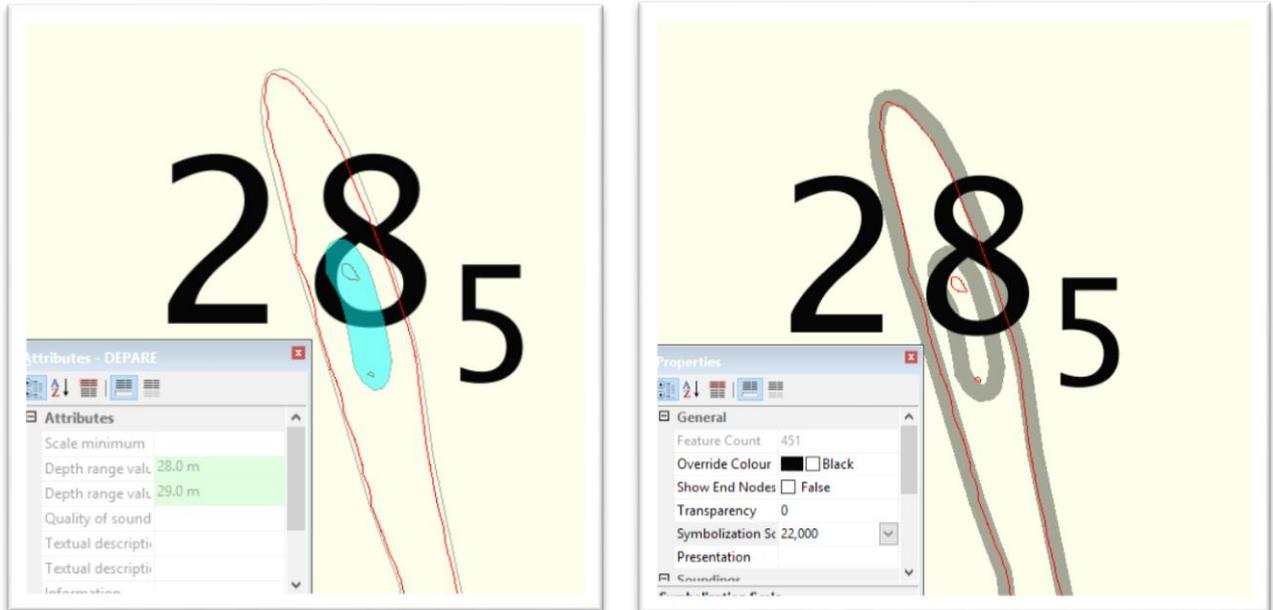
### 7.2 SCAMIN on soundings

Soundings must have SCAMIN applied in accordance with the general accepted practice for the Hydrographic Office.

## 8 Managing Shoals and Deeps

The automated contouring process may generate contours that are too small to easily be displayed at HD ENC compilation scale. It is recommended that no isolated shoal or deep area should be smaller than 2.75mm across any dimension at the compilation scale of the HD ENC. Appropriate automated contour generation algorithms so as to avoid the creation of small shoals should be investigated.

Small isolated deeps may be filtered out of the HD ENC data.



*Figure 8.1 – Generalisation and enlarging of contours – example*

## 9 Testing

Prior to publication, it is strongly recommended that HD ENC datasets be supplied to harbour/port authorities and pilots for testing and feedback. If possible, consideration should also be given to supplying HD ENC datasets to local ship simulator training facilities for evaluation, testing and feedback.

## 10 Maintenance of HD ENC Data

HD ENCs should be maintained at a minimum as is done for the regular ENC maintenance regime, however where there is a requirement to release the data more regularly this would be possible with the agreement of the RENCs.

For post-dredging surveys the Hydrographic Office should consider processing the data and releasing an updated HD ENC dataset within 2 weeks of data receipt.

In all cases where the continued reliability of a HD ENC may be questioned (for example changed circumstances in ability to resurvey in areas of changeable seabed or in dredged areas; consequences of natural disaster), a course of action should be determined in full consultation with the key stakeholders. This may include, for HD ENC datasets having full HD bathymetry coverage, a decision to cancel the cell pending resolution of the issue. Such action should commence as soon as it is considered that the CATZOC for the HD bathymetry within the dataset has degraded beyond the recommended CATZOC A1 or A2 level.

**Annex B**

# **S-57 ENC to S-101 Conversion Guidance**

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## Document Control

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# 1 Introduction

## 1.1 General

The following clauses specify the conventions that are recommended for preparing and finalising S-57 ENC datasets for conversion to S-101 Edition 1.0.2 ENC compliant data. This document is laid out, as far as possible, along the lines of the IHO publication S-57 Appendix B.1: *ENC Product Specification, Annex A - Use of the Object Catalogue for ENC*.

This document describes how to adapt S-57 ENC data so as to optimise the automation of S-57 ENC data conversion to S-101 data. It is important to note that S-101 is not a “clone” or “duplication” of the S-57 Object Catalogue (S-57 Appendix A, Chapters 1 and 2) and the S-57 ENC Product Specification. New functionality introduced in S-100 and improvements from the S-57 data model that have been implemented in S-101 as a result of lessons learned from S-57 ENC operational use mean that there is not a direct “one to one” equivalence between S-57 encoding and the corresponding S-101 encoding in many cases. Also, automated conversion processes differ in their capabilities and operations and the model for co-production of both S-57 and S-101 data from a common database may vary between individual Data Producers. This may result in an inability for full automated conversion of an operational S-57 ENC dataset to a fully operational and compliant S-101 dataset, thus requiring the Data Producer to apply further manual changes to the converted dataset. Where manual intervention may be required by the Data Producer after an automated conversion process has been completed, this guidance is also included in this document.

It is important to note the following:

- **The guidance included in this document is intended to optimise S-57 ENC data for initial conversion to S-101.**
- **Where possible, every effort must be made such that the performance of officially published S-57 ENCs in ECDIS is not compromised. For example, this document includes guidance on the population of the S-57 INFORM attribute to facilitate automated conversion. Such attribute population may adversely affect the use of this data in ECDIS (display of unwanted “information” indicators and additional information not required by the mariner for safe navigation).**
- **It is strongly recommended that, where possible, these changes are made at the database or product source dataset level only, and not included in the officially published S-57 ENC dataset for use in ECDIS.**

Because of the differences between the S-57 and S-101 data models, there are instances where an S-57 Object class, attribute or enumerate value will not be converted to S-101 during the automated conversion process due to an equivalent concept not being included in S-101. These instances are identified individually throughout this document in the relevant S-57 Object class-specific clauses, along with any recommendations for pre- and post-conversion encoding. Conversely, there have been enhancements made in the S-101 data model that have no equivalency in S-57 and therefore cannot be implemented as part of the automated S-57 to S-101 conversion process. This document does not provide guidance as to how these enhancements may be manually implemented post-conversion, however references to these enhancements and the recommended encoding guidance included in S-101 Annex A – *Data Classification and Encoding Guide*, is included in Appendix A to this document. Data Producers should also note that conversion tools may be customised so as to adapt to their specific data encoding policies and practices (for example variations in national spelling conventions and conventions for the encoding of specific text strings in the attribute INFORM). Where such customisation has been implemented, Data Producers should take this into account when implementing the guidance included in this document.

Appendix A includes three Tables intended as quick references to assist in preparing and managing data during the S-57 to S-101 data conversion process:

- Table A.1 is a summary Table of the differences between the S-57 and S-101 data models. This Table provides a quick reference for Data Producers to indicate, by S-57 Object class, where pre- or post-conversion manual Data Producer intervention may be required in accordance with the guidance included in the body of this document.
- Table A.2 highlights the differences between S-57 and S-101 in allowable enumerate lists for enumerate type attributes as applicable for the binding Object/Feature. The “allowable enumerate

list” for S-57 enumerate type attributes is based on IHO Publication S-58 – *ENC Validation Checks*, Check 2000. This Table also indicates new enumerate values that have been included in S-101.

- Table A.3 summarises extensions included in S-101 by Feature type in regard to geometric primitives and attributes; and new features included in S-101 for which there is no S-57 equivalent. Application of these extensions to converted S-101 datasets is not a requirement in regard to full equivalency between an S-57 ENC and its corresponding S-101 ENC. However, Data Producers may consider application of these extensions in order to produce “full capability” S-101 ENCs.

## 1.2 Presentation of the document

The following conventions are used:

- Presentation conventions:
 

S-57 Object class:	<b>WRECKS</b>
S-101 Feature type:	<b>Wreck</b>
Geometric primitive:	(P,A); (P,S)*
S-57 Attribute:	EXPSOU
S-101 Attribute:	<b>exposition of sounding</b>
Attribute value:	-2.4

\* For geometric primitives: P = point; [L = line; C = S-100 curve]; [A = area; S = S-100 surface]; N = none. **Data Producers should note in particular where allowable geometric primitives for S-57 Object classes are prohibited for the corresponding Feature type(s) in S-101 and consider amending their S-57 data holdings accordingly.**

Guidance is included in this document on the restriction of allowable values for enumerate type attributes by Feature type that has been introduced in S-101. This guidance is only included where the list of allowable values in S-101 differs from the list of recommended allowable values by S-57 Object class as included in S-58 – *ENC Validation Checks*, Check 2000. **Data producers are to note that the failure of any encoded S-57 Object against S-58 Check 2000 will result in the instance of the attribute responsible for the Check failure not converting across to the corresponding S-101 attribute instance.** Further information can be found in Appendix A, Table A.2.

Where the term “Not applicable” has been used in any clause within this document, this means that there is no impact of this information as presented in S-57 Appendix B.1, Annex A on the S-57 to S-101 conversion process. This is generally because the clause relates to encoding which is prohibited for S-101 ENC; or not relevant in relation to the conversion of S-57 base datasets.

## 1.3 Use of language

Within this document:

“Must” indicates a mandatory requirement in order to for Data Producers to meet the requirements of the S-101 DCEG or S-101 Feature Catalogue constraints. It must be noted that where a requirement is for a particular text string to be encoded (for example using the S-57 attribute INFORM) minor national variations in spelling may be accounted for in conversion software.

“Should” indicates an optional requirement, that is the recommended process to be followed by Data Producers (normally in reference to the S-101 DCEG), but is not mandatory (as required by the S-101 Product Specification or Feature Catalogue).

“May” means “allowed to” or “could possibly”, and is not mandatory in an S-101 context.

The above terms relate to the requirements for the preparation of S-57 data and post-conversion requirements so as to create S-101 datasets that satisfy SOLAS requirements for the S-101 data to be at least the equivalent of S-57 data.

“Will” indicates an expected outcome of the automated conversion process. However it must be noted that S-57 to S-101 automated conversion results may differ between conversion software manufacturers; and Producing Authorities may utilise additional functionality within conversion applications (if available) to enhance conversion output.

This document is intended for guidance only and none of its content should be regarded as “mandatory” in itself. Where the phrase “It is considered that this information is not required for S-101” appears it indicates that a decision has been made during the development of S-101 that this information is not required in ENC.

## 1.4 Maintenance

Changes to this document are coordinated by ENC Maintenance Working Group (ENCWG). Individuals that wish to make changes to the document must address their comments to the ENCWG.

There are three change proposal types to the S-57 to S-101 Conversion Guidance document. They are:

- (1) Clarification;
- (2) Revision; and
- (3) New Edition.

Any change proposal must be one of these types.

**ALL** proposed changes must be technically assessed before approval.

Approved changes must be issued and entered on the Document Control page of this document.

### 1.4.1 Clarification

Clarifications are non-substantive changes to the document. Typically, clarifications: remove ambiguity; correct grammatical and spelling errors; amend or update cross references; and insert improved graphics. A clarification must not cause any substantive semantic change to the document.

### 1.4.2 Revision

Revisions are defined as substantive semantic changes to the document. Typically, revisions will change the document to correct factual errors; or introduce necessary changes to ENC data encoding guidance that has become evident as a result of practical experience or changing circumstances. A revision must not also be classified as a clarification. Revisions could have an impact on either existing users or future users of the document. All cumulative clarifications must be included with the release of approved revisions.

### 1.4.3 New Edition

New Editions are significant changes to the encoding guidance in the document, noting that such changes must not change or be contrary to the rules and conventions described in S-57 and S-101 documentation. They can include additional information from the ENCWG or related committees that were not originally included in the document. New Editions result in a new major version of the document. One New Edition may result in multiple related actions. All cumulative clarifications and revisions must be included with the release of an approved New Edition. After approval the New Edition will be available for use at a date specified by the ENCWG.

### 1.4.4 Version control

The ENCWG must release new versions of the document as necessary. New versions must include clarifications, corrections and extensions. Each version must contain a change list that identifies the changes between versions of the document.

#### 1.4.4.1 Clarification version control

Clarifications must be denoted as 0.0.x. Each clarification or set of clarifications approved at a single point in time must increment x by 1.

#### 1.4.4.2 Revision version control

Revisions must be denoted as 0.x.0. Each revision or set of revisions approved at a single point in time must increment x by 1. Revision version control will set clarification version control to 0.

#### 1.4.4.3 New Edition version control

New Editions must be denoted as x.0.0. Each New Edition approved at a single point in time must increment x by 1. New Edition version control will set the clarification and revision version control to 0.

## 2 General rules

### 2.1 Cartographic framework

#### 2.1.1 Horizontal datum

The value of the horizontal datum encoded in the “Horizontal Geodetic Datum” [HDAT] subfield of the “Data Set Parameter” [DSPM] field for the S-57 dataset is populated in the “Datum Name” [DTNM] subfield of the “Geodetic Datum” [GDAT] field for the S-101 dataset. As for S-57, the horizontal datum for S-101 ENCs must be WGS 84.

S-57 Meta Object: Horizontal datum (**M\_HOPA**) (A)

There is no equivalent Meta Feature type in S-101 for the S-57 Meta Object **M\_HOPA**. It is considered that this information is not required for S-101. Data Producers should consider removing instances of **M\_HOPA** from their S-57 data for consistency.

#### 2.1.2 Vertical datum

The default vertical datum for the entire data set encoded in the “Vertical Datum” [VDAT] subfield of the “Data Set Parameter” [DSPM] field for the S-57 dataset will be populated in the “Datum Identifier” [DTID] subfield of the “Vertical Datum” [VDAT] field for the S-101 dataset. This value will also be populated in the mandatory verticalDatum field for the Dataset Discovery Metadata of the S-101 dataset.

The vertical datum populated for VDAT and VERDAT on **M\_VDAT** must be taken from the following table in order for the values to be directly converted to S-101:

ID	Meaning
3	Mean sea level
16	Mean high water
17	Mean high water springs
18	High water
19	Approximate mean sea level
20	High water springs
21	Mean higher high water
24	Local datum
25	International Great Lakes datum 1985
26	Mean water level
28	Higher high water large tide
29	Nearly highest high water
30	Highest astronomical tide (HAT)

table 2.1

All other values in the S-57 VERDAT attribute are prohibited for vertical datum in S-101. Data Producers should consider replacing prohibited values with a permitted value before conversion to S-101. Note that other information (typically attribute HEIGHT or VERCLR, etc.) may need to be reviewed (if relevant) as a consequence of a modification of the vertical datum.

S-57 Meta Object: Vertical datum (**M\_VDAT**) (A)

S-101 Meta Feature: **Vertical Datum** (S) (S-101 DCEG Clause 3.9)

Conversion of these features can be automated only if the value populated for VERDAT is in accordance with table 2.1 above. If a value other than those listed in table 2.1 is populated, Data Producers should consider replacing this value with a permitted value before conversion to S-101. Note that other related encoded information (such as values for the attributes HEIGHT, VERCLR, etc.) may need to be reviewed as a consequence of a modification of the vertical datum.

The following is a list of additional S-57 Object classes requiring a value for VERDAT populated from the list in table 2.1 above in order for the **vertical datum** attribute for the corresponding S-101 feature(s) to be converted automatically:

**BRIDGE    BUISGL    CBLOHD    CONVYR    CRANES    GATCON    LIGHTS**  
**PIPOHD    TUNNEL**

### 2.1.3 Sounding datum

The default sounding datum for the entire data set encoded in the “Sounding Datum” [SDAT] subfield of the “Data Set Parameter” [DSPM] field for the S-57 dataset will be populated in the “Datum Identifier” [DTID] subfield of the “Vertical Datum” [VDAT] field for the S-101 dataset. This value will also be populated in the mandatory soundingDatum field for the Dataset Discovery Metadata of the S-101 dataset.

The sounding datum populated for SDAT and VERDAT on **M\_SDAT** must be taken from the following table:

ID	Meaning
1	Mean low water springs
2	Mean lower low water springs
3	Mean sea level
4	Lowest low water
5	Mean low water
6	Lowest low water springs
7	Approximate mean low water springs
8	Indian spring low water
9	Low water springs
10	Approximate lowest astronomical tide
11	Nearly lowest low water
12	Mean lower low water
13	Low water
14	Approximate mean low water
15	Approximate mean lower low water
19	Approximate mean sea level
22	Equinoctial spring low water
23	Lowest astronomical tide
24	Local datum
25	International Great Lakes datum 1985
26	Mean water level
27	Lower low water large tide
44	Baltic Sea chart datum 2000

table 2.2

All other values in the S-57 VERDAT attribute are prohibited for sounding datum in S-101. Producing Authorities should consider replacing prohibited values with a permitted value before conversion to S-101. Note that other information (such as sounding values and values for attribute VALSOU, etc.) may need to be changed (if relevant) as a consequence of a modification of the vertical datum.

**S-57 Meta Object:**    Sounding datum (**M\_SDAT**)    (A)

**S-101 Meta Feature:**    **Sounding Datum**    (S)    (S-101 DCEG Clause 3.8)

Conversion of these features is automated only if the value populated for VERDAT is in accordance with table 2.2 above. If a value other than those listed in table 2.2 is populated, Data Producers should

consider replacing this value with a permitted value before conversion to S-101. Note that other related encoded information (such as sounding values and values for the attribute VALSOU, etc.) may need to be reviewed as a consequence of a modification of the sounding datum.

#### 2.1.4 Units

Not applicable.

#### 2.1.5 Dates

The S-57 attributes DATEND, DATSTA, PEREND, PERSTA, SORDAT, SUREND and SURSTA are replaced in S-101 by the complex attributes **fixed date range**, **periodic date range** and **survey date range**; and the attributes **dredged date**, **reported date** and **swept date**. Unless otherwise stated against an individual Object class within this document, all encoded dates will be converted to the appropriate S-101 attribute automatically on conversion.

Data Producers should consider interrogating their S-57 data holdings and deleting any objects where the date indicated by the attribute DATEND means that the object is time expired (that is, the date in DATEND is earlier than the date of conversion).

S-101 Information type: **Non-Standard Working Day** (N) (S-101 DCEG Clause 24.3)

##### 2.1.5.1 Seasonal Objects

Unless otherwise stated against an individual Object class within this document, all instances of encoding of attribute STATUS = 5 (periodic/intermittent) will be converted to the S-101 attribute **status** on conversion. See also Appendix A, Table A.2.

Unless otherwise stated against an individual Object class within this document, all instances of encoding of the attributes PERSTA and PEREND will be converted to the S-101 complex attribute **periodic date range** on conversion.

The encoding guidance for taking into account leap years (“last day in February”) for PEREND/PERSTA remains unchanged in S-101.

#### 2.1.6 Times

Not applicable.

S-101 Information type: **Service Hours** (N) (S-101 DCEG Clause 24.2)

#### 2.1.7 Cells

In S-57, the recommended coordinate multiplication factor for latitude and longitude coordinates is  $10000000$  ( $10^7$ ). This has been mandated in S-101. The value in the Coordinate Multiplication Factor [COMF] subfield of the Data Set Parameter [DSPM] field in S-57 will be populated in the “Coordinate Multiplication Factor for X-coordinate” [CMFX] and “Coordinate Multiplication Factor for Y-coordinate” [CMFY] subfields of the “Dataset Structure Information” [DSSI] field for the S-101 dataset.

#### 2.1.8 Seamless ENC coverage

The rules regarding ENC coverage (gaps in data coverage) remain unchanged for S-101.

The rules regarding ENC data overlaps are now described in terms of the maximum display scale for the data rather than Navigational Purpose, and are out of scope for this document. See S-101 DCEG clause 2.5.5 and S-101 Main document clause 4.5.3.

##### 2.1.8.1 Feature Object Identifiers

The value for Feature Object Identifiers (FOIDs) may be retained for all S-57 objects during conversion to S-101 features where a one-to-one Object/Feature relationship exists, if it is considered that this may aid in data management. The encoding guidance for assigning FOIDs to representations of real-world features (that is, each feature must have a unique FOID however multiple parts of an individual real-world feature within the cell may have the same FOID) remains unchanged in S-101.

### 2.1.8.2 180° Meridian of Longitude

The rule prohibiting datasets from crossing the 180° meridian remains unchanged for S-101.

## 2.2 Data quality description

### 2.2.1 Production information

The Producing Authority provided in the “Producing Agency” [AGEN] subfield of the “Data Set Identification” [DSID] field will be populated in the mandatory producingAgency field of the Dataset Discovery Metadata for the S-101 dataset.

### 2.2.2 Up-to-datedness information

Up-to-datedness information (provided in the “Edition Number” [EDTN], “Update Number” [UPDN], “Update Application Date” [UADT] and “Issue Date” [ISDT] subfields of the “Data Set Identification” [DSID] field) may be automatically reset in the corresponding S-101 file, ISO 8211 and Dataset Discovery Metadata fields, to reflect the release of a new S-101 dataset during the automated conversion process. The population of this information is at the discretion of the Data Producer, noting that there is no requirement for this information to be aligned between S-57 ENCs and the corresponding S-101 ENCs in ECDIS.

### 2.2.3 Quality, reliability and accuracy of bathymetric data

S-101 Information type: **Spatial Quality** (N) (S-101 DCEG Clause 24.5)

#### 2.2.3.1 Quality of bathymetric data

S-57 Meta Object: Quality of data (**M\_QUAL**) (A)

S-101 Meta Feature: **Quality of Bathymetric Data** (S) (S-101 DCEG Clause 3.7)

S-101 Association: **Quality of Bathymetric Data Composition** (N) (S-101 DCEG Clause 25.12)

The differences in the data modelling between the S-57 **M\_QUAL** Meta Object and the S-101 **Quality of Bathymetric Data** Meta Feature constitute one of the most significant changes from S-57 to S-101. In the S-101 data model, the defining S-57 CATZOC attribute has been effectively “deconstructed” into its component parts of position and depth accuracies; and seafloor coverage (including feature detection) in addition to the one-to-one translation to the S-101 attribute **category of zone of confidence in data**. This has been done in order to provide the mariner with more detailed information as to the quality of the bathymetric data included in the ENC dataset. For an indication of optional enhanced encoding available in S-101, see Appendix A, Table A.3.

Category of Zone of Confidence in Data: During the automated conversion process, the value populated in the S-57 attribute CATZOC will be converted directly to the S-101 attribute **category of zone of confidence in data**; and in addition will be used to populate the S-101 mandatory attributes **data assessment, features detected** (complex attribute), **full seafloor coverage achieved, horizontal position uncertainty** (complex attribute) and **vertical uncertainty** (complex attribute). The values populated for these attributes will correspond to the values shown in the ZOC table included in S-57 Appendix A, Chapter 2 – *Attributes*, as amended by S-57 Supplement No. 3. Data Producers may choose to re-evaluate these values in order to provide more accurate indications of these individual components of bathymetric data quality to the mariner, given that the automated values populated will correspond to the “worst case” for each component (see also additional comments for the **data assessment** attribute below). For this reason, and also so as to ensure consistent portrayal of the indication of overall bathymetric data quality during the S-57 to S-101 transition period, the S-101 attribute **category of zone of confidence in data** is included as identical to the S-57 CATZOC attribute, from which ECDIS portrayal will be derived.

Where the S-57 attributes POSACC or SOUACC have been populated for **M\_QUAL** to indicate a higher accuracy than the CATZOC indicates, these values will override the CATZOC categorisation of position and depth accuracy in populating the **horizontal position uncertainty** and **vertical uncertainty** complex attributes during the automated conversion process.

Data Assessment: The S-101 mandatory attribute **data assessment** introduces an option to reduce screen clutter in some ECDIS display modes through population of value 2 (assessed (oceanic)). This

value is intended for use where an indication of the overall data quality is not considered to be required – generally in depths deeper than 200 metres. However, determination as to when this value may be populated cannot be made during the automated conversion process, therefore for all **M\_QUAL** except those where CATZOC = 6 (zone of confidence U (data not assessed)), the corresponding **Quality of Bathymetric Data** will have **data assessment** populated with value 1 (assessed).

**Temporal Variation:** The S-101 mandatory attribute **category of temporal variation** introduces the ability for the Data Producer to incorporate the temporal impact on bathymetric data quality in areas where the seabed is likely to change over time, or in the wake of an extreme event such as a hurricane or tsunami. During the automated conversion process, for all **M\_QUAL** except those where CATZOC = 6 (zone of confidence U (data not assessed)), the corresponding **Quality of Bathymetric Data** will have **category of temporal variation** populated with value 5 (unlikely to change). For full S-101 functionality, Data Producers will be required to reassess the value of this attribute as required. For CATZOC = 6 (zone of confidence U (data not assessed)), **category of temporal variation** will be populated with value 6 (unassessed).

**Survey Data Range:** In S-57, the attribute SUREND is not mandatory for **M\_QUAL**. In S-101, the complex attribute **survey date range**, sub-attribute **date end**, is mandatory for **Quality of Bathymetric Data**. In order to optimise the S-57 to S-101 conversion process, Data Producers should ensure that the attribute SUREND is populated with appropriate values, if available, on all **M\_QUAL** Meta Objects for their S-57 datasets (for example, where the seabed is likely to change over time). If this is not done, **survey date range**, sub-attribute **date end** will be populated as empty (null) during the automated conversion process.

**Technique of Sounding Measurement:** While the S-57 attribute TECSOU is an allowable attribute for **M\_QUAL** in S-57 data, the corresponding S-101 attribute **technique of vertical measurement** is prohibited for **Quality of Bathymetric Data**. If it is considered important to retain this information when converting to S-101, Data Producers should remove TECSOU from **M\_QUAL** and may populate it on the individual features (wrecks, obstructions etc) as required. Alternatively, an S-101 Meta Feature **Quality of Survey** may be manually encoded.

**Bathymetric Data Quality and Dataset Compilation Scale:** In S-101, **Quality of Bathymetric Data** is not mandatory for data at smaller than 1:700000 maximum display scale. **M\_QUAL** will be converted to **Quality of Bathymetric Data** at all scales during the automated conversion process, however Data Producers may consider removing these features from converted S-101 data at smaller than 1:700000 maximum display scale, or utilising attribute **data assessment** value 2 (assessed (oceanic)) as appropriate.

### 2.2.3.2 Survey reliability

**S-57 Meta Object:** Survey reliability (**M\_SREL**) (L,A)

**S-101 Meta Feature:** **Quality of Survey** (C,S) (S-101 DCEG Clause 3.10)

All populated attributes for **M\_SREL** will be converted to the corresponding **Quality of Survey** attributes during the automated conversion process. However, the S-101 enumerate type attribute **quality of horizontal measurement** for **Quality of Survey** has restricted the list of allowable values from those allowed for the S-57 attribute QUAPOS to the following:

4 - approximate

Data Producers are advised to review their S-57 data holdings prior to conversion and amend any populated values for QUAPOS to value 4, if required. Other values for QUAPOS on **M\_SREL** will not be converted across to S-101.

In S-101, the **Quality of Survey** attributes **survey authority** and **survey type**; and complex attribute **survey date range** sub-attribute **date end** are mandatory, while in S-57 the corresponding attributes SURATH, SURTYP and SUREND are optional. During the automated conversion process, these attributes will be populated as empty (null) if they are not included in the S-57 dataset.

**Quality of Survey** includes the attribute **technique of vertical measurement** as an allowable attribute, while for **M\_SREL** the corresponding attribute TECSOU is prohibited. For guidance on the use of **technique of vertical measurement** for **Quality of Survey** in S-101, see clause 2.2.3.1.

### 2.2.3.3 Quality of sounding

Data Producers are advised that the value QUASOU = 5 (no bottom found at value shown) is prohibited for the corresponding S-101 attribute **quality of vertical measurement**. Where a **SOUNDG** object carries QUASOU = 5, it will be converted to an instance of the S-101 Feature type **Depth – No Bottom Found**. For any other S-57 objects carrying QUASOU = 5, the attribute will not be converted across to S-101.

For many Feature types in S-101, the allowable list of enumerate values for **quality of vertical measurement** is restricted from the full list allowable for QUASOU in S-57 ENCs, or **quality of vertical measurement** has been prohibited. These restrictions are identified against each of the Object class/Feature type descriptions in this document. Where appropriate, Data Producers should check their data holdings to ensure that encoded values for QUASOU are allowable values for **quality of vertical measurement** for the relevant binding Feature type. During the automated conversion process, prohibited values will not be converted across to S-101.

### 2.2.3.4 Sounding accuracy

Values populated for the S-57 attribute SOUACC will be converted to the S-101 complex attribute **vertical uncertainty**, sub-attribute **uncertainty fixed**. Note however that, while SOUACC is allowable for the Object class **SWPARE** in S-57, **vertical uncertainty** has been prohibited for the Feature type **Swept Area** in S-101 (see clause 5.6).

### 2.2.3.5 Technique of sounding measurement

The S-101 enumerate type attribute **technique of vertical measurement** has a restricted list of allowable values from those allowed for the S-57 attribute TECSOU for the following Object classes:

**DWRTCL DWRTPT RCRTCL RECTRC SOUNDG SWPARE TWRTPT M\_QUAL**

See entries for TECSOU in Appendix A, Table A.2. All other instances of encoding of TECSOU will be converted to the corresponding **technique of sounding measurement** values on conversion, except for the following:

- The TECSOU value 7 (found by laser) is prohibited in S-101. This value has been replaced by the **technique of vertical measurement** value 15 (found by LIDAR). During the automated conversion process, all instances of TECSOU = 7 will be converted to **technique of vertical measurement** = 15.
- The TECSOU value 14 (computer generated) is prohibited in S-101. During the automated conversion process, all instances of TECSOU = 14 will be converted to **technique of vertical measurement** = 17 (hyperspectral imagery). Data Producers should check their data holdings and amend as required so as to achieve the required conversion outcome.
- While TECSOU is allowable for the Object class **M\_QUAL** in S-57, **technique of vertical measurement** has been prohibited for the Meta Feature **Quality of Bathymetric Data** in S-101 (see clause 2.2.3.1).

## 2.2.4 Accuracy of non-bathymetric data

### 2.2.4.1 Quality of positions

S-57 Meta Object: Accuracy of data (**M\_ACCY**) (A)

S-101 Meta Feature: **Quality of Non-Bathymetric Data** (S) (S-101 DCEG Clause 3.3)

All instances of encoding of the S-57 Meta Object **M\_ACCY** and its binding attributes will be converted to an instance of the S-101 Meta Feature **Quality of Non-Bathymetric Data** during the automated conversion process.

### 2.2.4.2 Horizontal accuracy

Values populated for the S-57 attribute HORACC will be converted to the S-101 sub-attribute **horizontal distance uncertainty**. Note however that while HORACC is an allowable attribute for the following S-57 Object classes, **horizontal distance uncertainty** is prohibited for the corresponding S-101 features, and will therefore not be converted:

[DRYDOC]	<b>Dry Dock</b>
[FLODOC]	<b>Floating Dock</b>

[GRIDRN]	<b>Gridiron</b>
[HULKES]	<b>Hulk</b>
[LITFLT]	<b>Light Float</b>
[LITVES]	<b>Light Vessel</b>

It is considered that **horizontal distance uncertainty** is not relevant for these features in S-101.

Where HORACC has been populated for an instance of the S-57 Object class **BRIDGE**, this will be converted to **horizontal distance uncertainty** on an instance of the S-101 Feature type **Span Fixed** or **Span Opening**, noting that **horizontal distance uncertainty** is prohibited for the S-101 Feature type **Bridge** (see clause 4.8.10).

### 2.2.4.3 Vertical accuracy

Values populated for the S-57 attribute VERACC will be converted to the S-101 complex attribute **vertical uncertainty**, sub-attribute **uncertainty fixed** where allowed. Note however that **vertical uncertainty** has been prohibited for most S-101 features for which VERACC is allowable for the corresponding S-57 Object class, as it is considered that **vertical uncertainty** is not relevant for these features in S-101. Where this is the case, it is stated against the individual Object classes within this document.

Where VERACC has been populated for an instance of the S-57 Object class **BRIDGE**, this will be converted to **vertical uncertainty/uncertainty fixed** on an instance of the S-101 Feature type **Span Fixed** or **Span Opening**, noting that **vertical uncertainty** is prohibited for the S-101 Feature type **Bridge** (see clause 4.8.10).

## 2.2.5 Source of data

### 2.2.5.1 Source of bathymetric data

Values populated for the S-57 attribute SURATH on the **M\_SREL** Meta Object will be converted to the S-101 attribute **survey authority** for the **Quality of Survey** Meta Feature.

There is no equivalent S-101 attribute for the S-57 attribute SORIND, as it is considered that this information is not required for S-101 ENCs. During the automated conversion process, SORIND will not be converted across to S-101.

Except for reported dates, there is no equivalent S-101 attribute for the S-57 attribute SORDAT, as it is considered that this information is not required for S-101 ENCs. In S-101, reported dates are encoded using the attribute **reported date**. During the automated conversion process, where an S-57 Object class converts to an S-101 Feature type having **reported date** as an allowable attribute, values populated in SORDAT will be converted to **reported date**. Data Producers are advised to evaluate their data holdings to ensure that the value populated in SORDAT for these instances is actually the date that the instance was reported.

### 2.2.5.2 Source of other data

As for clause 2.2.5.1 above.

## 2.2.6 Compilation scale

There have been significant changes made in the way that scale information relevant to S-101 compiled data is encoded in comparison to S-57. Data Producers will be required to ensure that, when S-57 datasets are converted across to S-101, the scale information included in the dataset(s) is as intended, in terms of both the dataset itself and the intended performance in terms of dataset loading and unloading in ECDIS for the entire ENC portfolio.

The compilation scale appropriate to the greater part of the data in the cell provided in the "Compilation Scale of Data" [CSCL] subfield of the "Data Set Parameter" [DSPM] field will be converted to the mandatory maximumDisplayScale field of the Dataset Discovery Metadata for the S-101 dataset.

For S-101, the primary source of scale information for areas of data coverage within an S-101 dataset comes from the S-101 Meta Feature **Data Coverage**. This Meta Feature is effectively a combination of the S-57 Meta Object classes **M\_COVR** and **M\_CSCL**.

<u>S-57 Meta Object:</u>	Coverage ( <b>M_COVR</b> )	(A)
<u>S-57 Meta Object:</u>	Compilation scale of data ( <b>M_CSCL</b> )	(A)
<u>S-101 Meta Feature:</u>	<b>Data Coverage</b>	(S) (S-101 DCEG Clause 3.4)

See also S-101 DCEG clause 2.5.5 and S-101 Main document clause 4.5.3 for further information regarding S-101 data coverage and dataset loading and unloading.

The entire area of data coverage for the S-101 dataset must be covered by one or more non-overlapping **Data Coverage** features, having values for the mandatory attributes **maximum display scale** and **minimum display scale**. It is important to note that the values for these attributes, and the maximumDisplayScale field of the Dataset Discovery Metadata, must be taken from the following table:

Maximum display scale	Minimum display scale
10,000,000	empty (null)
3,500,000	10,000,000
1,500,000	3,500,000
700,000	1,500,000
350,000	700,000
180,000	350,000
90,000	180,000
45,000	90,000
22,000	45,000
12,000	22,000
8,000	12,000
4,000	8,000
3,000	4,000
2,000	3,000
1,000	2,000

table 2.3

During the automated conversion process, values for the maximumDisplayScale field of the Dataset Discovery Metadata and the **maximum display scale** attribute will be directly converted across from the S-57 dataset. If the S-57 scale value is not equal to one of the values from table 2.3 above, the corresponding S-101 value will be populated as the next largest scale value as taken from table 2.3.

For an S-57 dataset containing no **M\_CSCL** Meta Objects, an S-101 **Data Coverage** Meta Feature is created for each area of the dataset corresponding to **M\_COVR** having attribute CATCOV = 1 (coverage available), and taking the value populated in the "Compilation Scale of Data" [CSCL] subfield of the "Data Set Parameter" [DSPM] field to convert to **maximum display scale** based on the above paragraph.

Where an S-57 dataset contains one or more **M\_CSCL** Meta Objects, the **Data Coverage** Meta Feature(s) created from **M\_COVR** are effectively "cookie-cut" to create separate disjoint **Data Coverage** Meta Feature(s), having **maximum display scale** converted in accordance with the value populated for the attribute CSCALE for the **M\_CSCL** based on table 2.3 and above paragraphs.

In all cases during the automated conversion process, the mandatory attribute **minimum display scale** will be set to an empty (null) value. Data Producers will be required to manually populate this attribute in accordance with the intended ECDIS performance, based on the available S-101 ENC portfolio.

### 2.2.7 Use of the attribute SCAMIN

S-57 Attribute: Scale minimum (SCAMIN)

S-101 Attribute: **scale minimum** (S-101 DCEG Clause 2.5.9)

In S-101 a direct relationship has been defined between the display scale of data encoded in the S-101 dataset; the values encoded for the attribute **scale minimum**; and ECDIS data display scales. This has

been done in order to ensure optimum performance of S-101 ENC in ECDIS, and has been achieved by:

- Restricting the allowable compilation scales indicated by the values for the attributes **maximum display scale** and **minimum display scale** (see clause 2.2.6);
- Recommending that ECDIS manufacturers use this restricted list of compilation scales as a minimum list of allowable ECDIS display step scales when the mariner zooms in or out; and
- Restricting the allowable values for the attribute **scale minimum** based on harmonisation with dataset compilation scales and recommended ECDIS display scales.

In S-101, values for the attribute **scale minimum** must be taken from the following table:

19999999
9999999
4999999
3499999
1499999
999999
699999
499999
349999
259999
179999
119999
89999
59999
44999
29999
21999
17999
11999
7999
3999
2999
1999
999

table 2.4 – S-101 **scale minimum** values

For an optimum outcome during the automated conversion process and to ensure consistent data display in a “dual fuel” ECDIS environment, Data Producers are advised to examine their S-57 ENC portfolios and amend values assigned for the attribute SCAMIN in accordance with table 2.4 above. SCAMIN values other than those in table 2.4 will be converted to the value corresponding to the next smallest scale value in table 2.4 for **scale minimum**.

### 2.2.7.1 Sample SCAMIN policy

The S-101 sample **scale minimum** policy is consistent with that for the S-57 attribute SCAMIN. There is no requirement to amend SCAMIN in this regard.

## 2.3 Textual information

Information contained in the S-57 attributes INFORM, NINFOM, TXTDSC and NTXTDS on individual Object instances in S-57 is encoded in S-101 using the attributes **information** (complex attribute) and **pictorial representation** on the feature instance or by using the information type **Nautical Information**.

**Nautical Information** is associated to the feature instance for which the information applies using the association **Additional Information**.

<u>S-101 Information type:</u>	<b>Nautical Information</b>	(N)	(S-101 DCEG Clause 24.4)
<u>S-101 Information type:</u>	<b>Contact Details</b>	(N)	(S-101 DCEG Clause 24.1)
<u>S-101 Association:</u>	<b>Additional Information</b>	(N)	(S-101 DCEG Clause 25.1)

Information contained in the S-57 attributes INFORM and NINFOM will generally be converted directly to an instance of the S-101 complex attribute **information**, sub-attribute **text** for the corresponding S-101 feature instance during the automated conversion process. However, the following exceptions and issues must be noted:

- In some cases, information encoded using INFORM/NINFOM in S-57 has been implemented in S-101 as an enhancement to the data model such as a new dedicated feature, attribute or enumerate value. Within this document, this is indicated against the relevant Object class along with any additional guidance to assist in the automated conversion process. This guidance may include instruction as to a standard text string to be populated in INFORM that can be recognised by the S-57 to S-101 converter so as to convert to a new S-101 feature/attribute/enumerate. This may be specific to a particular conversion technology and will require Data Producers to check their S-57 ENC portfolio prior to conversion and apply these changes as required, noting however that data conversion tools may include the capability to customise the conversion process in accordance with national encoding practices. In such cases an instance of **information** may not be created;
- In relation to the above, Data Producers must note that additional encoded instances of INFORM in an ENC dataset so as to aid in the conversion process may result in excessive screen clutter (display of “information” symbols) in certain S-57 ECDIS display settings. Data Producers should evaluate the impact for the mariner of guidance within this document to populate INFORM additional to existing instances in their S-57 ENC portfolio and consider options to mitigate this impact. This may include population of INFORM (or database specific variant attributes) in the S-57 source database and filtering out these instances on creation of the S-57 product dataset; and
- Information encoded in NINFOM, when converted to S-101, requires an entry in the **information** complex attribute instance, sub-attribute **language** to indicate the language of the text string. There is no corresponding attribute in S-57 to provide this information. Data Producers may be required to manually populate this attribute during the conversion process, however a suitably configured converter may populate this attribute as part of the automated conversion process (see S-101 DCEG clause 2.4.6).

The attributes TXTDSC and NTXTDS will be converted directly to an instance of the S-101 complex attribute **information**, sub-attribute **file reference** for the corresponding S-101 feature instance during the automated conversion process. However, the following issues must be noted:

- The file naming convention for support files in S-101 is different from the convention used in S-57. Data Producers will be required to revisit automatically converted instances of the **file reference** sub-attribute during the conversion process and apply the new convention for both the **file reference value** and the name of the referenced file itself (see S-101 Main document clause 11.4); and
- Information encoded in NTXTDS, when converted to S-101, requires an entry in the **information** complex attribute instance, sub-attribute **language** to indicate the language of the text in the associated text file. There is no corresponding attribute in S-57 to provide this information. Data Producers may be required to manually populate this attribute during the conversion process, however a suitably configured converter may populate this attribute as part of the automated conversion process (see S-101 DCEG clause 2.4.6).

Where information contained in INFORM, NINFOM, TXTDSC and NTXTDS is duplicated for multiple Object instances in an S-57 dataset, this may be encoded more economically in the corresponding S-101 dataset by associating an instance of the S-101 Information type **Nautical Information** to the relevant S-101 Geo Features (see S-101 DCEG clause 24.4) using the association **Additional Information** (see S-101 DCEG clause 25.1). Where this is considered to be the preferred encoding, Data Producers will be required to manually encode the **Nautical Information**; associate this feature to the relevant S-101 Geo Features using the association **Additional Information**; and remove the complex attribute **information** from these Geo Features. Note that this encoding may also be considered where textual information is duplicated across multiple datasets within the S-57/S-101 ENC portfolio.

## 2.4 Colours and colour patterns

With the exception of the cases described below, all instances of encoding of attribute COLOUR will be converted to the S-101 attribute **colour** during the automated conversion process.

The allowable list of enumerate values for **colour** is restricted from the full list allowable for COLOUR in S-57 ENCs for the following features:

<b>Coastline</b>	[COALNE]	(S-101 DCEG clause 5.3)
<b>Light Air Obstruction</b>	[LIGHTS]	(S-101 DCEG clause 19.5)
<b>Light All Around</b>	[LIGHTS]	(S-101 DCEG clause 19.2)
<b>Light Fog Detector</b>	[LIGHTS]	(S-101 DCEG clause 19.4)
<b>Light Sectored</b>	[LIGHTS]	(S-101 DCEG clause 19.3)
<b>Sloping Ground</b>	[SLOGRD]	(S-101 DCEG clause 5.14)
<b>Slope Topline</b>	[SLOTOP]	(S-101 DCEG clause 5.15)

The list of allowable colours for these features can be found in the S-101 DCEG clauses cited against each feature above and in Appendix A, Table A.2 of this document. Data Producers are advised to check values of COLOUR populated for the corresponding S-57 objects, as conversion of this attribute is automated only if the value populated for COLOUR is an allowable value in S-101.

Note that **colour** has been prohibited for the S-101 Feature type **Seabed Area**, for which COLOUR is allowable for the corresponding S-57 **SBDARE** Object class. It is considered that **colour** is not relevant for this feature in S-101.

All instances of encoding of attribute COLPAT will be converted to the S-101 attribute **colour pattern** during the automated conversion process. However where COLPAT has more than one value, Data Producers should evaluate this encoding and populate only the most important value required for marine navigation, noting that **colour pattern** has multiplicity [0..1] in S-101 (see S-101 DCEG clause 2.4.10).

## 2.5 Reference to other publications

S-57 Meta Object: Nautical publication information (**M\_NPUB**) (P,A)

S-101 Geo Feature: **Information Area** (P,C,S) (S-101 DCEG Clause 16.11)

Information contained in the S-57 attributes INFORM and NINFOM for **M\_NPUB** will be converted to the S-101 complex attribute **information**, sub-attribute **text** for an instance of the S-101 Feature type **Information Area** during the automated conversion process. See also clause 2.3.

References to nautical publication information contained in the S-57 attribute PUBREF for **M\_NPUB** will be converted to the S-101 complex attribute **information**, sub-attribute **headline** on **Information Area** during the automated conversion process.

## 2.6 Updating

Not applicable.

### 2.6.1 Issuing Updates in advance

Not applicable.

#### 2.6.1.1 Advance notification of changes to traffic separation schemes

Not applicable.

### 2.6.2 Guidelines for encoding Temporary and Preliminary ENC Updates

Not applicable.

## 2.7 Multiple objects and objects shown out of position on paper charts

In S-101, the textual indication of the existence of multiple real-world features represented by a single encoded feature instance has been enhanced by the introduction of a new complex attribute **multiplicity of features**. However this complex attribute has not been bound to all S-101 Geo Features.

During the S-57 to S-101 automated conversion process, unless otherwise described against individual Object classes within this document, all instances of encoding of the attributes INFORM will be converted automatically to the S-101 complex attribute **information**, sub-attribute **text**. Data Producers will be required to evaluate these incidences manually and, if the information is related to multiplicity of features and the S-101 feature carries **multiplicity of features** as an allowable attribute, populate this attribute accordingly. If no other information is included in the **information** attribute, this attribute can be removed.

## **2.8 Minimal depiction areas**

### **2.8.1 Wide blank areas**

The S-57 Meta Object **M\_COVR** having attribute CATCOV = 2 (no coverage available) will not be converted across to S-101. There is no requirement in S-101 to indicate areas of the ENC dataset that have no data coverage. See also clause 2.2.6.

The requirement to avoid leaving “holes” in data coverage for an ENC dataset on the assumption that the end user also has the larger scale ENC(s) available remains unchanged in S-101.

### **2.8.2 Simplified or minimal depiction areas**

The S-101 encoding guidance for the encoding of simplified or minimal depiction areas in ENCs has not changed from S-57 (see also clause 6.6).

## 3 Time Varying Objects

### 3.1 Magnetic data

#### 3.1.1 Magnetic variation

S-57 Geo Object: Magnetic variation (**MAGVAR**) (P,L,A)

S-101 Geo Feature: **Magnetic Variation** (P,C,S) (S-101 DCEG Clause 4.1)

All instances of encoding of the S-57 Object class **MAGVAR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Magnetic Variation** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes DATEND and DATSTA for **MAGVAR** will not be converted. It is considered that these attributes are not relevant for **Magnetic Variation** in S-101.

#### 3.1.2 Abnormal magnetic variation

S-57 Geo Object: Local magnetic anomaly (**LOCMAG**) (P,L,A)

S-101 Geo Feature: **Local Magnetic Anomaly** (P,C,S) (S-101 DCEG Clause 4.2)

All instances of encoding of the S-57 Object class **LOCMAG** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Local Magnetic Anomaly** during the automated conversion process. However the following exceptions apply:

- The S-57 mandatory attribute VALLMA has been remodelled in S-101 as the mandatory complex attribute **value of local magnetic anomaly**, having sub-attributes **magnetic anomaly value maximum** (mandatory) and **magnetic anomaly value minimum**, where:
  - **magnetic anomaly value maximum** is intended to indicate the positive anomaly value where **magnetic anomaly value minimum** is also populated; or both the positive and negative values where **magnetic anomaly value maximum** only is populated; and
  - **magnetic anomaly value minimum** is intended to indicate the negative anomaly value, but only where the positive and negative values are not equal.

During the automated conversion process, the value populated in VALLMA will be converted across to **magnetic anomaly value maximum**. Data Producers will be required to confirm whether the value populated in VALLMA is intended to indicate both the positive and negative values of the anomaly, or a disparate range; noting that S-57 guidance recommends encoding the values of a range in INFORM for the **LOCMAG**. Where the anomaly is a disparate range, Data producers will be required to adjust the values of **magnetic anomaly value maximum** and **magnetic anomaly value minimum** accordingly; and if the information contained in INFORM relates only to the range of anomaly values, remove the associated instance of the complex attribute **information** (see clause 2.3).

### 3.2 Tidal data

Tidal data is not included in S-101. It is recommended that Data Producers evaluate any tidal information that is included in S-57 ENCs and consider inclusion of this information in datasets conforming to Product Specification S-104 – *Water Level Information for Surface Navigation* (in development 2022).

### 3.3 Tidal stream data

#### 3.3.1 Tidal stream (flood/ebb)

S-57 Geo Object: Tidal stream-flood/ebb (**TS\_FEB**) (P,A)

S-101 Geo Feature: **Tidal Stream – Flood/Ebb** (P,S) (S-101 DCEG Clause 10.2)

All instances of encoding of the S-57 Object class **TS\_FEB** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Tidal Stream – Flood/Ebb** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes PEREND and PERSTA for **TS\_FEB** will not be converted. It is considered that these attributes are not relevant for **Tidal Stream – Flood/Ebb** in S-101.

### 3.3.2 Tidal stream time series

Not applicable.

### 3.3.3 Prediction by harmonic methods

Not applicable.

### 3.3.4 Prediction by non-harmonic methods

Not applicable.

### 3.3.5 Tidal stream panels

S-57 Geo Object: Tidal steam panel data (**TS\_PAD**) (P,A)

S-101 Geo Feature: **Tidal Stream Panel Data** (P,S) (S-101 DCEG Clause 10.5)

All instances of encoding of the S-57 Object class **TS\_PAD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Tidal Stream Panel Data** during the automated conversion process.

It is important to note that the S-57 formatted text type mandatory attribute TS\_TSP has been remodelled in **Tidal Stream Panel Data** to its constituent parts as follows (see also example in DCEG clause 10.5.1 Remarks):

- First value (tidal station number) -> **station number** (optional). This attribute will only be populated in S-101 if the first character of TS\_TSP is not a delimiting comma.
- Second value (tidal station name) -> **station name** (mandatory).
- Third value (reference tide) -> **tidal stream panel values/reference tide** (mandatory)
- Fourth to 29<sup>th</sup> values (stream orientation and rate, 13 x ordered pairs) -> **tidal stream panel values**, ordered instances (x 13) of sub-complex attribute **tidal stream value** (mandatory). Each instance of **tidal stream value** is converted to a single pair of stream orientation (**orientation/orientation value**) and stream rate (**speed maximum**) values (mandatory). For each ordered instance of **tidal stream value** the sub-attribute **time relative to tide** will be populated with the hourly rate values from values -6 to 6 corresponding to the hours before/at (0)/after the reference tide time.

The S-101 mandatory attribute **tidal stream panel values/reference tide type** will be populated during the automated conversion process with value 1 (springs). If the referenced tide is to neap or mean tides, Data Producers may populate this information using a standardised text string in the attribute INFORM, for instance “*Neaps*” or “*Mean*”; or will be required to manually amend this value after conversion.

## 3.4 Current data

S-57 Geo Object: Current (**CURRENT**) (P)

S-101 Geo Feature: **Current – Non-Gravitational** (P) (S-101 DCEG Clause 10.3)

All instances of encoding of the S-57 Object class **CURRENT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Current – Non-Gravitational** during the automated conversion process.

## 4 Topography

The encoding guidance for level of topographic detail to be included in ENC remains unchanged in S-101.

### 4.1 Land area

S-57 Geo Object: Land area (**LNDARE**) (P,L,A)

S-101 Geo Feature: **Land Area** (P,C,S) (S-101 DCEG Clause 5.4)

All instances of encoding of the S-57 Object class **LNDARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Land Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Land Area** in S-101:

**status** (STATUS)

See S-101 DCEG clause 5.4 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **LNDARE** and amend appropriately.

### 4.2 Vertical measurements

#### 4.2.1 Vertical datum

See clause 2.1.2.

#### 4.2.2 Heights and elevations

All instances of encoding of the attribute ELEVAT will be converted automatically to an instance of the S-101 attribute **elevation** on conversion.

Unless otherwise stated against an individual Object class within this document, all instances of encoding of the attributes HEIGHT and VERLEN will be converted automatically to an instance of the S-101 attributes **height** and **vertical length**, respectively, on conversion.

### 4.3 Control points

S-57 Geo Object: Control point (**CTRPNT**) (P)

For S-101, it is considered that control point information is not required for ENC. In general, therefore, encoded **CTRPNT** will not be converted. However, in certain circumstances where a control point may be visible from seaward and therefore used as a navigational fixing mark, this information may be encoded in S-101 using a **Landmark** feature. During the automated conversion process, the following **CTRPNT/CATCTR** encoding instances will be converted to the corresponding **Landmark/category of landmark** instances, along with any other common **CTRPNT/Landmark** attributes.

CATCTR = 1 (triangulation mark) -> **category of landmark** = 22 (triangulation mark)

CATCTR = 5 (boundary mark) -> **category of landmark** = 23 (boundary mark)

Data Producers are advised to evaluate their data holdings to ensure that any encoded **CTRPNT** objects that may be used as a navigational fixing mark are encoded as **CTRPNT** with CATCTR = 1 or 5, or re-encode as a **LNDMRK** object, prior to conversion.

### 4.4 Distance marks

S-57 Geo Object: Distance mark (**DISMAR**) (P)

S-101 Geo Feature: **Distance Mark** (P) (S-101 DCEG Clause 8.9)

All instances of encoding of the S-57 Object class **DISMAR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Distance Mark** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- In S-57, the value of the measured distance and its unit of measurement is encoded using the attribute INFORM. In S-101 a new complex attribute **measured distance value** having sub-

attributes **distance unit of measurement** and **waterway distance** has been introduced to encode this information. In order for the attributes **distance unit of measurement** and **waterway distance** to be populated during the automated conversion process, the text string encoded in INFORM on the **DISMAR** should be in a standardised format, such as “*Waterway distance = [xxx] [yyyy]*”, where [xxx] is the value of the distance relevant to the mark and [yyyy] is the units of measure for the measured distance which must correspond to one of the allowable values for the attribute **distance unit of measurement** (see S-101 DCEG clause 8.9). For example *Waterway distance = 300 metres*.

- The S-57 attribute CATDIS has been replaced in S-101 by the Boolean type attribute **distance mark visible**. Where the value populated for **distance mark visible** during the automated conversion process is set to *True*, Data Producers must ensure that there is an appropriate structure feature encoded at the position of the distance mark and a **Structure/Equipment** relationship is established between this structure feature and the **Distance Mark** feature.

## 4.5 Coastline

### 4.5.1 Natural coastline

S-57 Geo Object: Coastline (**COALNE**) (L)

S-101 Geo Feature: **Coastline** (C) (S-101 DCEG Clause 5.3)

All instances of encoding of the S-57 Object class **COALNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Coastline** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Coastline** in S-101:

**category of coastline** (CATCOA)

**colour** (COLOUR)

See S-101 DCEG clause 5.3 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101, with the following exceptions:

- The attribute **nature of surface** has been included as an allowable attribute for **Coastline** in S-101. During the automated conversion process, the following **COALNE/CATCOA** encoding instances will be converted to the corresponding **Coastline/nature of surface** instances.
  - CATCOA = 3 (sandy shore) -> **nature of surface** = 4 (sand)
  - CATCOA = 4 (stony shore) -> **nature of surface** = 5 (stone)
  - CATCOA = 5 (shingly shore) -> **nature of surface** = 7 (pebbles)
  - CATCOA = 9 (coral reef) -> **nature of surface** = 14 (coral)
  - CATCOA = 11 (shelly shore) -> **nature of surface** = 17 (shells)

Data Producers are advised to check any populated values for COLOUR on **COALNE** and amend appropriately.

### 4.5.2 Artificial coastline

S-57 Geo Object: Shoreline construction (**SLCONS**) (P,L,A)

S-101 Geo Feature: **Shoreline Construction** (P,C,S) (S-101 DCEG Clause 8.6)

All instances of encoding of the S-57 Object class **SLCONS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Shoreline Construction** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Shoreline Construction** in S-101:

**status** (STATUS)

See S-101 DCEG clause 8.6 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **SLCONS** and amend appropriately.

Data Producers are advised that the S-57 attribute CATSLC value 6 (wharf (quay)) has been split into two values for the S-101 attribute **category of shoreline construction** of 6 (wharf) and 22 (quay); and instances of conversion to value 6 in S-101 should be evaluated if considered necessary and amended as appropriate.

## 4.6 Harbour installations

### 4.6.1 Harbour facilities

S-57 Geo Object: Harbour facility (**HRBFAC**) (P,A)

S-101 Geo Feature: **Harbour Facility** (P,S) (S-101 DCEG Clause 22.7)

All instances of encoding of the S-57 Object class **HRBFAC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Harbour Facility** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Harbour Facility** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 22.7 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **HRBFAC** and amend appropriately.

### 4.6.2 Berths

S-57 Geo Object: Berth (**BERTHS**) (P,L,A)

S-101 Geo Feature: **Berth** (P,C,S) (S-101 DCEG Clause 8.13)

All instances of encoding of the S-57 Object class **BERTHS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Berth** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Berth** in S-101:

**quality of vertical measurement** (QUASOU)

**status** (STATUS)

See S-101 DCEG clause 8.13 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for QUASOU and STATUS on **BERTHS** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The attribute **maximum permitted draught** has been introduced in S-101 to encode the maximum permitted vessel draught at the berth. This information is encoded in S-57 on **BERTHS** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **BERTHS** should be in a standardised format, such as *Maximum draught permitted = [xx.x] metres*, where [xx.x] is the value of the maximum permitted vessel draught (decimal part not required if the value is whole metres). For example *Maximum draught permitted = 11.5 metres*.

### 4.6.3 Harbour offices

See clause 4.8.15.

### 4.6.4 Checkpoints

S-57 Geo Object: Checkpoint (**CHKPNT**) (P,A)

S-101 Geo Feature: **Checkpoint** (P,S) (S-101 DCEG Clause 8.2)

All instances of encoding of the S-57 Object class **CHKPNT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Checkpoint** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Checkpoint** in S-101:

**status** (STATUS)

See S-101 DCEG clause 8.2 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **CHKPNT** and amend appropriately.

#### 4.6.5 Small craft facilities

S-57 Geo Object: Small craft facility (**SMCFAC**) (P,A)

S-101 Geo Feature: **Small Craft Facility** (P,S) (S-101 DCEG Clause 22.8)

All instances of encoding of the S-57 Object class **SMCFAC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Small Craft Facility** during the automated conversion process.

#### 4.6.6 Docks

##### 4.6.6.1 Dry docks

S-57 Geo Object: Dry dock (**DRYDOC**) (A)

S-101 Geo Feature: **Dry Dock** (S) (S-101 DCEG Clause 8.15)

All instances of encoding of the S-57 Object class **DRYDOC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dry Dock** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute HORACC for **DRYDOC** will not be converted. It is considered that this attribute is not relevant for **Dry Dock** in S-101.

The following additional requirements for S-57 attribution must be noted:

- The attribute **maximum permitted draught** has been introduced in S-101 to encode the maximum permitted vessel draught at the dock. This information is encoded in S-57 on **DRYDOC** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **DRYDOC** should be in a standardised format, such as *Maximum draught permitted = [xx.x] metres*, where [xx.x] is the value of the maximum permitted vessel draught (decimal part not required if the value is whole metres). For example *Maximum draught permitted = 11.5 metres*.

##### 4.6.6.2 Floating docks

S-57 Geo Object: Floating dock (**FLODOC**) (L,A)

S-101 Geo Feature: **Floating Dock** (P,C,S) (S-101 DCEG Clause 8.16)

All instances of encoding of the S-57 Object class **FLODOC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Floating Dock** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute HORACC for **FLODOC** will not be converted. It is considered that this attribute is not relevant for **Floating Dock** in S-101.

For S-57 **FLODOC** of type area is designated as being part of Group 1 (Skin of the Earth) feature coverage. In S-101, **Floating Dock** has been removed from Group 1 (see S-101 Main document clause 4.3.2.1.1). Data Producers must ensure that appropriate S-101 Skin of the Earth feature coverage exists under any converted **Floating Dock** feature, for example an **Unsurveyed Area** feature that shares the geometry of the **Floating Dock**. Where an instance of the Object class **CTNARE** has been encoded in S-57 to indicate periodicity of the dock using the attributes INFORM or TXTDSC, the corresponding S-101 instance of the Feature type **Caution Area** must be examined and amended/deleted as required; and the date information encoded using the complex attribute **fixed date range** for the **Floating Dock**.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Floating Dock** in S-101:

**condition** (CONDTN)

See S-101 DCEG clause 8.16 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CONDTN on **FLODOC** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The attribute **maximum permitted draught** has been introduced in S-101 to encode the maximum permitted vessel draught at the dock. This information is encoded in S-57 on **FLODOC** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the

text string encoded in INFORM on the **FLODOC** should be in a standardised format, such as *Maximum draught permitted = [xx.x] metres*, where [xx.x] is the value of the maximum permitted vessel draught (decimal part not required if the value is whole metres). For example *Maximum draught permitted = 11.5 metres*.

#### 4.6.6.3 Tidal and non-tidal basins

S-57 Geo Object: Dock area (**DOCARE**) (A)

S-101 Geo Feature: **Dock Area** (S) (S-101 DCEG Clause 8.18)

All instances of encoding of the S-57 Object class **DOCARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dock Area** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes DATEND, DATSTA and SCAMIN for **DOCARE** will not be converted. In S-101, the **Dock Area** feature has been included as a Skin of the Earth feature (see S-101 Main document clause 4.3.2.1.1), and as such cannot be removed from the ECDIS portrayal based on date or viewing scale dependency. Date dependency for **Dock Area** in S-101, if required, is indicated by including this information in the complex attribute **information**. See S-101 DCEG clause 8.18.1.

As **Dock Area** has been included as a Skin of the Earth (Group 1) feature in S-101, the geometry of the S-57 Group 1 coverage will be “cookie cut” to incorporate the geometry of the **Dock Area**, and the associated features amended accordingly including removal of the S-57 Group 1 overlapping area. In order to simplify the creation of the required geometry in the S-101 ENC dataset, Data Producers may consider amending their S-57 Group 1 coverage to have a discrete Group 1 object, such as **UNSARE**, coincident with the **DOCARE**.

The following additional requirements for S-57 attribution must be noted:

- The attribute **maximum permitted draught** has been introduced in S-101 to encode the maximum permitted vessel draught at the dock. This information is encoded in S-57 on **DOCARE** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **DOCARE** should be in a standardised format, such as *Maximum draught permitted = [xx.x] metres*, where [xx.x] is the value of the maximum permitted vessel draught (decimal part not required if the value is whole metres). For example *Maximum draught permitted = 11.5 metres*.

#### 4.6.6.4 Gates

S-57 Geo Object: Gate (**GATCON**) (P,L,A)

S-101 Geo Feature: **Gate** (P,C,S) (S-101 DCEG Clause 8.10)

All instances of encoding of the S-57 Object class **GATCON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Gate** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Gate** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 8.10 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **GATCON** and amend appropriately.

#### 4.6.6.5 Locks

S-57 Geo Object: Lock basin (**LOKBSN**) (A)

S-101 Geo Feature: **Lock Basin** (S) (S-101 DCEG Clause 8.20)

All instances of encoding of the S-57 Object class **LOKBSN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Lock Basin** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes DATEND, DATSTA and SCAMIN for **LOKBSN** will not be converted. In S-101, the **Lock Basin** feature has been included as a Skin of the Earth feature (see S-101 Main document clause 4.3.2.1.1), and as such cannot be removed from the ECDIS portrayal based on date or

viewing scale dependency. Date dependency for **Lock Basin** in S-101, if required, is indicated by including this information in the complex attribute **information**. See S-101 DCEG clause 8.20.1.

As **Lock Basin** has been included as a Skin of the Earth (Group 1) feature in S-101, the geometry of the S-57 Group 1 coverage will be “cookie cut” to incorporate the geometry of the **Lock Basin**, and the associated features amended accordingly including removal of the S-57 Group 1 overlapping area. In order to simplify the creation of the required geometry in the S-101 ENC dataset, Data Producers may consider amending their S-57 Group 1 coverage to have a discrete Group 1 object, such as **UNSARE**, coincident with the **LOKBSN**.

#### 4.6.6.6 Gridirons

S-57 Geo Object: Gridiron (**GRIDRN**) (P,A)

S-101 Geo Feature: **Gridiron** (S) (S-101 DCEG Clause 8.19)

All instances of encoding of the S-57 Object class **GRIDRN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Gridiron** during the automated conversion process. However the following exceptions apply:

- **GRIDRN** of type point will not be converted. In S-101, the S-101 **Gridiron** feature has allowable primitive surface only as it is considered that this feature is only required for the largest scale ENC data. Data Producers will be required to amend their S-57 data as appropriate.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Gridiron** in S-101:

**nature of construction** (NATCON)

**status** (STATUS)

**water level effect** (WATLEV)

See S-101 DCEG clause 8.19 for the listing of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON, STATUS and WATLEV on **GRIDRN** and amend appropriately.

#### 4.6.7 Mooring / warping facilities and pontoons

##### 4.6.7.1 Mooring / warping facilities

S-57 Geo Object: Mooring / warping facility (**MORFAC**) (P,L,A)

S-101 Geo Feature: **Mooring/Warping Facility** (P,C,S) (S-101 DCEG Clause 8.14)

All instances of encoding of the S-57 Object class **MORFAC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Mooring/Warping Facility** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Mooring/Warping Facility** in S-101:

**nature of construction** (NATCON)

**status** (STATUS)

**water level effect** (WATLEV)

See S-101 DCEG clause 8.14 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON, STATUS and WATLEV on **MORFAC** and amend appropriately.

##### 4.6.7.2 Piles

S-57 Geo Object: Pile (**PILPNT**) (P)

S-101 Geo Feature: **Pile** (P,C,S) (S-101 DCEG Clause 8.4)

All instances of encoding of the S-57 Object class **PILPNT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pile** during the automated conversion process.

### 4.6.7.3 pontoons

S-57 Geo Object: Pontoon (**PONTON**) (L,A)

S-101 Geo Feature: **Pontoon** (P,C,S) (S-101 DCEG Clause 8.17)

All instances of encoding of the S-57 Object class **PONTON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pontoon** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute NATCON for **PONTON** will not be converted. It is considered that this attribute is not relevant for **Pontoon** in S-101.

For S-57 **PONTON** of geometric primitive area is designated as being part of Group 1 (Skin of the Earth) feature coverage. In S-101, **Pontoon** has been removed from Group 1 (see S-101 Main document clause 4.3.2.1.1). Data Producers must ensure that appropriate S-101 Skin of the Earth coverage exists under any converted **Pontoon** feature, for example an **Unsurveyed Area** feature that shares the geometry of the **Pontoon**. Where an instance of the S-57 Object class **CTNARE** has been encoded in to indicate periodicity of the pontoon using the attributes INFORM or TXTDSC, the corresponding S-101 instance of the Feature type **Caution Area** must be examined and amended/deleted as required; and the date information encoded using the complex attribute **fixed date range** for the **Pontoon**.

### 4.6.8 Hulks

S-57 Geo Object: Hulk (**HULKES**) (P,A)

S-101 Geo Feature: **Hulk** (P,S) (S-101 DCEG Clause 8.3)

All instances of encoding of the S-57 Object class **HULKES** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Hulk** during the automated conversion process.

For S-57 **HULKES** of geometric primitive area is designated as being part of Group 1 (Skin of the Earth) feature coverage. In S-101, **Hulk** has been removed from Group 1 (see S-101 Main document clause 4.3.2.1.1). Data Producers must ensure that appropriate S-101 Skin of the Earth coverage exists under any converted **Hulk** feature, for example an **Unsurveyed Area** feature that shares the geometry of the **Hulk**. Where an instance of the S-57 Object class **CTNARE** has been encoded in to indicate periodicity of the dock using the attributes INFORM or TXTDSC, the corresponding S-101 instance of the Feature type **Caution Area** must be examined and amended/deleted as required; and the date information encoded using the complex attribute **fixed date range** for the **Hulk**.

### 4.6.9 Dockside buildings and structures

#### 4.6.9.1 Transit sheds and warehouses

See clause 4.8.15.

#### 4.6.9.2 Timber yards

See clause 4.8.13.

#### 4.6.9.3 Cranes

S-57 Geo Object: Crane (**CRANES**) (P,A)

S-101 Geo Feature: **Crane** (P,C,S) (S-101 DCEG Clause 8.12)

All instances of encoding of the S-57 Object class **CRANES** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Crane** during the automated conversion process.

S-101 includes the system attribute **in the water** to indicate that a crane that is located offshore is to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with the S-101 **Crane** feature so as to ensure display of a feature at the position of the crane in ECDIS Base display. Data Producers should consider removing these features from their S-101 data during the conversion process.

#### 4.6.10 Works in progress and projected

The encoding guidance for the indication of works in progress or projected remains unchanged in S-101, and as such all indications of works in progress or projected in S-57 data will be included in the converted S-101 dataset. See S-101 DCEG clause 8.1.

### 4.7 Natural features

#### 4.7.1 Natural sceneries

S-57 Geo Object: Land region (**LNDRGN**) (P,A)

S-101 Geo Feature: **Land Region** (P,C,S) (S-101 DCEG Clause 5.11)

All instances of encoding of the S-57 Object class **LNDRGN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Land Region** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute NATQUA for **LNDRGN** will not be converted. It is considered that this attribute is not relevant for **Land Region** in S-101.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Land Region** in S-101:

**water level effect** (WATLEV)

See S-101 DCEG clause 5.11 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for WATLEV on **LNDRGN** and amend appropriately.

#### 4.7.2 Height contours, spot heights

S-57 Geo Object: Land elevation (**LNDELV**) (P,L)

S-101 Geo Feature: **Land Elevation** (P,C) (S-101 DCEG Clause 5.6)

All instances of encoding of the S-57 Object class **LNDELV** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Land Elevation** during the automated conversion process.

#### 4.7.3 Marsh

The guidance for the encoding of marshes remains unchanged in S-101. See S-101 DCEG clause 5.11.1.1.

#### 4.7.4 Dunes, sand hills

S-57 Geo Object: Sloping ground (**SLOGRD**) (P,A)

S-101 Geo Feature: **Sloping Ground** (P,S) (S-101 DCEG Clause 5.14)

All instances of encoding of the S-57 Object class **SLOGRD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Sloping Ground** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Sloping Ground** in S-101:

**colour** (COLOUR)

**nature of surface** (NATSUR)

See S-101 DCEG clause 5.14 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for COLOUR and NATSUR on **SLOGRD** and amend appropriately.

#### 4.7.5 Cliffs

S-57 Geo Object: Slope topline (**SLOTOP**) (L)

S-101 Geo Feature: **Slope Topline** (C) (S-101 DCEG Clause 5.15)

All instances of encoding of the S-57 Object class **SLOTOP** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Slope Topline** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Slope Topline** in S-101:

**category of slope** (CATSLO)

**colour** (COLOUR)

**nature of surface** (NATSUR)

See S-101 DCEG clause 5.15 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATSLO, COLOUR and NATSUR on **SLOTOP** and amend appropriately.

#### 4.7.6 Rivers

S-57 Geo Object: River (**RIVERS**) (L,A)

S-101 Geo Feature: **River** (C,S) (S-101 DCEG Clause 5.7)

All instances of encoding of the S-57 Object class **RIVERS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **River** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **River** in S-101:

**status** (STATUS)

See S-101 DCEG clause 5.7 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **RIVERS** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- S-57 allows for **RIVERS** of type area to be covered by the Group 1 objects **LNDARE** or **UNSARE**, however in S-101 all **Rivers** of type area must be covered by the Skin of the Earth feature **Land Area**. During the automated conversion process, the converter may have the capability to convert **UNSARE** covering **RIVERS** to **Land Area** (taking into account the attribution of any adjoining **LNDARE** objects) and merge with any adjoining **Land Area** features. If the converter does not have this capability, Data Producers are advised to check their S-57 data holdings and amend their Group 1 coverage to have **RIVERS** of type area covered by **LNDARE** (and merge with adjoining **LNDARE** as appropriate).
- S-57 guidance recommends the encoding of intermittent lakes using an instance of the S-57 Object class **RIVERS**. Data Producers are advised to check all instances of **RIVERS** of type area having attribute STATUS = 5 (periodic/intermittent) and if the real-world feature is a lake to amend to an instance of the S-101 Feature type **Lake** (see S-101 DCEG clause 5.10).

#### 4.7.7 Rapids, waterfalls

##### 4.7.7.1 Rapids

S-57 Geo Object: Rapids (**RAPIDS**) (P,L,A)

S-101 Geo Feature: **Rapids** (P,C,S) (S-101 DCEG Clause 5.8)

All instances of encoding of the S-57 Object class **RAPIDS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Rapids** during the automated conversion process.

##### 4.7.7.2 Waterfalls

S-57 Geo Object: Waterfall (**WATFAL**) (P,L)

S-101 Geo Feature: **Waterfall** (P,C) (S-101 DCEG Clause 5.9)

All instances of encoding of the S-57 Object class **WATFAL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Waterfall** during the automated conversion process.

#### 4.7.8 Lakes

S-57 Geo Object: Lake (**LAKARE**) (A)

S-101 Geo Feature: **Lake** (S) (S-101 DCEG Clause 5.10)

All instances of encoding of the S-57 Object class **LAKARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Lake** during the automated conversion process.

The S-101 attribute **status** has been added as an allowable attribute for **Lake**, in order to allow for the encoding of intermittent lakes. In S-57, it is recommended that intermittent lakes are encoded using the Object class **RIVERS**. Data Producers will be required to evaluate their S-57 data holdings for any intermittent lakes that have been encoded as **RIVERS**, and amend these to **Lake** features during the conversion process as required.

The following additional requirements for S-57 dataset conversion must be noted:

- S-57 allows for **LAKARE** to be covered by the Group 1 objects **LNDARE** or **UNSARE**, however in S-101 all **Lake** features must be covered by the Skin of the Earth feature **Land Area**. During the automated conversion process, the converter may have the capability to convert **UNSARE** covering **LAKARE** to **Land Area** (taking into account the attribution of any adjoining **LNDARE** objects) and merge with any adjoining **Land Area** features. If the converter does not have this capability, Data Producers are advised to check their S-57 data holdings and amend their Group 1 coverage to have **LAKARE** covered by **LNDARE** (and merge with adjoining **LNDARE** as appropriate).

#### 4.7.9 Salt pans

The guidance for the encoding of salt pans remains unchanged in S-101. See S-101 DCEG clause 5.11.1.2.

#### 4.7.10 Glaciers

The guidance for the encoding of glaciers remains unchanged in S-101. See S-101 DCEG clause 5.13.1.1.

#### 4.7.11 Vegetation

S-57 Geo Object: Vegetation (**VEGATN**) (P,L,A)

S-101 Geo Feature: **Vegetation** (P,C,S) (S-101 DCEG Clause 5.12)

All instances of encoding of the S-57 Object class **VEGATN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Vegetation** during the automated conversion process. However the following exceptions apply:

- **VEGATN** with attribute **CATVEG** = 7 (mangroves) or 21 (mangrove tree) will convert to an instance of the S-101 Feature type **Obstruction** with attribute **category of obstruction** = 23 (mangrove), mandatory attribute **water level effect** = 1 (partially submerged at high water) and conditional mandatory attribute **height** = empty (null) if no value is populated for the attribute **HEIGHT** on the **VEGATN** object.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Vegetation** in S-101:

**category of vegetation** (CATVEG)

See S-101 DCEG clause 5.12 for the listings of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for **CATVEG** on **VEGATN** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- S-57 guidance recommends the encoding of an instance of the S-57 Object class **COALNE** along the seaward edge of encoded mangrove (**VEGATN**) areas located in the intertidal area. Where a **COALNE** object has been encoded in S-57 to indicate the seaward edge of the mangrove area, the corresponding S-101 instance of the Feature type **Coastline**, if created during the conversion process, must be deleted where it is coincident with the seaward edge of the converted **Obstruction** feature.

#### 4.7.12 Lava flow

See clause 4.7.1.

### 4.8 Artificial features

#### 4.8.1 Canals

S-57 Geo Object: Canal (**CANALS**) (L,A)

S-101 Geo Feature: **Canal** (C,S) (S-101 DCEG Clause 8.8)

All instances of encoding of the S-57 Object class **CANALS** and its binding attributes will be populated automatically against the S-101 Feature type **Canal** during the automated conversion process.

The following additional requirements for S-57 dataset conversion must be noted:

- S-57 allows for **CANALS** of type area to be covered by the Group 1 objects **LNDARE** or **UNSARE**, however in S-101 all **Canal** features of type area must be covered by the Skin of the Earth feature **Land Area**. During the automated conversion process, the converter may have the capability to convert **UNSARE** covering **CANALS** to **Land Area** (taking into account the attribution of any adjoining **LNDARE** objects) and merge with any adjoining **Land Area** features. If the converter does not have this capability, Data Producers are advised to check their S-57 data holdings and amend their Group 1 coverage to have **CANALS** of type area covered by **LNDARE** (and merge with adjoining **LNDARE** as appropriate).

#### 4.8.2 Railways

S-57 Geo Object: Railway (**RAILWY**) (L)

S-101 Geo Feature: **Railway** (C) (S-101 DCEG Clause 6.13)

All instances of encoding of the S-57 Object class **RAILWY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Railway** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Railway** in S-101:

**condition** (CONDTN)

See S-101 DCEG clause 6.13 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CONDTN on **RAILWY** and amend appropriately.

#### 4.8.3 Tunnels

S-57 Geo Object: Tunnel (**TUNNEL**) (P,L,A)

S-101 Geo Feature: **Tunnel** (C,S) (S-101 DCEG Clause 6.15)

All instances of encoding of the S-57 Object class **TUNNEL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Tunnel** during the automated conversion process. However the following exceptions apply:

- **TUNNEL** of type point will not be converted. Data Producers will be required to check their S-57 data holdings and address as appropriate.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Tunnel** in S-101:

**condition** (CONDTN)

**status** (STATUS)

See S-101 DCEG clause 6.15 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CONDTN and STATUS on **TUNNEL** and amend appropriately.

#### 4.8.4 Cuttings and embankments

See clauses 4.7.4 and 4.7.5.

#### 4.8.5 Dams

S-57 Geo Object: Dam (**DAMCON**) (P,L,A)

S-101 Geo Feature: **Dam** (C,S) (S-101 DCEG Clause 8.11)

All instances of encoding of the S-57 Object class **DAMCON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dam** during the automated conversion process. However the following exceptions apply:

- Point is not an allowable geometric primitive for **Dam**, therefore **DAMCON** of type point will convert to an instance of the S-101 Feature type **Landmark** (see S-101 DCEG clause 7.2).

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Dam** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 8.11 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **DAMCON** and amend appropriately.

#### 4.8.6 Flood barrages

The guidance for the encoding of flood barrages remains unchanged in S-101. See S-101 DCEG clause 8.11.2.

#### 4.8.7 Dykes

S-57 Geo Object: Dyke (**DYKCON**) (L,A)

S-101 Geo Feature: **Dyke** (C,S) (S-101 DCEG Clause 8.5)

All instances of encoding of the S-57 Object class **DYKCON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dyke** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Dyke** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 8.5 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **DYKCON** and amend appropriately.

#### 4.8.8 Roads and tracks

S-57 Geo Object: Road (**ROADWY**) (P,L,A)

S-101 Geo Feature: **Road** (C,S) (S-101 DCEG Clause 6.14)

All instances of encoding of the S-57 Object class **ROADWY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Road** during the automated conversion process. However the following exceptions apply:

- **ROADWY** of type point will not be converted. Data Producers will be required to check their S-57 data holdings and address as appropriate.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Road** in S-101:

**condition** (CONDTN)

**nature of construction** (NATCON)

**status** (STATUS)

See S-101 DCEG clause 6.14 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are

advised to check any populated values for CONDTN, NATCON and STATUS on **ROADWY** and amend appropriately.

#### 4.8.9 Causeways

<u>S-57 Geo Object:</u>	Causeway ( <b>CAUSWY</b> )	(L,A)	
<u>S-101 Geo Feature:</u>	<b>Causeway</b>	(C,S)	(S-101 DCEG Clause 8.7)

All instances of encoding of the S-57 Object class **CAUSWY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Causeway** during the automated conversion process.

#### 4.8.10 Bridges

<u>S-57 Geo Object:</u>	Bridge ( <b>BRIDGE</b> )	(P,L,A)	
<u>S-101 Geo Feature:</u>	<b>Bridge</b>	(C,S,N)	(S-101 DCEG Clause 6.5)
<u>S-101 Geo Feature:</u>	<b>Span Fixed</b>	(C,S)	(S-101 DCEG Clause 6.6)
<u>S-101 Geo Feature:</u>	<b>Span Opening</b>	(C,S)	(S-101 DCEG Clause 6.7)
<u>S-101 Association:</u>	<b>Bridge Aggregation</b>	(N)	(S-101 DCEG Clause 25.4)

Significant changes to the modelling of bridges have been made in S-101 in order to improve presentation to the mariner. In order to allow for the encoding of the characteristics of each individual span of a bridge in addition to its overall characteristics, new S-101 Feature types **Span Fixed** and **Span Opening** have been introduced. During the automated conversion process, all instances of encoding of the S-57 Object class **BRIDGE** and its binding attributes will be converted automatically to an instance of the S-101 Feature types **Bridge** and **Span Fixed** or **Span Opening** as appropriate; and these features aggregated using the S-101 association **Bridge Aggregation**. However the following exceptions apply:

- Bridges encoded over non-navigable water in S-101 do not require the associated encoding and aggregation of bridge span(s). As such, during the automated conversion process a bridge that, in its entirety, does not cross navigable water in an ENC dataset will be converted automatically to an instance of the S-101 Feature type **Bridge** and its corresponding binding attributes only.
- Point is not an allowable geometric primitive for **Bridge**, therefore **BRIDGE** of type point will convert to an instance of the S-101 Feature type **Landmark** (see S-101 DCEG clause 7.2).

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for these features in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clauses 6.5-6.7 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **BRIDGE** and amend appropriately.

The following additional requirements for S-57 encoding must be noted:

- It is strongly recommended that each span of a bridge crossing navigable water in an ENC dataset is encoded as a separate **BRIDGE** object where known. This includes those spans of a bridge that may fall partly or entirely over the land. Where each component of a single bridge is encoded as a separate **BRIDGE** object, these **BRIDGE** objects and any encoded bridge pylons must be aggregated using the Collection Object **C\_AGGR** in order to ensure the correct representation and aggregation of the bridge components in the converted S-101 dataset. The attributes COLOUR, COLPAT, CONDTN, CONRAD, CONVIS, DATEND, DATSTA, NATCON, NOBJNM, OBJNAM, INFORM, NINFOM and SCAMIN must be identical for each of the **BRIDGE** objects comprising the bridge. Similarly, if an encoded bridge crossing navigable water is not separated into separate **BRIDGE** objects corresponding to each span of the bridge, the **BRIDGE** object and any encoded bridge pylons should be aggregated using the Collection Object **C\_AGGR** in order to ensure the correct aggregation of the bridge components in the converted S-101 dataset.
- For bridges that do not cross navigable water in an ENC dataset there is no requirement to encode each span of the bridge as a separate **BRIDGE** object.
- For opening bridges/bridge spans the attribute VERCOP is only mandatory where there is a limited vertical clearance when the bridge is open; while in S-101 the complex attribute **vertical clearance**

**open** is mandatory. Data Producers should check their S-57 data holdings and ensure that VERCOP is populated as appropriate, noting that an opening bridge instance having no binding VERCOP attribute will result in the converted S-101 bridge instance having **vertical clearance open**, sub-attribute **vertical clearance value** = empty (null) indicating an unlimited clearance.

#### 4.8.11 Conveyors

S-57 Geo Object: Conveyor (**CONVYR**) (L,A)

S-101 Geo Feature: **Conveyor** (C,S) (S-101 DCEG Clause 6.8)

All instances of encoding of the S-57 Object class **CONVYR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Conveyor** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Conveyor** in S-101:

**product** (PRODCT)

**status** (STATUS)

See S-101 DCEG clause 6.8 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for PRODCT and STATUS on **CONVYR** and amend appropriately.

#### 4.8.12 Airfields

S-57 Geo Object: Airport / airfield (**AIRARE**) (P,A)

S-101 Geo Feature: **Airport/Airfield** (P,S) (S-101 DCEG Clause 6.3)

All instances of encoding of the S-57 Object class **AIRARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Airport/Airfield** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Airport/Airfield** in S-101:

**status** (STATUS)

See S-101 DCEG clause 6.3 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **AIRARE** and amend appropriately.

S-57 Geo Object: Runway (**RUNWAY**) (P,L,A)

S-101 Geo Feature: **Runway** (P,C,S) (S-101 DCEG Clause 6.4)

All instances of encoding of the S-57 Object class **RUNWAY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Runway** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Runway** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 6.4 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **RUNWAY** and amend appropriately.

#### 4.8.13 Production and storage areas

S-57 Geo Object: Production / storage area (**PRDARE**) (P,A)

S-101 Geo Feature: **Production/Storage Area** (P,S) (S-101 DCEG Clause 7.6)

All instances of encoding of the S-57 Object class **PRDARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Production/Storage Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Production/Storage Area** in S-101:

**status** (STATUS)

See S-101 DCEG clause 7.6 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **PRDARE** and amend appropriately.

#### 4.8.14 Built-up areas

S-57 Geo Object: Built-up area (**BUAARE**) (P,A)

S-101 Geo Feature: **Built-Up Area** (P,S) (S-101 DCEG Clause 6.1)

All instances of encoding of the S-57 Object class **BUAARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Built-Up Area** during the automated conversion process.

#### 4.8.15 Buildings, landmarks, tanks, silos

S-57 Geo Object: Building, single (**BUISGL**) (P,A)

S-101 Geo Feature: **Building** (P,S) (S-101 DCEG Clause 6.2)

All instances of encoding of the S-57 Object class **BUISGL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Building** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Building** in S-101:

**nature of construction** (NATCON)

**status** (STATUS)

See S-101 DCEG clause 6.2 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON and STATUS on **BUISGL** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **function** includes the new enumerate value 47 (boathouse). This information is encoded in S-57 on **BUISGL** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **BUISGL** should be in a standardised format, such as *Boathouse* or *Boatshed*.

S-101 includes the system attribute **in the water** to indicate that a building that is located offshore is to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with the S-101 **Building** feature so as to ensure display of a feature at the position of the building in ECDIS Base display. Data Producers should consider removing these features from their S-101 data during the conversion process.

S-57 Geo Object: Landmark (**LNDMRK**) (P,L,A)

S-101 Geo Feature: **Landmark** (P,C,S) (S-101 DCEG Clause 7.2)

S-101 Geo Feature: **Wind Turbine** (P) (S-101 DCEG Clause 7.4)

All instances of encoding of the S-57 Object class **LNDMRK** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Landmark** during the automated conversion process. However the following exceptions apply:

- **LNDMRK** objects of type point and having attribute CATLMK = 19 (windmotor) will convert to an instance of the new S-101 Feature type **Wind Turbine**. The S-101 attribute **vertical clearance fixed** introduces the option to encode additional information related to **Wind Turbine**. There is no corresponding encoding for this information on **LNDMRK** in S-57 – for full capability S-101 data, Data Producers will be required to populate this attribute manually, if considered necessary.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Landmark** in S-101:

**nature of construction** (NATCON)

**status** (STATUS)

See S-101 DCEG clauses 7.2 and 7.4 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON and STATUS on **LNDMRK** and amend appropriately.

S-101 includes the system attribute **in the water** to indicate that a landmark that is located offshore is to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with the S-101 **Landmark** feature so as to ensure display of a feature at the position of the landmark in ECDIS Base display. Data Producers should consider removing these features from their S-101 data during the conversion process.

S-57 Geo Object: Silo / tank (**SILTNK**) (P,A)

S-101 Geo Feature: **Silo/Tank** (P,S) (S-101 DCEG Clause 7.3)

All instances of encoding of the S-57 Object class **SILTNK** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Silo/Tank** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Silo/Tank** in S-101:

**nature of construction** (NATCON)

**status** (STATUS)

See S-101 DCEG clause 7.3 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON and STATUS on **SILTNK** and amend appropriately.

S-101 includes the system attribute **in the water** to indicate that a silo/tank that is located offshore is to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with the S-101 **Silo/Tank** feature so as to ensure display of a feature at the position of the silo/tank in ECDIS Base display. Data Producers should consider removing these features from their S-101 data during the conversion process.

#### 4.8.16 Fences and walls

S-57 Geo Object: Fence/wall (**FNCLNE**) (L)

S-101 Geo Feature: **Fence/Wall** (C) (S-101 DCEG Clause 6.12)

All instances of encoding of the S-57 Object class **FNCLNE** and its binding attributes will be populated automatically against the S-101 Feature type **Fence/Wall** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Fence/Wall** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 6.12 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **FNCLNE** and amend appropriately.

#### 4.8.17 Fortified structures

S-57 Geo Object: Fortified structure (**FORSTC**) (P,L,A)

S-101 Geo Feature: **Fortified Structure** (P,C,S) (S-101 DCEG Clause 7.5)

All instances of encoding of the S-57 Object class **FORSTC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fortified Structure** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Fortified Structure** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 7.5 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **FORSTC** and amend appropriately.

S-101 includes the system attribute **in the water** to indicate that a fortified structure that is located offshore is to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with the S-101 **Fortified Structure** feature so as to ensure display of a feature at the position of the fortified structure in ECDIS Base display. Data Producers should consider removing these features from their S-101 data during the conversion process.

#### 4.8.18 Pylons and bridge supports

S-57 Geo Object: Pylon / bridge support (**PYLONS**) (P,A)

S-101 Geo Feature: **Pylon/Bridge Support** (P,S) (S-101 DCEG Clause 6.11)

All instances of encoding of the S-57 Object class **PYLONS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pylon/Bridge Support** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Pylon/Bridge Support** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 6.11 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **PYLONS** and amend appropriately.

#### 4.8.19 Oil barriers

S-57 Geo Object: Oil barrier (**OILBAR**) (L)

S-101 Geo Feature: **Oil Barrier** (C) (S-101 DCEG Clause 16.21)

All instances of encoding of the S-57 Object class **OILBAR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Oil Barrier** during the automated conversion process.

#### 4.8.20 Views and sketches, viewpoints

Values populated for the S-57 attribute PICREP will be converted to the S-101 attribute **pictorial representation**, however due to the changes to support file naming conventions in S-101 (see S-101 Main document, clause 11.4.1), data producers will be prompted to provide a new name for the picture file.

Where support file names contained in PICREP are duplicated for multiple object instances in an S-57 dataset, this may be encoded more economically in the corresponding S-101 dataset by associating an instance of the S-101 Information type **Nautical Information** to the relevant S-101 geo features (see S-101 DCEG clause 24.4) using the association **Additional Information** (see S-101 DCEG clause 25.1). Where this is considered to be the preferred encoding, Data Producers will be required to manually encode the **Nautical Information** feature; associate this feature to the relevant S-101 geo features using the association **Additional Information**; and remove the complex attribute **pictorial representation** from these geo features. Note that this encoding may also be considered where pictorial information is duplicated across multiple datasets within the S-57/S-101 ENC portfolio.

#### 4.8.21 Signs and Notice boards

The guidance for the encoding of signs and notice boards remains unchanged in S-101. See S-101 DCEG clause 20.12.2.

## 5 Depth

### 5.1 Sounding datum

See clause 2.1.3.

### 5.2 Depth contours

S-57 Geo Object: Depth contour (**DEPCNT**) (L)

S-101 Geo Feature: **Depth Contour** (C) (S-101 DCEG Clause 11.6)

All instances of encoding of the S-57 Object class **DEPCNT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Depth Contour** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- **DEPCNT** with attribute **QUAPOS** = 4 (approximate) will also be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **quality of horizontal measurement** = 4 (approximate), associated to the geometry of the **Depth Contour** feature using the association **Spatial Association**.

### 5.3 Soundings

S-57 Geo Object: Sounding (**SOUNDG**) (P)

S-101 Geo Feature: **Sounding** (P - Pointset) (S-101 DCEG Clause 11.3)

S-101 Geo Feature: **Depth – No Bottom Found** (P - Pointset) (S-101 DCEG Clause 11.8)

All instances of encoding of the S-57 Object class **SOUNDG** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Sounding** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute **EXPSOU** will not be converted. It is considered that this attribute is not relevant for **Sounding** in S-101.
- **SOUNDG** with attribute **QUASOU** = 5 (no bottom found at value shown) will be converted to to an instance of the S-101 Feature type **Depth – No Bottom Found**. Where this is the case, the attributes **EXPSOU**, **NOBJNM**, **OBJNAM**, **SOUACC** and **STATUS** will not be converted. It is considered that these attributes are not relevant for **Depth – No Bottom Found** in S-101.

The following additional requirements for S-57 attribution must be noted:

- **SOUNDG** with attribute **QUAPOS** = 4 (approximate) will also be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **quality of horizontal measurement** = 4 (approximate), associated to the geometry of the **Sounding** feature using the association **Spatial Association**.
- The S-57 attribute **SOUACC** will be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **vertical uncertainty/uncertainty fixed**, associated to the geometry of the **Sounding** features using the association **Spatial Association**. This encoding is mandatory in S-101 for all **Sounding** features of depth 30 metres or less. It is recommended that Data Producers evaluate their data holdings and populate values of **SOUACC** for **SOUNDG** of depth 30 metres or less at their earliest convenience.
- The S-101 attribute **reported date** has been introduced in S-101 to encode the date at which a sounding has been reported. This information is encoded in S-57 on **SOUNDG** using the attribute **SORDAT** (see clause 2.2.5.1). Unless the date populated in **SORDAT** is actually a reported date, Data Producers are advised to remove **SORDAT** from **SOUNDG** objects prior to conversion.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Sounding** in S-101:

**quality of vertical measurement** (QUASOU)

**technique of sounding measurement** (TECSOU)

See S-101 DCEG clause 11.3 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are

advised to check any populated values for QUASOU and TECSOU on **SOUNDG** and amend appropriately.

The S-101 Boolean attribute **display uncertainties** introduces the option to encode additional information related to **Sounding**, and is mandatory for all **Sounding** features of depth 30 metres or less. There is no corresponding encoding for this information on **SOUNDG** in S-57 – for full capability S-101 data, Data Producers will be required to evaluate their converted S-101 sounding coverage and populate this attribute appropriately, noting that during the automated conversion process the value of this attribute will be set to *False*.

## 5.4 Depth areas

### 5.4.1 Geo object depth areas

S-57 Geo Object: Depth area (**DEPARE**) (A)

S-101 Geo Feature: **Depth Area** (S) (S-101 DCEG Clause 11.7)

All instances of encoding of the S-57 Object class **DEPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Depth Area** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute QUASOU for **DEPARE** will not be converted. It is considered that this attribute is not relevant for **Depth Area** in S-101.

### 5.4.2 Geometry of depth areas

The guidance for the geometry of depth areas remains unchanged in S-101. See S-101 DCEG clause 11.7.2.

### 5.4.3 Use of attributes DRVAL1 and DRVAL2 for depth areas in general

The guidance for the encoding of depth range values remains unchanged in S-101. See S-101 DCEG clause 11.7.3.

5.4.4 Not applicable.

5.4.5 Not applicable.

5.4.6 Not applicable.

5.4.7 Not applicable.

### 5.4.8 Rivers, canals, lakes, basins, locks

The guidance for the encoding of rivers, canals and lakes remains unchanged in S-101. See S-101 DCEG clauses 5.7, 5.10 and 8.8. However, the S-101 Feature types **Dock Area (DOCARE)** and **Lock Basin (LOKBSN)** have been designated as Skin of the Earth features in S-101. See clauses 4.6.6.3 and 4.6.6.5 in this document.

## 5.5 Dredged areas

S-57 Geo Object: Dredged area (**DRGARE**) (A)

S-101 Geo Feature: **Dredged Area** (S) (S-101 DCEG Clause 11.4)

All instances of encoding of the S-57 Object class **DRGARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dredged Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Dredged Area** in S-101:

**restriction** (RESTRN)

See S-101 DCEG clause 11.4 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for RESTRN on **DRGARE** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- Where **SOUNDG** or **SEAARE** features have been encoded in order to display the depth of dredging in ECDIS, these features should be removed from the converted dataset.
- The S-101 attribute **dredged date** has been introduced in S-101 to encode the date of dredging or the date of the last control survey for the dredged area. This information is encoded in S-57 on **DRGARE** using the attribute SORDAT (see clause 2.2.5.1). Unless the date populated in SORDAT is actually a dredging date or date of the last control survey, Data Producers are advised to remove SORDAT from **DRGARE** objects prior to conversion.

## 5.6 Swept areas

S-57 Geo Object: Swept area (**SWPARE**) (A)

S-101 Geo Feature: **Swept Area** (S) (S-101 DCEG Clause 11.5)

All instances of encoding of the S-57 Object class **SWPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Swept Area** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes QUASOU, SOUACC and TECSOU for **SWPARE** will not be converted. It is considered that these attributes are not relevant for **Swept Area** in S-101.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **reported date** has been introduced in S-101 to encode the date of sweeping for the swept area. This information is encoded in S-57 on **SWPARE** using the attribute SORDAT (see clause 2.2.5.1). Unless the date populated in SORDAT is actually a date of sweeping, Data Producers are advised to remove SORDAT from **SWPARE** objects prior to conversion.

## 5.7 Areas of continual change

The indication that an area of encoded bathymetry is changeable over time is provided by the encoding of an instance of the S-101 Feature type **Quality of Bathymetric Data** having attribute **category of temporal variation** carrying the values 2 (likely to change and significant shoaling expected) or 3 (likely to change but significant shoaling not expected). See S-101 DCEG clause 11.7.5. Data Producers should consider removing any **Caution Area** features providing this information from their S-101 data during the conversion process.

The guidance for the encoding of sandwaves and provision of an indication of “Less Water” remains unchanged in S-101. See S-101 DCEG clauses 12.4 and 16.10.

## 5.8 Areas with inadequate depth information

### 5.8.1 Unsurveyed areas

S-57 Geo Object: Unsurveyed area (**UNSARE**) (A)

S-101 Geo Feature: **Unsurveyed Area** (S) (S-101 DCEG Clause 11.10)

All instances of encoding of the S-57 Object class **UNSARE** will be converted automatically to an instance of the S-101 Feature type **Unsurveyed Area** during the automated conversion process. However the following exceptions apply:

- S-57 allows for **RIVERS**, **CANALS** and **LAKARE** objects of type area to be covered by the Group 1 objects **LNDARE** or **UNSARE**, however in S-101 all **River**, **Canal** and **Lake** features must be covered by the Skin of the Earth feature **Land Area**. During the automated conversion process, **UNSARE** covered by objects **RIVERS**, **CANALS** or **LAKARE** may be converted to an instance of the S-101 Feature type **Land Area** (taking into account the attribution of any adjoining **LNDARE** objects). Data Producers will be required to ensure that these converted **Land Area** features are merged with any adjoining **Land Area** features as appropriate in order to avoid data validation errors. If the data converter does not have the capability to convert **UNSARE** covering **RIVERS**, **CANALS** or **LAKARE** to **Land Area**, Data Producers are advised to check their S-57 data holdings and amend their Group 1 coverage to have **RIVERS**, **CANALS** or **LAKARE** of type area covered by **LNDARE** (and merge with adjoining **LNDARE** as appropriate).

### **5.8.1.1 Satellite imagery as source information**

The guidance for the encoding of bathymetry sourced from satellite imagery remains unchanged in S-101. See S-101 DCEG clause 11.9.4, noting the guidance included in this clause for the encoding of underlying **Quality of Bathymetric Data** and **Quality of Survey** features.

### **5.8.2 Incompletely surveyed areas**

Not applicable.

### **5.8.3 Bathymetry in areas of minimal depiction of detail on paper charts**

#### **5.8.3.1 Areas of omitted bathymetry**

The guidance for the encoding of areas of omitted bathymetry on the source remains unchanged in S-101. See S-101 DCEG clause 11.9.2.1.

#### **5.8.3.2 Areas of very simplified bathymetry**

The guidance for the encoding of areas of very simplified bathymetry on the source remains unchanged in S-101. See S-101 DCEG clause 11.9.2.2.

### **5.8.4 Depth discontinuities between surveys**

The guidance for the encoding of depth discontinuities between source surveys remains unchanged in S-101. See S-101 DCEG clause 11.9.3.

## 6 Dangers

### 6.1 Rocks and coral reefs

The guidance for the encoding of isolated dangers as isolated nodes remains unchanged in S-101. See S-101 DCEG clause 13.

#### 6.1.1 Rocks which do not cover (islets)

The guidance for the encoding rocks that do not cover remains unchanged in S-101. See S-101 DCEG clause 5.4.2.

#### 6.1.2 Rocks which may cover

S-57 Geo Object: Underwater / awash rock (**UWTROC**) (P)

S-101 Geo Feature: **Underwater/Awash Rock** (P) (S-101 DCEG Clause 13.4)

All instances of encoding of the S-57 Object class **UWTROC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Underwater/Awash Rock** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute NATQUA will not be converted. It is considered that this attribute is not relevant for **Underwater/Awash Rock** in S-101.
- The S-57 attribute SOUACC will be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **vertical uncertainty/uncertainty fixed**, associated to the geometry of the **Underwater/Awash Rock** features using the association **Spatial Association**. This encoding is mandatory in S-101 for all **Underwater/Awash Rock** features of depth 30 metres or less. It is recommended that Data Producers evaluate their data holdings and populate values of SOUACC for **UWTROC** of depth 30 metres or less at their earliest convenience.

Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Underwater/Awash Rock** in S-101:

**exposition of sounding** (EXPSOU)

**nature of surface** (NATSUR)

**status** (STATUS)

See S-101 DCEG clause 13.4 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for EXPSOU, NATSUR and STATUS on **UWTROC** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **reported date** has been introduced in S-101 to encode the date at which a rock has been reported. This information is encoded in S-57 on **UWTROC** using the attribute SORDAT (see clause 2.2.5.1). Unless the date populated in SORDAT is actually a reported date, Data Producers are advised to remove SORDAT from **UWTROC** objects prior to conversion.

The S-101 Boolean attribute **display uncertainties** introduces the option to encode additional information related to **Underwater/Awash Rock**, and is mandatory for all **Underwater/Awash Rock** features of depth 30 metres or less. There is no corresponding encoding for this information on **UWTROC** in S-57 – for full capability S-101 data, Data Producers will be required to evaluate their converted S-101 data and populate this attribute appropriately, noting that during the automated conversion process the value of this attribute will be set to *False*.

### 6.2 Wrecks, foul ground and obstructions

#### 6.2.1 Wrecks

S-57 Geo Object: Wreck (**WRECKS**) (P,A)

S-101 Geo Feature: **Wreck** (P,S) (S-101 DCEG Clause 13.5)

All instances of encoding of the S-57 Object class **WRECKS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Wreck** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute SOUACC will be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **vertical uncertainty/uncertainty fixed**, associated to the geometry of the **Wreck** features using the association **Spatial Association**. This encoding is mandatory in S-101 for **Wreck** features of type point and depth 30 metres or less. It is recommended that Data Producers evaluate their data holdings and populate values of SOUACC for **WRECKS** of type point and depth 30 metres or less at their earliest convenience.

The S-101 Boolean attribute **display uncertainties** introduces the option to encode additional information related to **Wreck**, and is mandatory for all **Wreck** features of type point and depth 30 metres or less. There is no corresponding encoding for this information on **WRECKS** in S-57 – for full capability S-101 data, Data Producers will be required to evaluate their converted S-101 data and populate this attribute appropriately, noting that during the automated conversion process the value of this attribute will be set to *False*.

### 6.2.2 Obstructions, foul areas and foul ground

<u>S-57 Geo Object:</u>	Obstruction ( <b>OBSTRN</b> )	(P,L,A)	
<u>S-101 Geo Feature:</u>	<b>Obstruction</b>	(P,C,S)	(S-101 DCEG Clause 13.6)
<u>S-101 Geo Feature:</u>	<b>Foul Ground</b>	(P,C,S)	(S-101 DCEG Clause 13.7)

All instances of encoding of the S-57 Object class **OBSTRN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Obstruction** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes NATCON and NATQUA will not be converted. It is considered that these attributes are not relevant for **Obstruction** in S-101.
- **OBSTRN** with attribute CATOBS = 7 (foul ground) will be converted to an instance of the S-101 Feature type **Foul Ground**. Where this is the case, the attributes CONDTN, EXPSON, NATCON, NATQUA, NATSUR, PRODC, VERLEN and WATLEV will not be converted. It is considered that these attributes are not relevant for **Foul Ground** in S-101.
- **OBSTRN** of type area or line with attribute INFORM = *Submerged weir* will be converted to an instance of the S-101 Feature type **Dam**. Where this is the case, the attributes CATOBS, EXPSON, NATQUA, NATSUR, PRODC, QUASOU, SOUACC, TECSOU and VALSOU will not be converted. It is considered that these attributes are not relevant for **Dam** in S-101.
- The S-57 attribute SOUACC will be converted to an instance of the S-101 Information type **Spatial Quality** (see S-101 DCEG clause 24.5), attribute **vertical uncertainty/uncertainty fixed**, associated to the geometry of the **Obstruction** features using the association **Spatial Association**. This encoding is mandatory in S-101 for all **Obstruction** features of type point and depth 30 metres or less. It is recommended that Data Producers evaluate their data holdings and populate values of SOUACC for **OBSTRN** of type point and depth 30 metres or less at their earliest convenience.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **category of obstruction** includes the new enumerate value 21 (active submarine volcano). This information is encoded in S-57 on **OBSTRN** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **OBSTRN** should be in a standardised format, such as *Active submarine volcano*.

The S-101 Boolean attribute **display uncertainties** introduces the option to encode additional information related to **Obstruction**, and is mandatory for all **Obstruction** features of type point and depth 30 metres or less. There is no corresponding encoding for this information on **OBSTRN** in S-57 – for full capability S-101 data, Data Producers will be required to evaluate their converted S-101 data and populate this attribute appropriately, noting that during the automated conversion process the value of this attribute will be set to *False*.

## 6.3 Danger lines

### 6.3.1 Danger line around a point danger or an isolated sounding

Not applicable.

### 6.3.2 Danger line limiting an area of wrecks or obstructions

The guidance for the encoding of danger lines limiting areas of wrecks or obstructions remains unchanged in S-101. See S-101 DCEG clause 13.1.

### 6.3.3 Danger line bordering an area through which navigation is not safe

The guidance for the encoding of danger lines through which navigation is not safe remains unchanged in S-101. See S-101 DCEG clause 13.2.

## 6.4 Overfalls, races, breakers, eddies

S-57 Geo Object: Water turbulence (**WATTUR**) (P,L,A)

S-101 Geo Feature: **Water Turbulence** (P,C,S) (S-101 DCEG Clause 10.4)

All instances of encoding of the S-57 Object class **WATTUR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Water Turbulence** during the automated conversion process.

## 6.5 Doubtful dangers

S-101 Geo Feature: **Discoloured Water** (P,S) (S-101 DCEG Clause 13.8)

The guidance for the encoding of doubtful dangers unchanged in S-101. See S-101 DCEG clause 13.3. However the following requirements for S-57 attribution must be noted:

- The S-101 Feature type **Discoloured Water** has been introduced in S-101 to encode areas of discoloured water. This information is encoded in S-57 as an instance of the S-57 Object class **CTNARE**, using the attribute **INFORM** (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **CTNARE** should be in a standardised format, such as *Discoloured water*.

## 6.6 Caution areas

S-57 Geo Object: Caution area (**CTNARE**) (P,A)

S-101 Geo Feature: **Caution Area** (P,S) (S-101 DCEG Clause 16.10)

S-101 Association: **Caution Area Association** (N) (S-101 DCEG Clause 25.5)

All instances of encoding of the S-57 Object class **CTNARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Caution Area** during the automated conversion process.

## 7 Nature of the seabed

### 7.1 Description of the bottom

S-57 Geo Object: Seabed area (**SBDARE**) (P,L,A)

S-101 Geo Feature: **Seabed Area** (P,C,S) (S-101 DCEG Clause 12.1)

All instances of encoding of the S-57 Object class **SBDARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Seabed Area** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute COLOUR for **SBDARE** will not be converted. It is considered that this attribute is not relevant for **Seabed Area** in S-101.

### 7.2 Special bottom types

#### 7.2.1 Sandwaves

S-57 Geo Object: Sandwaves (**SNDWAV**) (P,L,A)

S-101 Geo Feature: **Sandwave** (P,C,S) (S-101 DCEG Clause 12.4)

All instances of encoding of the S-57 Object class **SNDWAV** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Sandwave** during the automated conversion process.

#### 7.2.2 Weed - Kelp

S-57 Geo Object: Weed / Kelp (**WEDKLP**) (P,A)

S-101 Geo Feature: **Weed/Kelp** (P,S) (S-101 DCEG Clause 12.2)

S-101 Geo Feature: **Seagrass** (P,S) (S-101 DCEG Clause 12.3)

All instances of encoding of the S-57 Object class **WEDKLP** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Weed/Kelp** during the automated conversion process. However the following exceptions apply:

- **WEDKLP** with attribute CATWED = 3 (sea grass) will convert to an instance of the S-101 Feature type **Seagrass**.

#### 7.2.3 Springs in the seabed

S-57 Geo Object: Spring (**SPRING**) (P)

S-101 Geo Feature: **Spring** (P) (S-101 DCEG Clause 12.5)

All instances of encoding of the S-57 Object class **SPRING** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Spring** during the automated conversion process.

#### 7.2.4 Tideways

S-57 Geo Object: Tideway (**TIDEWY**) (L,A)

S-101 Geo Feature: **Tideway** (C,S) (S-101 DCEG Clause 5.16)

All instances of encoding of the S-57 Object class **TIDEWY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Tideway** during the automated conversion process.

## 8 Sea areas

S-57 Geo Object: Sea area (**SEAARE**) (P,A)

S-101 Geo Feature: **Sea Area/Named Water Area** (P,S) (S-101 DCEG Clause 9.1)

All instances of encoding of the S-57 Object class **SEAARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Sea Area/Named Water Area** during the automated conversion process.

## 9 Harbour regulations

### 9.1 Regulations within harbour limits

#### 9.1.1 Administrative harbour areas

S-57 Geo Object: Harbour area (**HRBARE**) (A)

S-101 Geo Feature: **Harbour Area (Administrative)** (S) (S-101 DCEG Clause 16.19)

All instances of encoding of the S-57 Object class **HRBARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Harbour Area (Administrative)** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Harbour Area (Administrative)** in S-101:

**status** (STATUS)

See S-101 DCEG clause 16.19 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **HRBARE** and amend appropriately.

#### 9.1.2 Speed limits

The guidance for the encoding of speed limits remains unchanged in S-101. See S-101 DCEG clause 17.4.

### 9.2 Anchorages and prohibited/restricted anchorages; moorings

#### 9.2.1 Anchorages

S-57 Geo Object: Anchorage area (**ACHARE**) (P,A)

S-101 Geo Feature: **Anchorage Area** (P,S) (S-101 DCEG Clause 16.3)

All instances of encoding of the S-57 Object class **ACHARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Anchorage Area** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **category of anchorage** includes the new enumerate value *15* (reported anchorage). This information is encoded in S-57 on **ACHARE** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **ACHARE** should be in a standardised format, such as *Reported anchorage*.

#### 9.2.2 Anchor berths

S-57 Geo Object: Anchor berth (**ACHBRT**) (P,A)

S-101 Geo Feature: **Anchor Berth** (P,S) (S-101 DCEG Clause 16.4)

All instances of encoding of the S-57 Object class **ACHBRT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Anchor Berth** during the automated conversion process.

#### 9.2.3 Anchoring restricted

The guidance for the encoding of the indication that anchorage is restricted remains unchanged in S-101. See S-101 DCEG clause 17.5.

#### 9.2.4 Mooring buoys

The guidance for the encoding of mooring buoys remains unchanged in S-101. See S-101 DCEG clause 8.14.1.1.

#### 9.2.5 Mooring trots

S-101 Geo Feature: **Mooring Trot** (N) (S-101 DCEG Clause 8.21)

S-101 Association:    **Mooring Trot Aggregation**    (N)                    (S-101 DCEG Clause 25.10)

The guidance for the encoding of the individual components of a mooring trot remains unchanged in S-101. See S-101 DCEG clause 8.21.1.

Where the components of a mooring trot have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Mooring Trot**. The **Mooring Trot** and its individual components will be aggregated using the named association **Mooring Trot Aggregation**.

#### **9.2.6 Anchorage - relationships**

Not applicable.

## 10 Recommended tracks and routes

### 10.1 Leading, clearing and transit lines and recommended tracks

#### 10.1.1 Navigation lines and recommended tracks

S-57 Geo Object: Navigation line (**NAVLNE**) (L)

S-101 Geo Feature: **Navigation Line** (C) (S-101 DCEG Clause 15.4)

All instances of encoding of the S-57 Object class **NAVLNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Navigation Line** during the automated conversion process.

S-57 Geo Object: Recommended track (**RECTRC**) (L,A)

S-101 Geo Feature: **Recommended Track** (C) (S-101 DCEG Clause 15.5)

All instances of encoding of the S-57 Object class **RECTRC** of type line and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Recommended Track** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Recommended Track** in S-101:

**quality of vertical measurement** (QUASOU)

**technique of vertical measurement** (TECSOU)

See S-101 DCEG clause 15.5 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for QUASOU and TECSOU on **RECTRC** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **maximum permitted draught** has been introduced in S-101 to encode the maximum permitted vessel draught at the berth. This information is encoded in S-57 on **RECTRC** using the attribute **INFORM** (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **RECTRC** should be in a standardised format, such as *Maximum draught permitted = [xx.x] metres*, where [xx.x] is the value of the maximum permitted vessel draught (decimal part not required if the value is whole metres). For example *Maximum permitted draught = 11.5 metres*.
- The S-101 attribute **measured distance** has been introduced in S-101 to encode the specified measured distance along a track to be followed. This information is encoded in S-57 on **NAVLNE** using the attribute **INFORM** (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **NAVLNE** should be in a standardised format, such as *Measured distance = xxxx metres*, where xxxx is the value of the measured distance

Data Producers must note that in S-101 the type surface is not included as an allowable geometric primitive for **Recommended Track**, therefore **RECTRC** of type area will not be converted across to S-101. Where **RECTRC** has been encoded as type area in a S-57 dataset, Data Producers should evaluate their data holdings and re-encode these objects as another appropriate routing object of type area (for example **FAIRWY**, **TWRTPT**, **DWRTPT**) or as **RECTRC** of type line prior to conversion to S-101.

#### 10.1.2 Range systems - relationship

S-101 Geo Feature: **Range System** (N) (S-101 DCEG Clause 15.6)

S-101 Association: **Range System Aggregation** (N) (S-101 DCEG Clause 25.13)

The guidance for the encoding of range systems remains unchanged in S-101. See S-101 DCEG clause 15.1.1.

Where the components of a range system have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Range System**. The **Range System** and its individual components will be aggregated using the named association **Range System Aggregation** (see S-101 DCEG clause 25.13).

Where a **C\_ASSO** has been created to associate a range system with the dangers that it marks, this will not be converted. It is considered that this relationship is not relevant for S-101.

### 10.1.3 Measured distances

S-101 Geo Feature: **Range System** (N) (S-101 DCEG Clause 15.6)

S-101 Association: **Range System Aggregation** (N) (S-101 DCEG Clause 25.13)

The guidance for the encoding of measured distances remains unchanged in S-101. See S-101 DCEG clause 15.4.2. However, the following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **measured distance** has been introduced in S-101 to encode the specified measured distance along the track to be followed. See clause 10.1.1.

The components of each transit of the measured distance that have been aggregated using the S-57 Collection Object **C\_AGGR** will be converted during the automated conversion process to an instance of the S-101 Feature type **Range System**. Each **Range System** and its individual components will be aggregated using the named association **Range System Aggregation**. These range systems and the track to be followed will be further aggregated using **Range System Aggregation** to create the hierarchical relationship.

## 10.2 Routeing measures

### 10.2.1 Traffic separation schemes

NOTE: The S-57 attribute CATTSS for the individual components of a traffic separation scheme has been remodelled in S-101 to the Boolean type attribute **IMO adopted** on the Feature type **Traffic Separation Scheme** (see clause 10.2.3). In order for an instance of **Traffic Separation Scheme** to be created during the automated conversion process, Data Producers are advised to ensure that all the components of a traffic separation scheme have been aggregated using the S-57 Collection Object **C\_AGGR**; and all components have the same value populated for CATTSS.

#### 10.2.1.1 Traffic separation scheme lanes

S-57 Geo Object: Traffic separation scheme lane part (**TSSLPT**) (A)

S-101 Geo Feature: **Traffic Separation Scheme Lane Part** (S) (S-101 DCEG Clause 15.18)

All instances of encoding of the S-57 Object class **TSSLPT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Scheme Lane Part** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSSLPT** will not be converted. See clause 10.2.1.

#### 10.2.1.2 Traffic separation scheme boundaries

S-57 Geo Object: Traffic separation scheme boundary (**TSSBND**) (L)

S-101 Geo Feature: **Traffic Separation Scheme Boundary** (C) (S-101 DCEG Clause 15.21)

All instances of encoding of the S-57 Object class **TSSBND** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Scheme Boundary** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSSBND** will not be converted. See clause 10.2.1.

#### 10.2.1.3 Traffic separation lines

S-57 Geo Object: Traffic separation line (**TSELNE**) (L)

S-101 Geo Feature: **Traffic Separation Line** (C) (S-101 DCEG Clause 15.20)

All instances of encoding of the S-57 Object class **TSELNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Line** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSELNE** will not be converted. See clause 10.2.1.

#### 10.2.1.4 Traffic separation zones

S-57 Geo Object: Traffic separation zone (**TSEZNE**) (A)

S-101 Geo Feature: **Traffic Separation Zone** (S) (S-101 DCEG Clause 15.19)

All instances of encoding of the S-57 Object class **TSEZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Zone** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSEZNE** will not be converted. See clause 10.2.1.

#### 10.2.1.5 Traffic separation scheme crossings

S-57 Geo Object: Traffic separation scheme crossing (**TSSCRS**) (A)

S-101 Geo Feature: **Traffic Separation Scheme Crossing** (S) (S-101 DCEG Clause 15.22)

All instances of encoding of the S-57 Object class **TSSCRS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Scheme Crossing** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSSCRS** will not be converted. See clause 10.2.1.

#### 10.2.1.6 Traffic separation scheme roundabouts

S-57 Geo Object: Traffic separation scheme roundabout (**TSSRON**) (A)

S-101 Geo Feature: **Traffic Separation Scheme Roundabout** (S) (S-101 DCEG Clause 15.23)

All instances of encoding of the S-57 Object class **TSSRON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Traffic Separation Scheme Roundabout** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **TSSRON** will not be converted. See clause 10.2.1.

#### 10.2.1.7 Inshore traffic zones

S-57 Geo Object: Inshore traffic zone (**ISTZNE**) (A)

S-101 Geo Feature: **Inshore Traffic Zone** (S) (S-101 DCEG Clause 15.16)

All instances of encoding of the S-57 Object class **ISTZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Inshore Traffic Zone** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute CATTSS for **ISTZNE** will not be converted. See clause 10.2.1.

#### 10.2.1.8 Precautionary areas

S-57 Geo Object: Precautionary area (**PRCARE**) (P,A)

S-101 Geo Feature: **Precautionary Area** (P,S) (S-101 DCEG Clause 15.17)

All instances of encoding of the S-57 Object class **PRCARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Precautionary Area** during the automated conversion process. However the following exceptions apply:

- The relevant cautionary information encoded in the mandatory attributes INFORM and TXTDSC will be converted to an instance of the complex attribute **information**. See also clause 2.3.

#### 10.2.2 Deep water routes

S-101 Geo Feature: **Deep Water Route** (N) (S-101 DCEG Clause 15.15)

S-101 Association: **Deep Water Route Aggregation** (N) (S-101 DCEG Clause 25.6)

Where the components of a deep water route have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Deep Water Route**. The **Deep Water Route** and its individual components will be aggregated using the named association **Deep Water Route Aggregation**. Data Producers are to note that where a **Deep Water Route** has been created during the automated conversion process, it will be required to populate the attribute **IMO adopted** manually, if considered necessary.

### 10.2.2.1 Deep water route parts

S-57 Geo Object: Deep water route part (**DWRTPT**) (A)

S-101 Geo Feature: **Deep Water Route Part** (S) (S-101 DCEG Clause 15.14)

All instances of encoding of the S-57 Object class **DWRTPT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Deep Water Route Part** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Deep Water Route Part** in S-101:

**technique of vertical measurement** (TECSOU)

See S-101 DCEG clause 15.14 for the listing of allowable values. Values populated in S-57 for this attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for TECSOU on **DWRTPT** and amend appropriately.

### 10.2.2.2 Deep water route centrelines

S-57 Geo Object: Deep water route centreline (**DWRTCL**) (L)

S-101 Geo Feature: **Deep Water Route Centreline** (C) (S-101 DCEG Clause 15.13)

All instances of encoding of the S-57 Object class **DWRTCL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Deep Water Route Centreline** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Deep Water Route Centreline** in S-101:

**technique of vertical measurement** (TECSOU)

See S-101 DCEG clause 15.13 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for TECSOU on **DWRTCL** and amend appropriately.

### 10.2.3 Traffic separation scheme systems

S-101 Geo Feature: **Traffic Separation Scheme** (N) (S-101 DCEG Clause 15.24)

S-101 Association: **Traffic Separation Scheme Aggregation** (N) (S-101 DCEG Clause 25.17)

Where the components of a traffic separation scheme (TSS) have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Traffic Separation Scheme**. The **Traffic Separation Scheme** and its individual components will be aggregated using the named association **Traffic Separation Scheme Aggregation**. Data Producers are to note that where a **Traffic Separation Scheme** has been created during the automated conversion process, it may be required to populate the attributes **IMO adopted** and **maximum permitted draught** manually, if considered necessary.

The following additional requirements for S-57 encoding must be noted:

- Where the name of the TSS has been encoded in the S-57 dataset using an instance of the S-57 Object class **SEAARE** or by populating OBJNAM for the most representative object in the TSS, Data Producers are advised to also populate the name using OBJNAM on the **C\_AGGR** prior to conversion. The **Sea Area/Named Water Area** or **feature name** for the most representative feature in the TSS should then be removed from the converted S-101 dataset in this case.

### 10.2.4 Recommended routes

S-57 Geo Object: Recommended route centreline (**RCRTCL**) (L)

S-101 Geo Feature: **Recommended Route Centreline** (C) (S-101 DCEG Clause 15.9)

All instances of encoding of the S-57 Object class **RCRTCL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Recommended Route Centreline** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Recommended Route Centreline** in S-101:

**technique of vertical measurement** (TECSOU)

See S-101 DCEG clause 15.9 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for TECSOU on **RCRTCL** and amend appropriately.

### 10.2.5 Recommended direction of traffic flow

S-57 Geo Object: Recommended traffic lane part (**RCTLPT**) (P,A)

S-101 Geo Feature: **Recommended Traffic Lane Part** (P,S) (S-101 DCEG Clause 15.12)

All instances of encoding of the S-57 Object class **RCTLPT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Recommended Traffic Lane Part** during the automated conversion process.

### 10.2.6 Two-way routes

S-57 Geo Object: Two-way route part (**TWRTPT**) (P,A)

S-101 Geo Feature: **Two-Way Route Part** (P,S) (S-101 DCEG Clause 15.10)

S-101 Geo Feature: **Two-Way Route** (N) (S-101 DCEG Clause 15.11)

S-101 Association: **Two-Way Route Aggregation** (N) (S-101 DCEG Clause 25.18)

All instances of encoding of the S-57 Object class **TWRTPT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Two-Way Route Part** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Two-Way Route Part** in S-101:

**technique of vertical measurement** (TECSOU)

See S-101 DCEG clause 15.10 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for TECSOU on **TWRTPT** and amend appropriately.

Where the components of a two-way route have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Two-Way Route**. The **Two-Way Route** and its individual components will be aggregated using the named association **Two-Way Route Aggregation**. Data Producers are to note that where a **Two-Way Route** has been created in the conversion process, it will be required to populate the attribute **maximum permitted draught** manually, if considered necessary.

The following additional requirements for S-57 encoding must be noted:

- Where the name of the two-way route has been encoded in the S-57 dataset using an instance of the S-57 Object class **SEAARE** or by populating OBJNAM for the most representative object in the two-way route, Data producers are advised to also populate the name using OBJNAM on the **C\_AGGR** prior to conversion. The **Sea Area/Named Water Area** or **feature name** for the most representative feature in the two-way route should then be removed from the converted S-101 dataset in this case.

### 10.2.7 Areas to be avoided

The guidance for the encoding an IMO Area to be Avoided remains unchanged in S-101. See S-101 DCEG clause 17.6.

## 10.3 Ferries

S-57 Geo Object: Ferry route (**FERYRT**) (L,A)

S-101 Geo Feature: **Ferry Route** (C,S) (S-101 DCEG Clause 15.29)

All instances of encoding of the S-57 Object class **FERYRT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Ferry Route** during the automated conversion process.

## 10.4 Fairways

<u>S-57 Geo Object:</u>	Fairway ( <b>FAIRWY</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Fairway</b>	(S)	(S-101 DCEG Clause 15.7)
<u>S-101 Geo Feature:</u>	<b>Fairway System</b>	(N)	(S-101 DCEG Clause 15.8)
<u>S-101 Association:</u>	<b>Fairway Aggregation</b>	(N)	(S-101 DCEG Clause 25.7)
<u>S-101 Association:</u>	<b>Fairway Auxiliary</b>	(N)	(S-101 DCEG Clause 25.8)

All instances of encoding of the S-57 Object class **FAIRWY** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fairway** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Fairway** in S-101:

**quality of vertical measurement** (QUASOU)

See S-101 DCEG clause 15.7 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for QUASOU on **FAIRWY** and amend appropriately.

Where the components of a fairway have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Fairway System**. The **Fairway System** and its individual components will be aggregated using the named association **Fairway Aggregation** (see S-101 DCEG clause 25.7). Data Producers are to note that where a **Fairway System** has been created in the conversion process, it will be required to populate the attributes **fixed date range**, **maximum permitted draught** and **periodic date range** manually, if considered necessary.

The following additional requirements for S-57 encoding must be noted:

- Where the name of the fairway has been encoded in the S-57 dataset using an instance of the S-57 Object class **SEAARE** or by populating OBJNAM for the most representative object in the fairway, Data producers are advised to also populate the name using OBJNAM on the **C\_AGGR** prior to conversion. The **Sea Area/Named Water Area** or **feature name** for the most representative feature in the fairway should be removed from the converted S-101 dataset in this case.

## 10.5 Archipelagic Sea Lane

### 10.5.1 Archipelagic Sea Lanes

<u>S-57 Geo Object:</u>	Archipelagic Sea Lane ( <b>ARCSLN</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Archipelagic Sea Lane Area</b>	(S)	(S-101 DCEG Clause 15.25)

All instances of encoding of the S-57 Object class **ARCSLN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Archipelagic Sea Lane Area** during the automated conversion process.

### 10.5.2 Archipelagic Sea Lane Axis

<u>S-57 Geo Object:</u>	Archipelagic Sea Lane Axis ( <b>ASLXIS</b> )	(L)	
<u>S-101 Geo Feature:</u>	<b>Archipelagic Sea Lane Axis</b>	(C)	(S-101 DCEG Clause 15.26)

All instances of encoding of the S-57 Object class **ASLXIS** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Archipelagic Sea Lane Axis** during the automated conversion process.

### 10.5.3 Archipelagic Sea Lane systems

<u>S-101 Geo Feature:</u>	<b>Archipelagic Sea Lane</b>	(N)	(S-101 DCEG Clause 15.27)
<u>S-101 Association:</u>	<b>ASL Aggregation</b>	(N)	(S-101 DCEG Clause 25.3)

Where the components of an Archipelagic Sea Lane (ASL) have been aggregated using the S-57 Collection Object **C\_AGGR**, this will be converted during the automated conversion process to an instance of the S-101 Feature type **Archipelagic Sea Lane**. The **Archipelagic Sea Lane** and its

individual components will be aggregated using the named association **ASL Aggregation**. Data Producers are to note that where an **Archipelagic Sea Lane** has been created in the conversion process, it will be required to populate the attributes **fixed date range** and **nationality** manually, if considered necessary.

The following additional requirements for S-57 encoding must be noted:

- Where the name of the ASL has been encoded in the S-57 dataset using an instance of the S-57 Object class **SEAARE** or by populating OBJNAM for the most representative object in the ASL, Data producers are advised to also populate the name using OBJNAM on the **C\_AGGR** prior to conversion. The **Sea Area/Named Water Area** or **feature name** for the most representative feature in the ASL should be removed from the converted S-101 dataset in this case.

## 11 Regulated areas

### 11.1 Restricted areas in general

<u>S-57 Geo Object:</u>	Restricted area ( <b>RESARE</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Restricted Area Navigational</b>	(S)	(S-101 DCEG Clause 17.8)
<u>S-101 Geo Feature:</u>	<b>Restricted Area Regulatory</b>	(S)	(S-101 DCEG Clause 17.9)

All instances of encoding of the S-57 Object class **RESARE** and its binding attributes will be converted automatically to an instance of one of the S-101 Feature types **Restricted Area Navigational** or **Restricted Area Regulatory** during the automated conversion process. The following requirements for S-57 encoding must be noted:

- The determination as to which of the features **Restricted Area Navigational** or **Restricted Area Regulatory** is created (or possibly both where multiple values are populated) is dependent on the value(s) of the attribute **RESTRN** on the S-57 **RESARE** object. Where **RESTRN** is not present or is populated with an empty (null) value, the **RESARE** will be converted to a **Restricted Area Navigational** feature. Data Producers are advised to check encoded instances of **RESARE** in their ENC portfolio and ensure that **RESTRN** is populated as required.

### 11.2 Maritime jurisdiction areas

The general guidance for the encoding of maritime jurisdiction areas remains unchanged in S-101. See S-101 DCEG clause 16.2.

#### 11.2.1 National territories

<u>S-57 Geo Object:</u>	Administration area ( <b>ADMARE</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Administration Area</b>	(S)	(S-101 DCEG Clause 16.8)

All instances of encoding of the S-57 Object class **ADMARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Administration Area** during the automated conversion process, with the following exceptions:

- **ADMARE** encoded to indicate a marine pollution regulations area (see clause 11.16).
- **ADMARE** encoded to indicate a vessel traffic service area (see clause 12.13).
- **ADMARE** encoded to indicate a pilotage district (see clause 13.1.2).

The following requirements for S-57 attribution must be noted:

- The S-101 attribute **in dispute** has been introduced in S-101 to provide an indication to the mariner that an administration is in dispute. This information may be encoded in S-57 using an instance of the S-57 Object class **CTNARE** covering the area that is in dispute. In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **CTNARE** should be in a standardised format, such as *In dispute*. Where this occurs, the **ADMARE** should be partitioned into two discrete **Administration Area** features during the conversion process. One **Administration Area** should be created coincident with the **CTNARE**, with **in dispute** set to *True*; and the other **Administration Area** created to cover the remaining **ADMARE**, with **in dispute** not populated or set to *False*. The S-101 **Caution Area** feature resulting from the conversion of the **CTNARE** should be removed from the converted S-101 dataset in this case.

#### 11.2.2 Custom zones

<u>S-57 Geo Object:</u>	Custom zone ( <b>CUSZNE</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Custom Zone</b>	(S)	(S-101 DCEG Clause 16.14)

All instances of encoding of the S-57 Object class **CUSZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Custom Zone** during the automated conversion process.

#### 11.2.3 Free port areas

<u>S-57 Geo Object:</u>	Free port area ( <b>FRPARE</b> )	(A)	
<u>S-101 Geo Feature:</u>	<b>Free Port Area</b>	(S)	(S-101 DCEG Clause 16.18)

All instances of encoding of the S-57 Object class **FRPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Free Port Area** during the automated conversion process.

#### 11.2.4 Territorial Seas

S-57 Geo Object: Straight Territorial Sea Baseline (**STSLNE**) (L)

S-101 Geo Feature: **Straight Territorial Sea Baseline** (C) (S-101 DCEG Clause 16.22)

All instances of encoding of the S-57 Object class **STSLNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Straight Territorial Sea Baseline** during the automated conversion process.

S-57 Geo Object: Territorial Sea area (**TESARE**) (A)

S-101 Geo Feature: **Territorial Sea Area** (S) (S-101 DCEG Clause 16.23)

All instances of encoding of the S-57 Object class **TESARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Territorial Sea Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Territorial Sea Area** in S-101:

**restriction** (RESTRN)

See S-101 DCEG clause 16.23 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for RESTRN on **TESARE** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **in dispute** has been introduced in S-101 to provide an indication to the mariner that a territorial sea area is in dispute. This information may be encoded in S-57 using an instance of the S-57 Object class **CTNARE** covering the area that is in dispute. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **CTNARE** should be in a standardised format, such as *In dispute*. Where this occurs, the **TESARE** should be partitioned into two discrete **Territorial Sea Area** features during the conversion process. One **Territorial Sea Area** should be created coincident with the **CTNARE**, with **in dispute** set to *True*; and the other **Territorial Sea Area** created to cover the remaining **TESARE**, with **in dispute** not populated or set to *False*. The S-101 **Caution Area** feature resulting from the conversion of the **CTNARE** should be removed from the converted S-101 dataset in this case.

#### 11.2.5 Contiguous Zones

S-57 Geo Object: Contiguous Zone (**CONZNE**) (A)

S-101 Geo Feature: **Contiguous Zone** (S) (S-101 DCEG Clause 16.12)

All instances of encoding of the S-57 Object class **CONZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Contiguous Zone** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute STATUS for **CONZNE** will not be converted. It is considered that this attribute is not relevant for **Contiguous Zone** in S-101.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **in dispute** has been introduced in S-101 to provide an indication to the mariner that a contiguous zone is in dispute. This information may be encoded in S-57 using an instance of the S-57 Object class **CTNARE** covering the area that is in dispute. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **CTNARE** should be in a standardised format, such as *In dispute*. Where this occurs, the **CONZNE** should be partitioned into two discrete **Contiguous Zone** features during the conversion process. One **Contiguous Zone** should be created coincident with the **CTNARE**, with **in dispute** set to *True*; and the other **Contiguous Zone** created to cover the remaining **CONZNE**, with **in dispute** not populated or set to *False*. The S-101 **Caution Area** feature resulting from the conversion of the **CTNARE** should be removed from the converted S-101 dataset in this case.

### 11.2.6 Fishery zones

S-57 Geo Object: Fishery zone (**FSHZNE**) (A)

S-101 Geo Feature: **Fishery Zone** (S) (S-101 DCEG Clause 16.16)

All instances of encoding of the S-57 Object class **FSHZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fishery Zone** during the automated conversion process.

The following requirements for S-57 attribution must be noted:

- For S-57 ENC it is recommended that the seaward extent of the limit of a fishery zone (6 or 12 NM) is encoded using the attribute **INFORM**. For S-101 this has been amended to recommend the encoding of this information using the complex attribute **feature name**. Data Producers are advised to evaluate their S-57 data holdings and amend the encoding of this information as required.

### 11.2.7 Continental Shelves

S-57 Geo Object: Continental Shelf area (**COSARE**) (A)

S-101 Geo Feature: **Continental Shelf Area** (S) (S-101 DCEG Clause 16.13)

All instances of encoding of the S-57 Object class **COSARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Continental Shelf Area** during the automated conversion process.

### 11.2.8 Exclusive Economic Zones

S-57 Geo Object: Exclusive Economic Zone (**EXEZNE**) (A)

S-101 Geo Feature: **Exclusive Economic Zone** (S) (S-101 DCEG Clause 16.15)

All instances of encoding of the S-57 Object class **EXEZNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Exclusive Economic Zone** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **in dispute** has been introduced in S-101 to provide an indication to the mariner that an Exclusive Economic Zone is in dispute. This information may be encoded in S-57 using an instance of the S-57 Object class **CTNARE** covering the area that is in dispute. In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **CTNARE** should be in a standardised format, such as *In dispute*. Where this occurs, the **EXEZNE** should be partitioned into two discrete **Exclusive Economic Zone** features during the conversion process. One **Exclusive Economic Zone** should be created coincident with the **CTNARE**, with **in dispute** set to *True*; and the other **Exclusive Economic Zone** created to cover the remaining **EXEZNE**, with **in dispute** not populated or set to *False*. The S-101 **Caution Area** feature resulting from the conversion of the **CTNARE** should be removed from the converted S-101 dataset in this case.

## 11.3 Military practice areas; submarine transit lanes; minefields

### 11.3.1 Military practice areas

S-57 Geo Object: Military practice area (**MIPARE**) (P,A)

S-101 Geo Feature: **Military Practice Area** (P,S) (S-101 DCEG Clause 16.7)

All instances of encoding of the S-57 Object class **MIPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Military Practice Area** during the automated conversion process.

### 11.3.2 Submarine transit lanes

S-57 Geo Object: Submarine transit lane (**SUBTLN**) (A)

S-101 Geo Feature: **Submarine Transit Lane** (S) (S-101 DCEG Clause 16.24)

All instances of encoding of the S-57 Object class **SUBTLN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Submarine Transit Lane** during the automated conversion process.

### 11.3.3 Minefields

The guidance for the encoding of minefields remains unchanged in S-101. See S-101 DCEG clause 17.1.

## 11.4 Dumping grounds

S-57 Geo Object: Dumping ground (**DMPGRD**) (P,A)

S-101 Geo Feature: **Dumping Ground** (P,S) (S-101 DCEG Clause 16.6)

All instances of encoding of the S-57 Object class **DMPGRD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Dumping Ground** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Dumping Ground** in S-101:

**restriction** (RESTRN)

See S-101 DCEG clause 16.6 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for RESTRN on **DMPGRD** and amend appropriately.

## 11.5 Cables and cable areas

### 11.5.1 Submarine cables

S-57 Geo Object: Cable, submarine (**CBLSUB**) (L)

S-101 Geo Feature: **Cable Submarine** (C) (S-101 DCEG Clause 14.2)

All instances of encoding of the S-57 Object class **CBLSUB** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Cable Submarine** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes DRVAL1 and DRVAL2 for **CBLSUB** will not be converted. It is considered that these attributes are not relevant for **Cable Submarine** in S-101.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Cable Submarine** in S-101:

**category of cable** (CATCBL) \*

See S-101 DCEG clause 14.2 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATCBL on **CBLSUB** and amend appropriately.

\* CATCBL value 4 (telephone) will convert to **category of cable** value 8 (fibre optic cable).

### 11.5.2 Overhead cables

S-57 Geo Object: Cable, overhead (**CBLOHD**) (L)

S-101 Geo Feature: **Cable Overhead** (C) (S-101 DCEG Clause 6.9)

All instances of encoding of the S-57 Object class **CBLOHD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Cable Overhead** during the automated conversion process.

### 11.5.3 Submarine cable areas

S-57 Geo Object: Cable area (**CBLARE**) (A)

S-101 Geo Feature: **Cable Area** (S) (S-101 DCEG Clause 14.3)

All instances of encoding of the S-57 Object class **CBLARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Cable Area** during the automated conversion

process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Cable Area** in S-101:

**category of cable** (CATCBL) \*

**restriction** (RESTRN)

See S-101 DCEG clause 14.3 for the listing of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATCBL and RESTRN on **CBLARE** and amend appropriately.

\* CATCBL value 4 (telephone) will convert to **category of cable** value 8 (fibre optic cable).

## 11.6 Pipelines and pipeline areas

### 11.6.1 Pipelines, submarine or on land

S-57 Geo Object: Pipeline, submarine / on land (**PIPSOL**) (P,L)

S-101 Geo Feature: **Pipeline Submarine/On Land** (C) (S-101 DCEG Clause 14.4)

All instances of encoding of the S-57 Object class **PIPSOL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pipeline Submarine/On Land** during the automated conversion process. However the following exceptions apply:

- **PIPSOL** of type point will convert to an instance of the S-101 Feature type **Obstruction** if extending from the seabed; or to an instance of the S-101 Feature type **Landmark** if located on land. Data Producers will be required to evaluate their converted S-101 data and review the attribution of these features as required.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Pipeline Submarine/On Land** in S-101:

**product** (PRODCT)

See S-101 DCEG clause 14.4 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for PRODCT on **PIPSOL** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **category of pipeline/pipe** includes the new enumerate value 7 (bubble curtain). This information is encoded in S-57 on **PIPSOL** using the attribute CATPIP value 5 (bubbler system). Data Producers will be required to evaluate their converted S-101 data and amend this attribution if considered necessary.

### 11.6.2 Diffusers, cribs

The guidance for the encoding of diffusers and cribs remains unchanged in S-101. See S-101 DCEG clause 14.4.2.

### 11.6.3 Overhead pipelines

S-57 Geo Object: Pipeline overhead (**PIPOHD**) (L)

S-101 Geo Feature: **Pipeline Overhead** (C) (S-101 DCEG Clause 6.10)

All instances of encoding of the S-57 Object class **PIPOHD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pipeline Overhead** during the automated conversion process.

### 11.6.4 Pipeline areas

S-57 Geo Object: Pipeline area (**PIPARE**) (P,A)

S-101 Geo Feature: **Submarine Pipeline Area** (P,S) (S-101 DCEG Clause 14.5)

All instances of encoding of the S-57 Object class **PIPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Submarine Pipeline Area** during the automated

conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Submarine Pipeline Area** in S-101:

**product** (PRODCT)

**restriction** (RESTRN)

See S-101 DCEG clause 14.5 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for PRODCT and RESTRN on **PIPARE** and amend appropriately.

## 11.7 Oil and Gas fields

### 11.7.1 Wellheads

The guidance for the encoding of wellheads remains unchanged in S-101. See S-101 DCEG clause 14.1.2.

### 11.7.2 Offshore platforms

S-57 Geo Object: Offshore platform (**OFSPLF**) (P,A)

S-101 Geo Feature: **Offshore Platform** (P,S) (S-101 DCEG Clause 14.1)

All instances of encoding of the S-57 Object class **OFSPLF** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Offshore Platform** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute NATCON for **OFSPLF** will not be converted. It is considered that this attribute is not relevant for **Offshore Platform** in S-101.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Offshore Platform** in S-101:

**status** (STATUS)

See S-101 DCEG clause 14.1 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **OFSPLF** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 Boolean type attribute **flare stack** has been introduced in S-101 to encode the existence of a flare stack on the offshore platform. This information is encoded in S-57 as an instance of the S-57 Object class **LNDMRK** with attribute CATLMK = 6 (flare stack). Data producers will be required to manually amend this encoding by populating **flare stack** = *True* and removing the **Landmark** feature in the converted S-101 dataset.

### 11.7.3 Offshore safety zones

The guidance for the encoding of offshore safety zones remains unchanged in S-101. See S-101 DCEG clause 14.1.3.

### 11.7.4 Offshore production areas

S-57 Geo Object: Offshore production area (**OSPARE**) (A)

S-101 Geo Feature: **Offshore Production Area** (S) (S-101 DCEG Clause 14.6)

All instances of encoding of the S-57 Object class **OSPARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Offshore Production Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Offshore Production Area** in S-101:

**condition** (CONDTN)

See S-101 DCEG clause 14.6 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **OSPARE** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- The S-57 attribute CATPRA (category of production area) should be converted to the S-101 attribute **category of offshore production area**, which does not exist in S-57. Data Producers must note that there is only a direct correlation to S-101 with CATPRA values 8 (tank farm) and 9 (wind farm), and should therefore evaluate their S-101 converted datasets to ensure that an appropriate value for **category of offshore production area** is populated.
- Individual wind turbines within offshore wind farms encoded in S-57 as an instance of the S-57 Object class **LNDMRK** will be converted to an instance of the S-101 Feature type **Wind Turbine** (see clause 4.8.15).
- The S-101 attribute **category of offshore production area** values 2 (wave farm) and 3 (current farm) have been introduced to encode wave and current farms. This information is encoded in S-57 on **OSPARE** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **OSPARE** should be in a standardised format, such as *Wave farm* or *Current farm*.

### 11.7.5 Offshore tanker loading systems

The guidance for the encoding of offshore tanker loading systems remains unchanged in S-101. See S-101 DCEG clause 14.6.2.

### 11.7.6 Flare stacks

The guidance for the encoding of flare stacks on land remains unchanged in S-101. See S-101 DCEG clause 7.2. For the conversion of flare stacks located on offshore platforms, see clause 11.7.2 above.

## 11.8 Spoil grounds, dredging areas

The guidance for the encoding of spoil grounds and dredging areas remains unchanged in S-101. See S-101 DCEG clause 16.6.2.

## 11.9 Fishing equipment and aquaculture areas

### 11.9.1 Fishing facilities

S-57 Geo Object: Fishing facility (**FSHFAC**) (P,L,A)

S-101 Geo Feature: **Fishing Facility** (P,C,S) (S-101 DCEG Clause 13.9)

All instances of encoding of the S-57 Object class **FSHFAC** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fishing Facility** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Fishing Facility** in S-101:

**status** (STATUS)

See S-101 DCEG clause 13.9 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **FSHFAC** and amend appropriately.

### 11.9.2 Marine farms

S-57 Geo Object: Marine farm / culture (**MARCUL**) (P,L,A)

S-101 Geo Feature: **Marine Farm/Culture** (P,C,S) (S-101 DCEG Clause 13.10)

All instances of encoding of the S-57 Object class **MARCUL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Marine Farm/Culture** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Marine Farm/Culture** in S-101:

**exposition of sounding** (EXPSOU)

See S-101 DCEG clause 13.10 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for EXPSOU on **MARCUL** and amend appropriately.

### 11.9.3 Fish havens

The guidance for the encoding of fish havens remains unchanged in S-101. See S-101 DCEG clause 13.10.2.

### 11.9.4 Fishing grounds

S-57 Geo Object: Fishing ground (**FSHGRD**) (A)

S-101 Geo Feature: **Fishing Ground** (S) (S-101 DCEG Clause 16.17)

All instances of encoding of the S-57 Object class **FSHGRD** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fishing Ground** during the automated conversion process.

### 11.10 Degaussing ranges

The guidance for the encoding of degaussing ranges remains unchanged in S-101. See S-101 DCEG clause 17.2.

### 11.11 Historic wrecks

The guidance for the encoding of historic wrecks remains unchanged in S-101. See S-101 DCEG clause 13.5.2.

### 11.12 Seaplane landing areas

S-57 Geo Object: Seaplane landing area (**SPLARE**) (P,A)

S-101 Geo Feature: **Seaplane Landing Area** (P,S) (S-101 DCEG Clause 16.5)

All instances of encoding of the S-57 Object class **SPLARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Seaplane Landing Area** during the automated conversion process.

### 11.13 Various maritime areas

#### 11.13.1 Ice areas

S-57 Geo Object: Ice area (**ICEARE**) (A)

S-101 Geo Feature: **Ice Area** (S) (S-101 DCEG Clause 5.13)

All instances of encoding of the S-57 Object class **ICEARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Ice Area** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Ice Area** in S-101:

**status** (STATUS)

See S-101 DCEG clause 5.13 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **ICEARE** and amend appropriately.

#### 11.13.2 Log ponds

S-57 Geo Object: Log pond (**LOGPON**) (P,A)

S-101 Geo Feature: **Log Pond** (P,S) (S-101 DCEG Clause 16.20)

All instances of encoding of the S-57 Object class **LOGPON** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Log Pond** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Log Pond** in S-101:

**status** (STATUS)

See S-101 DCEG clause 16.20 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **LOGPON** and amend appropriately.

### 11.13.3 Incineration areas

S-57 Geo Object: Incineration area (**ICNARE**) (P,A)

S-101 Geo Feature: None

The S-57 Object class **ICNARE** will not be converted.

### 11.13.4 Cargo transshipment areas

S-57 Geo Object: Cargo transshipment area (**CTSARE**) (P,A)

S-101 Geo Feature: **Cargo Transshipment Area** (P,S) (S-101 DCEG Clause 16.9)

All instances of encoding of the S-57 Object class **CTSARE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Cargo Transshipment Area** during the automated conversion process.

### 11.13.5 Collision regulations

S-101 Geo Feature: **Collision Regulations Limit** (C) (S-101 DCEG Clause 16.26)

The S-101 Feature type **Collision Regulations Limit** has been introduced in S-101 to encode collision regulations (COLREGS) demarcation lines. This information is encoded in S-57 using the Object class **CTNARE**. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **CTNARE** should be in a standardised format, such as *Collision regulations limit*. Data Producers are advised to examine any **Collision Regulations Limit** features created during the automated conversion process and confirm the attribution for these features as required, including any values populated for the complex attribute **information**.

## 11.14 Nature reserves

The guidance for the encoding of nature reserves remains unchanged in S-101. See S-101 DCEG clause 17.3.

## 11.15 Environmentally Sensitive Sea Areas

The guidance for the encoding of Environmentally Sensitive Sea Areas remains unchanged in S-101. See S-101 DCEG clause 17.7.

## 11.16 Marine pollution regulations

S-101 Geo Feature: **Marine Pollution Regulations Area** (S) (S-101 DCEG Clause 16.27)

The S-101 Feature type **Marine Pollution Regulations Area** has been introduced in S-101 to encode areas subject to marine pollution regulations. This information is encoded in S-57 using the Object class **ADMARE**. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **ADMARE** should be in a standardised format, such as *Marine pollution regulations area*. Data Producers are advised to examine any **Marine Pollution Regulations Area** features created during the automated conversion process and confirm the attribution for these features as required, including any values populated for the complex attribute **information**.

## 12 Aids to navigation

### 12.1 Lighthouses, navigational marks - relationships

#### 12.1.1 Geo objects forming parts of navigational aids

The guidance regarding Geo Objects forming parts of navigational aids remains unchanged in S-101. See S-101 DCEG clause 18.1.

#### 12.1.2 Relationships

S-101 Association:    **Structure/Equipment**            (N)                            (S-101 DCEG Clause 25.15)

The guidance regarding relationships for components of navigational aids remains unchanged in S-101. See S-101 DCEG clauses 18.2 and 19.1.8.

### 12.2 Buoyage systems and direction of buoyage

S-57 Meta Object:    Navigational system of marks (**M\_NSYS**)    (A)

S-101 Meta Feature:    **Navigational System of Marks**            (S)    (S-101 DCEG Clause 3.5)

S-101 Meta Feature:    **Local Direction of Buoyage**                            (S)    (S-101 DCEG Clause 3.6)

All instances of encoding of the S-57 Meta Object **M\_NSYS** and its binding attributes will be converted automatically to an instance of the S-101 Meta Features **Navigational System of Marks** or **Local Direction of Buoyage** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Navigational System of Marks** and **Local Direction of Buoyage** in S-101:

**marks navigational – system of**                            (MARSYS)

See S-101 DCEG clause 3.5 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will be converted to an empty (null) value. Data Producers are advised to check any populated values for MARSYS on **M\_NSYS** and amend appropriately.

The following additional requirements for S-57 attribution must be noted:

- Instances of **M\_NSYS** and having a value encoded in the attribute **ORIENT** will be converted to an instance of the S-101 Feature type **Local Direction of Buoyage** during the automated conversion process.

The general guidance regarding buoyage systems and direction of buoyage remains unchanged in S-101. See S-101 DCEG clause 18.3.

### 12.3 Fixed structures

#### 12.3.1 Beacons

S-57 Geo Object:    Beacon, cardinal (**BCNCAR**)                            (P)

S-101 Geo Feature:    **Beacon Cardinal**                            (P)                            (S-101 DCEG Clause 20.9)

S-57 Geo Object:    Beacon, isolated danger (**BCNISD**)                            (P)

S-101 Geo Feature:    **Beacon Isolated Danger**                            (P)                            (S-101 DCEG Clause 20.10)

S-57 Geo Object:    Beacon, lateral (**BCNLAT**)                            (P)

S-101 Geo Feature:    **Beacon Lateral**                            (P)                            (S-101 DCEG Clause 20.8)

S-57 Geo Object:    Beacon, safe water (**BCNSAW**)                            (P)

S-101 Geo Feature:    **Beacon Safe Water**                            (P)                            (S-101 DCEG Clause 20.11)

All instances of encoding of the above S-57 beacon Object classes and their binding attributes will be converted automatically to an instance of the corresponding above S-101 beacon Feature types during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for these beacon features in S-101:

**marks navigational – system of** (MARSYS)

**nature of construction** (NATCON)

See S-101 DCEG clauses 20.8-11 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for MARSYS and NATCON on beacon objects and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 complex attribute **topmark** has been introduced in S-101 to encode topmarks on aids to navigation features. This information is encoded in S-57 using the Object class **TOPMAR**. All instances of **TOPMAR** will be converted to **topmark** for the corresponding aid to navigation structure feature during the automated conversion process. However it must be noted that the **TOPMAR** attributes COLPAT, DATEND, DATSTA, HEIGHT, PEREND, PERSTA and STATUS will not be converted. Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 complex attribute **shape information**. See also clause 12.6.
- The S-101 attribute **nature of construction** includes the new enumerate value *11* (latticed). This information is encoded in S-57 on beacon Objects using the mandatory attribute BCNSHP value *4* (lattice beacon), which is not an allowable value for the mandatory attribute **beacon shape** in S-101. Data Producers will be required to evaluate their converted S-101 data and populate **beacon shape** with an appropriate allowable value.

S-57 Geo Object: Beacon, special purpose (**BCNSPP**) (P)

S-101 Geo Feature: **Beacon Special Purpose/General** (P) (S-101 DCEG Clause 20.12)

All instances of encoding of the S-57 Object class **BCNSPP** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Beacon Special Purpose/General** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Beacon Special Purpose/General** in S-101:

**category of special purpose mark** (CATSPM)

**marks navigational – system of** (MARSYS)

**nature of construction** (NATCON)

See S-101 DCEG clause 20.12 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATSPM, MARSYS and NATCON on **BCNSPP** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 complex attribute **topmark** has been introduced in S-101 to encode topmarks on aids to navigation features. This information is encoded in S-57 using the Object class **TOPMAR**. All instances of **TOPMAR** associated with **BCNSPP** will be converted to **topmark** for the corresponding **Beacon Special Purpose/General** during the automated conversion process. However it must be noted that the **TOPMAR** attributes COLPAT, DATEND, DATSTA, HEIGHT, PEREND, PERSTA and STATUS will not be converted. Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 complex attribute **shape information**. See also clause 12.6.
- The S-101 attribute **nature of construction** includes the new enumerate value *11* (latticed). This information is encoded in S-57 on **BCNSPP** using the mandatory attribute BCNSHP value *4* (lattice beacon), which is not an allowable value for the mandatory attribute **beacon shape** in S-101. Data Producers will be required to evaluate their converted S-101 data and populate **beacon shape** with an appropriate allowable value.

### 12.3.2 Lighthouses

The guidance for the encoding of lighthouses remains unchanged in S-101. See S-101 DCEG clause 19.1.6.

### 12.3.3 Daymarks

<u>S-57 Geo Object:</u>	Daymark ( <b>DAYMAR</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Daymark</b>	(P)	(S-101 DCEG Clause 20.13)

All instances of encoding of the S-57 Object class **DAYMAR** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Daymark** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Daymark** in S-101:

<b>category of special purpose mark</b>	(CATSPM)
<b>nature of construction</b>	(NATCON)

See S-101 DCEG clause 20.13 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATSPM and NATCON on **DAYMAR** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- Additional daymark shape information populated in the S-57 attribute **INFORM** will be converted to the S-101 complex attribute **shape information**. However, noting that **INFORM** may contain other information relevant to the daymark that is not related to the shape, the contents of **INFORM** may also be converted to the complex attribute **information** in addition to **shape information**. Data Producers are advised to check all instances of the population of **shape information** and **information** on **Daymark** during the automated conversion process and amend as appropriate. Alternatively, Data Producers may consider separating discrete information incidences in **INFORM** by, for instance, semicolons such that the converter may be customised to recognise particular standardised text strings and parse these strings to appropriate S-101 attributes as required.

## 12.4 Floating structures

### 12.4.1 Buoys

<u>S-57 Geo Object:</u>	Buoy, cardinal ( <b>BOYCAR</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Buoy Cardinal</b>	(P)	(S-101 DCEG Clause 20.2)
<u>S-57 Geo Object:</u>	Buoy, isolated danger ( <b>BOYISD</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Buoy Isolated Danger</b>	(P)	(S-101 DCEG Clause 20.3)
<u>S-57 Geo Object:</u>	Buoy, lateral ( <b>BOYLAT</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Buoy Lateral</b>	(P)	(S-101 DCEG Clause 20.1)
<u>S-57 Geo Object:</u>	Buoy, safe water ( <b>BOYSAW</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Buoy Safe Water</b>	(P)	(S-101 DCEG Clause 20.4)

All instances of encoding of the above S-57 buoy Object classes and their binding attributes will be converted automatically to an instance of the corresponding above S-101 buoy Feature types during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for these buoy features in S-101:

<b>marks navigational – system of</b>	(MARSYS)
<b>nature of construction</b>	(NATCON)

See S-101 DCEG clauses 20.1-4 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for MARSYS and NATCON on buoy objects and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 complex attribute **topmark** has been introduced in S-101 to encode topmarks on aids to navigation features. This information is encoded in S-57 using the Object class **TOPMAR**. All instances of **TOPMAR** will be converted to **topmark** for the corresponding aid to navigation structure

feature during the automated conversion process. However it must be noted that the **TOPMAR** attributes COLPAT, DATEND, DATSTA, HEIGHT, PEREND, PERSTA and STATUS will not be converted. Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 complex attribute **shape information**. See also clause 12.6.

S-57 Geo Object: Buoy, special purpose (**BOYSPP**) (P)

S-101 Geo Feature: **Buoy Special Purpose/General** (P) (S-101 DCEG Clause 20.5)

All instances of encoding of the S-57 Object class **BOYSPP** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Buoy Special Purpose/General** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Buoy Special Purpose/General** in S-101:

**category of special purpose mark** (CATSPM)

**marks navigational – system of** (MARSYS)

**nature of construction** (NATCON)

See S-101 DCEG clause 20.5 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATSPM, MARSYS and NATCON on **BOYSPP** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 complex attribute **topmark** has been introduced in S-101 to encode topmarks on aids to navigation features. This information is encoded in S-57 using the Object class **TOPMAR**. All instances of **TOPMAR** associated with **BOYSPP** will be converted to **topmark** for the corresponding **Buoy Special Purpose/General** during the automated conversion process. However it must be noted that the **TOPMAR** attributes COLPAT, DATEND, DATSTA, HEIGHT, PEREND, PERSTA and STATUS will not be converted. Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 complex attribute **shape information**. See also clause 12.6.

S-57 Geo Object: Buoy, installation (**BOYINB**) (P)

S-101 Geo Feature: **Buoy Installation** (P) (S-101 DCEG Clause 20.7)

All instances of encoding of the S-57 Object class **BOYINB** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Buoy Installation** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes MARSYS and VERLEN for **BOYINB** will not be converted. It is considered that these attributes are not relevant for **Buoy Installation** in S-101.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Buoy Installation** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 20.7 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **BOYINB** and amend appropriately.

#### 12.4.1.1 Emergency wreck marking buoys

S-101 Geo Feature: **Buoy New Danger Marking** (P) (S-101 DCEG Clause 20.6)

The S-101 Feature type **Buoy New Danger Marking** has been introduced in S-101 to encode the new IALA classification of buoys intended to mark newly identified dangers. This information is encoded in S-57 on **BOYSPP** using the attribute CATSPM value 27 (general warning mark). Instances of **BOYSPP** having CATSPM = 27 will be converted to an instance of **Buoy New Danger Marking** during the automated conversion process, noting however that the **BOYSPP** attributes PEREND and PERSTA will not be converted. Data Producers are advised to check instances of **BOYSPP** having CATSPM = 27 and, if the purpose of the buoy is not to mark a newly identified danger, amend the encoding as required.

Any equipment features associated with the **BOYSPP** will, on conversion, be associated with the **Buoy New Danger Marking** (see clause 12.1.2).

#### 12.4.2 Light floats and light vessels

<u>S-57 Geo Object:</u>	Light float ( <b>LITFLT</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Light Float</b>	(P)	(S-101 DCEG Clause 20.14)
<u>S-57 Geo Object:</u>	Light vessel ( <b>LITVES</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Light Vessel</b>	(P)	(S-101 DCEG Clause 20.15)

All instances of encoding of the S-57 Object classes **LITFLT** and **LITVES**, and their binding attributes, will be converted automatically to an instance of the S-101 Feature types **Light Float** and **Light Vessel** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Light Float** and **Light Vessel** in S-101:

**nature of construction** (NATCON)

See S-101 DCEG clause 20.14-15 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for NATCON on **LITFLT** and **LITVES** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 complex attribute **topmark** has been introduced in S-101 to encode topmarks on aids to navigation features. This information is encoded in S-57 using the Object class **TOPMAR**. All instances of **TOPMAR** associated with **LITFLT** will be converted to **topmark** for the corresponding **Light Float** during the automated conversion process. However it must be noted that the **TOPMAR** attributes COLPAT, DATEND, DATSTA, HEIGHT, PEREND, PERSTA and STATUS will not be converted. Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 complex attribute **shape information**. See also clause 12.6.

## 12.5 Fog signals

<u>S-57 Geo Object:</u>	Fog signal ( <b>FOGSIG</b> )	(P)	
<u>S-101 Geo Feature:</u>	<b>Fog Signal</b>	(P)	(S-101 DCEG Clause 20.18)

All instances of encoding of the S-57 Object class **FOGSIG** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Fog Signal** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- The S-101 attribute **signal generation** includes the new enumerate values 5 (radio activated) and 6 (call activated). This information is encoded in S-57 on **FOGSIG** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **FOGSIG** should be in a standardised format, such as *Radio activated* or *Call activated*.

## 12.6 Topmarks

All instances of encoding of the S-57 Object class **TOPMAR** will be converted automatically to to an instance of the complex attribute **topmark** on the associated S-101 navigational aid structure feature during the automated conversion process. See clauses 12.3.1, 12.4.1 and 12.4.2.

The following additional requirements for S-57 dataset conversion must be noted:

- Additional topmark shape information populated in the S-57 attribute INFORM will be converted to the S-101 sub-complex attribute **shape information**. However, noting that INFORM may contain other information relevant to the topmark that is not related to the shape, Data Producers are advised to check all instances of the population of **shape information** for the **topmark** complex attribute during the automated conversion process and amend as appropriate. This may include moving a relevant portion of the information from **shape information** to the complex attribute **information** on the navigational aid structure feature. Alternatively, Data Producers may consider separating discrete information incidences in INFORM by, for instance, semicolons such that the converter may

be customised to recognise particular standardised text strings and parse these strings to appropriate S-101 attributes as required.

## 12.7 Retroreflectors

S-57 Geo Object: Retroreflector (**RETRFL**) (P)

S-101 Geo Feature: **Retroreflector** (P) (S-101 DCEG Clause 20.16)

All instances of encoding of the S-57 Object class **RETRFL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Retroreflector** during the automated conversion process.

## 12.8 Lights

### 12.8.1 Description of lights

The S-57 Object class **LIGHTS** has been remodelled in S-101 to four discrete light Feature types as described in the following clauses. During the automated conversion process, encoded **LIGHTS** objects will be converted to an instance of one of the S-101 light features based on the following encoding combinations:

- LIGHTS:** Attributes ORIENT or SECTR1 and SECTR2 not present; and/or attribute CATLIT  $\neq 1$  (directional function), 6 (air obstruction light), 7 (fog detector light) or 16 (moiré effect) -> **Light All Around**
- LIGHTS:** Attributes ORIENT or SECTR1 and SECTR2 present; and/or attribute CATLIT = 1 (directional function) or 16 (moiré effect) -> **Light Sectored**
- LIGHTS:** Attribute CATLIT = 6 (air obstruction light) -> **Light Air Obstruction**
- LIGHTS:** Attribute CATLIT = 7 (fog detector light) -> **Light Fog Detector**

For **Light Sectored**, see clause 12.8.6.1.

S-57 Geo Object: Light (**LIGHTS**) (P)

S-101 Geo Feature: **Light All Around** (P) (S-101 DCEG Clause 19.2)

All instances of encoding of the S-57 Object class **LIGHTS** having:

- attributes ORIENT or SECTR1 and SECTR2 not present; and/or
- attribute CATLIT  $\neq 1$  (directional function), 6 (air obstruction light), 7 (fog detector light) or 16 (moiré effect)

and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Light All Around** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Light All Around** in S-101:

**marks navigational – system of** (MARSYS)

**light characteristic** (LITCHR)

See S-101 DCEG clause 19.2 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for MARSYS and LITCHR on **LIGHTS** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 Boolean type attribute **major light** has been introduced in S-101 to aid in improved portrayal of lights in ECDIS. This attribute will be populated as *True* during the automated conversion process for all lights having a nominal range of 10 Nautical Miles or greater. Data producers are advised to examine their converted ENCs and amend this encoding as required.
- The S-101 attribute **vertical length** has been introduced to encode the height of a light above the sea surface for **Light All Around** attached to floating structures. This information is encoded in S-57 on **LIGHTS** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **LIGHTS** should be in a standardised format, such as *Height of light xx metres*, where *xx* is the height of the light.

S-57 Geo Object: Light (**LIGHTS**) (P)

S-101 Geo Feature: **Light Fog Detector** (P) (S-101 DCEG Clause 19.4)

All instances of encoding of the S-57 Object class **LIGHTS** having attribute CATLIT = 7 (fog detector light) and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Light Fog Detector** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Light Fog Detector** in S-101:

**light characteristic** (LITCHR)

See S-101 DCEG clause 19.4 for the listings of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for LITCHR on **LIGHTS** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 attribute **vertical length** has been introduced to encode the height of a light above the sea surface for **Light Fog Detector** attached to floating structures. This information is encoded in S-57 on **LIGHTS** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **LIGHTS** should be in a standardised format, such as *Height of light xx metres*, where *xx* is the height of the light.

S-57 Geo Object: Light (**LIGHTS**) (P)

S-101 Geo Feature: **Light Air Obstruction** (P) (S-101 DCEG Clause 19.5)

All instances of encoding of the S-57 Object class **LIGHTS** having attribute CATLIT = 6 (air obstruction light) and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Light Air Obstruction** during the automated conversion process. However, Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Light Air Obstruction** in S-101:

**light characteristic** (LITCHR)

See S-101 DCEG clause 19.5 for the listings of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for LITCHR on **LIGHTS** and amend appropriately.

## 12.8.2 Types and functions of lights

The guidance for the encoding types and functions of lights remains unchanged in S-101. See S-101 DCEG clause 19.1.2.

## 12.8.3 Rhythms of lights

The guidance for the encoding the rhythm of lights remains unchanged in S-101. See S-101 DCEG clause 19.1.1.

## 12.8.4 Elevations of lights

The guidance for the encoding the elevation of lights remains unchanged in S-101. See S-101 DCEG clause 19.1.3.

## 12.8.5 Times of exhibition and exhibition conditions

### 12.8.5.1 Night lights

The guidance for the encoding of night lights remains unchanged in S-101. See S-101 DCEG clause 19.1.4.1.

### 12.8.5.2 Unwatched lights

The guidance for the encoding of unwatched lights remains unchanged in S-101. See S-101 DCEG clause 19.1.4.2.

### 12.8.5.3 Occasional lights

The guidance for the encoding of occasional lights remains unchanged in S-101. See S-101 DCEG clause 19.1.4.3.

#### 12.8.5.4 Daytime lights

The guidance for the encoding of daytime lights remains unchanged in S-101. See S-101 DCEG clause 19.1.4.4.

#### 12.8.5.5 Fog lights

The guidance for the encoding of fog lights remains unchanged in S-101. See S-101 DCEG clause 19.1.4.5.

#### 12.8.5.6 Manually-activated lights

The S-101 attribute **signal generation** includes the new enumerate values 5 (radio activated) and 6 (call activated). This information is encoded in S-57 on **LIGHTS** using the attribute **INFORM** (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in **INFORM** on the **LIGHTS** should be in a standardised format, such as *Radio activated light* or *Call activated light*. See S-101 DCEG clause 19.1.4.6.

### 12.8.6 Sector lights and lights not visible all round

#### 12.8.6.1 Sector lights

S-57 Geo Object: Light (**LIGHTS**) (P)

S-101 Geo Feature: **Light Sector** (P) (S-101 DCEG Clause 19.3)

All instances of encoding of the S-57 Object class **LIGHTS** having:

- attributes **ORIENT** or **SECTR1** and **SECTR2** present; and/or
- attribute **CATLIT** = 1 (directional function) or 16 (moiré effect)

and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Light Sector** during the automated conversion process. However, Data Producers are advised that the following enumerate type attributes have restricted allowable enumerate values for **Light All Around** in S-101:

**marks navigational – system of** (MARSYS)  
**light characteristic** (LITCHR)

See S-101 DCEG clause 19.3 for the listings of allowable values. Values populated in S-57 for these attributes other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for MARSYS and LITCHR on **LIGHTS** and amend appropriately.

The following additional requirements for S-57 dataset conversion must be noted:

- For S-57 ENC each light sector of a sectored light is required to be encoded as an individual **LIGHTS** object. For S-101 ENC all sectors of a sectored light are encoded within a single **Light Sector** feature using the complex attribute **sector characteristics**, sub-complex attribute **light sector**. During the automated conversion process, all **LIGHTS** objects with **ORIENT**, **SECTR1**, **SECTR2** and/or **CATLIT** populated as described above, sharing the same spatial object and included in the same structure/equipment relationship will be concatenated into a single **Light Sector** feature. Data Producers are advised to check their converted S-101 data and ensure that converted sector lights have been structured and attributed as intended.
- The guidance for the encoding of oscillating light sectors remains unchanged in S-101, however Data Producers should note that the text populated in the **INFORM** attribute for the S-57 **LIGHTS** object will convert to the sub-complex attribute **sector information**, sub-attribute **text** for the relevant instance of the **sector limit** complex on **Light Sector**. See S-101 DCEG clause 19.3.1.3.

#### 12.8.6.2 Lights obscured by obstructions

The guidance for the encoding of lights obscured by obstructions remains unchanged in S-101. See S-101 DCEG clause 19.3.1.1.

#### 12.8.6.3 White fairway sectors

The guidance for the encoding of fairways defined by a succession of white light sectors remains unchanged in S-101. See S-101 DCEG clause 19.3.1.

#### 12.8.6.4 Leading lights

The guidance for the encoding of leading lights remains unchanged in S-101. See S-101 DCEG clause 19.1.5.

#### 12.8.6.5 Directional lights

The guidance for the encoding of leading lights remains unchanged in S-101. See S-101 DCEG clause 19.3.1.2.

#### 12.8.6.6 Moiré effect lights

The guidance for the encoding of moiré effect lights remains unchanged in S-101. See S-101 DCEG clause 19.3.1.2.

#### 12.8.7 Various special types of lights

The guidance for the encoding various special types of remains unchanged in S-101. See S-101 DCEG clause 19.1.7.

#### 12.8.8 Light structures

The guidance for the encoding of light structures remains unchanged in S-101. See S-101 DCEG clause 19.1.8.

S-101 includes the system attribute **in the water** to indicate that particular light supporting structures that are located offshore are to be included in ECDIS Base display. This attribute is populated automatically during the conversion process based on the underlying Skin of the Earth feature. As such, there is no requirement to include an ECDIS Base display feature coincident with these features in S-101 so as to ensure display of a feature at the position of the feature in ECDIS Base display. Data Producers should consider removing any redundant Base display features from their S-101 data during the conversion process.

### 12.9 Radio stations

S-57 Geo Object: Radio station (**RDOSTA**) (P)

S-101 Geo Feature: **Radio Station** (P) (S-101 DCEG Clause 21.4)

All instances of encoding of the S-57 Object class **RDOSTA** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radio Station** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute ORIENT for **RDOSTA** will not be converted. It is considered that this attribute is not relevant for **Radio Station** in S-101.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Radio Station** in S-101:

**category of radio station** (CATROS)

See S-101 DCEG clause 21.4 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for CATROS on **RDOSTA** and amend appropriately.

#### 12.9.1 Marine and aero-marine radiobeacons

Not applicable.

#### 12.9.2 Aeronautical radiobeacons

Not applicable.

#### 12.9.3 Radio direction-finding stations

The guidance for the encoding of radio direction-finding stations remains unchanged in S-101. See S-101 DCEG clause 21.4.2.

#### 12.9.4 Coast radio stations providing QTG service

Not applicable.

### 12.10 Radar beacons

S-57 Geo Object: Radar transponder beacon (**RTPBCN**) (P)

S-101 Geo Feature: **Radar Transponder Beacon** (P) (S-101 DCEG Clause 21.5)

All instances of encoding of the S-57 Object class **RTPBCN** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radar Transponder Beacon** during the automated conversion process.

### 12.11 Radar surveillance systems

#### 12.11.1 Radar ranges

S-57 Geo Object: Radar range (**RADRNG**) (A)

S-101 Geo Feature: **Radar Range** (S) (S-101 DCEG Clause 15.31)

All instances of encoding of the S-57 Object class **RADRNG** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radar Range** during the automated conversion process.

#### 12.11.2 Radar reference lines

S-57 Geo Object: Radar line (**RADLNE**) (L)

S-101 Geo Feature: **Radar Line** (C) (S-101 DCEG Clause 15.30)

All instances of encoding of the S-57 Object class **RADLNE** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radar Line** during the automated conversion process.

#### 12.11.3 Radar station

S-57 Geo Object: Radar station (**RADSTA**) (P)

S-101 Geo Feature: **Radar Station** (P) (S-101 DCEG Clause 15.32)

All instances of encoding of the S-57 Object class **RADSTA** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radar Station** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes DATEND and DATSTA for **RADSTA** will not be converted. It is considered that these attributes are not relevant for **Radar Station** in S-101.

### 12.12 Radar conspicuous objects

The guidance for the encoding of radar conspicuous objects remains unchanged in S-101. See S-101 DCEG clause 2.4.11.

S-57 Geo Object: Radar reflector (**RADRFL**) (P)

S-101 Geo Feature: **Radar Reflector** (P) (S-101 DCEG Clause 20.17)

All instances of encoding of the S-57 Object class **RADRFL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radar Reflector** during the automated conversion process.

### 12.13 Radio reporting (calling-in) points

S-57 Geo Object: Radio calling-in point (**RDOCAL**) (P,L)

S-101 Geo Feature: **Radio Calling-In Point** (P,C) (S-101 DCEG Clause 15.28)

All instances of encoding of the S-57 Object class **RDOCAL** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Radio Calling-In Point** during the automated conversion process. However the following exceptions apply:

- The S-57 attribute COMCHA will convert to an instance of the S-101 Information type **Contact Details** (see S-101 DCEG clause 24.1), attribute **communication channel**, associated to the **Radio Calling-In Point** feature using the association **Additional Information**. Because of the capability to encode these relationships in a “one to many” manner in S-101, Data Producers are advised to check identical instances of **Additional Information** within a converted dataset and rationalise these instances accordingly.

The following additional requirements for S-57 dataset conversion must be noted:

- For S-57 ENCs a two-way radio-calling-in point having non-reciprocal directions of traffic flow required the encoding of separate instances of **RDOCAL** for each direction. For S-101 ENCs it is possible to encode both directions using a single instance of **Radio Calling-In Point**. Data producers will be required to examine their converted S-101 datasets and amend the encoding as required.

S-101 Geo Feature: **Vessel Traffic Service Area** (S) (S-101 DCEG Clause 22.2)

The S-101 Feature type **Vessel Traffic Service Area** has been introduced in S-101 as a dedicated feature to encode such areas. This information is encoded in S-57 using the Object class **ADMARE**. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **ADMARE** should be in a standardised format, such as *Vessel traffic service area*. Data Producers are advised to examine any **Vessel Traffic Service Area** features created during the automated conversion process and confirm the attribution for these features as required, including any values populated for the complex attribute **information**.

## 12.14 Automatic Identification Systems (AIS)

### 12.14.1 AIS equipped aids to navigation

S-101 Geo Feature: **Physical AIS Aid to Navigation** (P) (S-101 DCEG Clause 21.2)

The S-101 Feature type **Physical AIS Aid to Navigation** has been introduced in S-101 to provide the capability to encode a dedicated feature to indicate the presence of an AIS signal that is actually transmitted from a physical aid to navigation, or appears to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station. This information may be encoded in S-57 using the attribute INFORM on the physical aid to navigation structure object. In order for this information to be converted across to S-101, the text string encoded in INFORM on the navigation aid structure should be in a standardised format, such as *Automatic Identification System (AIS) aid to navigation*.

Data Producers will be required to evaluate each instance of the Feature type **Physical AIS Aid to Navigation** created during the automated conversion process and populate allowable attributes as required.

#### 12.14.1.1 Virtual AIS aids to navigation

S-57 Geo Object: New object (**NEWOBJ**) (P)

S-101 Geo Feature: **Virtual AIS Aid to Navigation** (P) (S-101 DCEG Clause 21.3)

The encoding of Virtual AIS aids to navigation using the Object class **NEWOBJ** is the only approved application of **NEWOBJ** in S-57. As such, all instances of encoding of the S-57 Object class **NEWOBJ** will be converted to an instance of the S-101 Feature type **Virtual AIS Aid to Navigation** during the automated conversion process.

The following additional requirements for S-57 dataset conversion must be noted:

- The S-101 mandatory attribute **virtual AIS aid to navigation type** will be automatically populated according to the value populated for the S-57 mandatory attribute CLSNAM on **NEWOBJ**.
- Similarly, values populated for the **NEWOBJ** attributes DATEND, DATSTA, NOBJNM, OBJNAM, SCAMIN and STATUS will be converted to the corresponding attributes for **Virtual AIS Aid to Navigation**. Note however that STATUS has restricted allowable enumerate values for **Virtual AIS Aid to Navigation** in S-101 (see S-101 DCEG clause 21.3); Data Producers are advised to check any populated values for STATUS on **NEWOBJ** and amend appropriately.

- Data Producers will be required to evaluate each instance of the Feature type **Virtual AIS Aid to Navigation** created during the automated conversion process and populate other allowable attributes as required.
- The S-57 attribute INFORM for **NEWOBJ** will not be converted, as information populated in INFORM in this case is intended to allow for ECDIS backward compatibility.

## 13 Marine services and signal stations

### 13.1 Pilot stations

#### 13.1.1 Pilot stations ashore

The guidance for the encoding of pilot stations ashore remains unchanged in S-101. See S-101 DCEG clause 22.1.2.

#### 13.1.2 Pilot boarding places

S-57 Geo Object: Pilot boarding place (**PILBOP**) (P,A)

S-101 Geo Feature: **Pilot Boarding Place** (P,S) (S-101 DCEG Clause 22.1)

All instances of encoding of the S-57 Object class **PILBOP** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Pilot Boarding Place** during the automated conversion process. However the following exceptions apply:

- The S-57 attributes NPLDST and PILDST for **PILBOP** will not be converted. See guidance on new S-101 Feature type **Pilotage District** below.
- The S-57 attribute COMCHA will convert to an instance of the S-101 Information type **Contact Details** (see S-101 DCEG clause 24.1), attribute **communication channel**, associated to the **Pilot Boarding Place** feature using the association **Additional Information**. Because of the capability to encode these relationships in a “one to many” manner in S-101, Data Producers are advised to check identical instances of **Additional Information** within a converted dataset and rationalise these instances accordingly.

Data Producers are advised that the following enumerate type attribute has restricted allowable enumerate values for **Pilot Boarding Place** in S-101:

**status** (STATUS)

See S-101 DCEG clause 22.1 for the listing of allowable values. Values populated in S-57 for this attribute other than the allowable values will not be converted across to S-101. Data Producers are advised to check any populated values for STATUS on **PILBOP** and amend appropriately.

S-101 Geo Feature: **Pilotage District** (S) (S-101 DCEG Clause 16.25)

S-101 Association: **Pilotage District Association** (N) (S-101 DCEG Clause 25.11)

The S-101 Feature type **Pilotage District** has been introduced in S-101 as a dedicated feature to encode such areas. This information is encoded in S-57 using the Object class **ADMARE**. In order for this information to be converted across to S-101, the text string encoded in INFORM on the **ADMARE** should be in a standardised format, such as *Pilotage district*. Data Producers are advised to examine any **Pilotage District** features created during the automated conversion process and confirm the attribution for these features as required, including any values populated for the complex attribute **information**.

### 13.2 Coastguard stations

S-57 Geo Object: Coastguard station (**CGUSTA**) (P)

S-101 Geo Feature: **Coast Guard Station** (P,S) (S-101 DCEG Clause 22.3)

All instances of encoding of the S-57 Object class **CGUSTA** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Coast Guard Station** during the automated conversion process.

The following additional requirements for S-57 attribution must be noted:

- The S-101 Boolean attribute **is MRCC** has been introduced in S-101 to indicate that a coast guard station also performs the function of a Maritime Rescue and Coordination Centres (MRCC). This information is encoded in S-57 on **CGUSTA** using the attribute INFORM (see clause 2.3). In order for this information to be converted across to S-101, the text string encoded in INFORM on the **CGUSTA** should be in a standardised format, such as *Maritime Rescue and Coordination Centre*.

### 13.3 Rescue stations

S-57 Geo Object: Rescue station (**RSCSTA**) (P)

S-101 Geo Feature: **Rescue Station** (P,S) (S-101 DCEG Clause 22.6)

All instances of encoding of the S-57 Object class **RSCSTA** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Rescue Station** during the automated conversion process.

### 13.4 Signal stations

S-57 Geo Object: Signal station, traffic (**SISTAT**) (P)

S-101 Geo Feature: **Signal Station Traffic** (P,S) (S-101 DCEG Clause 22.5)

All instances of encoding of the S-57 Object class **SISTAT** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Signal Station Traffic** during the automated conversion process.

S-57 Geo Object: Signal station, warning (**SISTAW**) (P)

S-101 Geo Feature: **Signal Station Warning** (P,S) (S-101 DCEG Clause 22.4)

All instances of encoding of the S-57 Object class **SISTAW** and its binding attributes will be converted automatically to an instance of the S-101 Feature type **Signal Station Warning** during the automated conversion process.

## 14 Geographic names

<u>S-101 Geo Feature:</u>	<b>Island Group</b>	(N)	(S-101 DCEG Clause 5.5)
<u>S-101 Association:</u>	<b>Island Aggregation</b>	(N)	(S-101 DCEG Clause 25.9)
<u>S-101 Association:</u>	<b>Text Association</b>	(N)	(S-101 DCEG Clause 25.16)

In general, the guidance for the encoding of geographic names remains unchanged in S-101. See S-101 DCEG clause 2.5.8. However, the following additional requirements for S-57 attribution must be noted:

- The S-101 Feature type **Island group** has been introduced in S-101 to provide a dedicated method for the encoding of named groups of islands and archipelagos (see S-101 DCEG clause 25.9). This information may be encoded in S-57 using an instance of the S-57 Object class **LNDRGN** covering or centred in the group of islands. In order for this information to be converted across to an incidence of **Island Group** S-101, the text string encoded in INFORM on the **LNDRGN** should be in a standardised format, such as *Island group*, noting that this should be done at the source database level only so as to avoid unwanted additional clutter in ECDIS (see clause 2.3). The S-101 **Land Region** feature resulting from the conversion of the **LNDRGN** should be removed from the converted S-101 dataset in this case.
- Information encoded in the attribute NOBJNM, when converted to S-101, requires an entry in the **feature name** complex attribute instance, sub-attribute **language** to indicate the language of the name. There is no corresponding attribute in S-57 to provide this information. Unless this functionality can be customised in the converter, Data Producers will be required to manually populate this attribute during the conversion process (see S-101 DCEG clause 2.5.8).

## 15 Collection objects

For a description of the Named Associations that may be encoded in S-101, see S-101 DCEG Section 25. Data Producers are advised to check all relationships created during the automated conversion process to ensure all relevant features are included as required.

The most common examples of the application of Collection Objects as described in S-57 Appendix B.1, Annex A – *Use of the Object Catalogue for ENC* will be converted during the automated conversion process as follows:

Relationships	S-57 Collection Object	S-101 Association	Comments
Mooring trots	C_AGGR	Mooring Trot Aggregation	S-101 DCEG clause 8.21.1 (not mandatory but recommended)
Measured distances	C_AGGR	Range System Aggregation	S-101 DCEG clause 15.4.2 (mandatory)
Traffic Separation Schemes systems	C_AGGR	Traffic Separation Scheme Aggregation	S-101 DCEG clause 15.3 (mandatory)
Navigation lines and tracks	C_AGGR	Range System Aggregation	S-101 DCEG clause 15.1.1 (not mandatory but recommended)
Navigation lines, tracks and dangers	C_ASSO	-	Not in S-101
Synchronised lights	C_ASSO	Range System Aggregation	S-101 DCEG clause 19.1.7 (not mandatory)
Airfield, airport, (runway, control etc.)	C_ASSO	-	Not in S-101
Tide, tidal stream (non-harmonic prediction – time series or harmonic prediction)	C_ASSO	-	Tide and tidal stream features not included in S-101.
Anchorage	C_ASSO	-	Not in S-101
Fairway	C_ASSO/C_AGGR	Fairway Aggregation	S-101 DCEG clause 15.8.1 (mandatory)
Radar beacon	C_AGGR	Range System Aggregation	S-101 DCEG clause 21.5.1 (not mandatory but recommended)

table 15.1

It is recommended that Data Producers, as a minimum, include the appropriate S-57 Collection Objects within their data holdings indicated for the corresponding S-101 associations in table 15.1 above as mandatory.

## **16 New Object**

See clause 12.14.1.1.

## **17 Masking**

The guidance for masking remains unchanged in S-101. See S-101 DCEG clause 2.5.10.

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## Appendix A: S-57 to S-101 conversion quick references

### A-1 Summary of differences

The following conventions apply for Table A.1 below:

- Column 3 provides an overall indication as to whether S-57 data may require some examination and/or intervention prior to or after conversion to S-101 in order to ensure that the converted S-101 dataset is at a minimum the equivalent, in terms of content and impact on safety of navigation, to the original S-57 dataset. If there is no “**x**” in this column, there will be direct “one for one” conversion of the S-57 Object class from S-57 to S-101.
- Columns 4 and 5 provide further qualification as to possible action required of the Data Producer:
  - Attribution: Indicates possible action required in S-57 attribute population, such as population of a standardised text string in the S-57 attribute INFORM (indicated by “x”); or information regarding conversion of attributes, such as allowable S-57 attributes that are not allowed in S-101, may be relevant (indicated by “x\*”).
  - Enumerates: Indicates that an enumeration type attribute(s) has allowable values in S-57 that are not allowable in S-101 and as such will not be converted. The list of S-57 “allowable” values is in accordance with the values listed in S-58 Check 2000. Further information can be found in Table A.2.
- Columns 6 to 8 provide indications of extensions to S-57 included in S-101. Undertaking additional S-101 encoding based on these extensions is optional (see also Tables A.2 and A.3).
  - New Attributes: Indicates that new attribute binding has been included in S-101 for the Feature type corresponding to the relevant S-57 Object class. New attributes may be either attributes that are new in S-101; or new allowable binding of existing S-57 attributes to the feature. However, this does not include new attributes that may be populated based on standardised S-57 to S-101 conversion rules, such as standardised text strings populated in the S-57 attribute INFORM. For lists of new attributes by Feature type in S-101, see Table A.3.
  - New Enumerates: Indicates that the enumerate list for at least one of the binding attributes for the Feature type corresponding to the relevant S-57 Object class has new enumerate values. New enumerate values may be either values that are new in S-101; or new allowable S-57 enumerate values other than those listed for the attribute in S-58 Check 2000. Further information can be found in Table A.2. Data Producers will be required to refer to the relevant clause(s) of the S-101 DCEG.

Additional guidance within this document can be found in the clause numbers listed in column 2. NOTE: Where there are multiple clause numbers listed against an S-57 Object class, the clause number listed in **bold** is the principle reference.

**NOTE 1:** All converted instances of the S-57 attributes NINFOM, NOBJNM and NTXTDS will require manual intervention in the S-101 converted dataset to provide an indication of the national language used. This is not indicated in the table below. See clauses 2.3 and 14.

**NOTE 2:** All S-101 Feature types corresponding to S-57 **BCN\*\*\*** and **BOY\*\*\*** Object classes have the new complex attribute **topmark** as an allowable attribute. Automatic population of this complex attribute during the S-57 to S-101 conversion process will be based on incidences of the S-57 Object class **TOPMAR** associated with the beacon or buoy structure. For impacts of this new S-101 modelling, see the table entry for **TOPMAR** and clauses 12.3.1, 12.4.1 and 12.4.2.

**NOTE 3:** The S-57 Object class **BRIDGE** has been remodelled in S-101 to allow for the encoding of individual bridge spans as separate features. Data Producers should check all converted instances of bridges to ensure desirable S-101 representation. See clause 4.8.10.

**NOTE 4:** For additional manual intervention required during the S-57 to S-101 conversion process regarding the population of the S-101 system attribute **in the water**, refer to the referenced clauses in this document.

1	2	3	4	5	6	7	8
S-57 Object class	Clause	Examination Required	Attribution	Enumerates	New Geo Primitive(s)	New Attributes	New Enumerates
ACHARE	9.2.1	x	x				x
ACHBRT	9.2.2						
ADMARE	11.2.1 11.16 12.13 13.1.2	x	x				
AIRARE	4.8.12	x		x			x
BCNCAR	12.3.1	x		x		Note 2	x
BCNISD	12.3.1	x		x		Note 2	x
BCNLAT	12.3.1	x		x		Note 2	x
BCNSAW	12.3.1	x		x		Note 2	x
BCNSPP	12.3.1	x		x		Note 2	x
BERTHS	4.6.2					x	
BOYCAR	12.4.1	x		x		Note 2	
BOYINB	12.4.1	x	x*	x			
BOYISD	12.4.1	x		x		Note 2	
BOYLAT	12.4.1	x		x		Note 2	
BOYSAW	12.4.1	x		x		Note 2	
BOYSPP	12.4.1	x		x		Note 2	x
BRIDGE	4.8.10	x	Note 3	x		x	x
BUAARE	4.8.14						x
BUISGL	4.8.15	x		x		x, Note 4	x
CANALS	4.8.1					x	
CAUSWY	4.8.9						x
CBLARE	11.5.3	x		x			x
CBLOHD	11.5.2					x	x
CBLSUB	11.5.1		x*			x	
CGUSTA	13.2	x	x		x		
CHKPNT	4.6.4	x		x			
COALNE	4.5.1	x	x	x		x	x
CONVYR	4.8.11	x		x			x
CONZNE	11.2.5	x	x, x*			x	
COSARE	11.2.7						
CRANES	4.6.9.3	x			x	Note 4	x
CTNARE	6.5 6.6 11.2.1 11.2.4 11.2.5 11.2.8 11.13.5	x	x			x	
CTRPNT	4.3	x	x	x		x	

1	2	3	4	5	6	7	8
S-57 Object class	Clause	Examination Required	Attribution	Enumerates	New Geo Primitive(s)	New Attributes	New Enumerates
CTSARE	11.13.4					x	x
CURRENT	3.4						
CUSZNE	11.2.2						
C_AGGR	9.2.5 10.1.2 10.1.3 10.2.2 10.2.3 10.2.6 10.4 10.5.3 15	x	x				
C_ASSO	10.1.2 15	x	x				
DAMCON	4.8.5	x		x		x	x
DAYMAR	12.3.3	x		x			x
DEPARE	5.4.1		x*				
DEPCNT	5.2						
DISMAR	4.4	x	x			x	
DOCARE	4.6.6.3	x	x, x*			x	
DMPGRD	11.4	x		x		x	
DRGARE	5.5	x	x	x		x	x
DRYDOC	4.6.6.1	x	x, x*			x	
DYKCON	4.8.7	x		x		x	x
DWRTCL	10.2.2.2	x		x		x	x
DWRTPT	10.2.2.1	x		x		x	x
EXEZNE	11.2.8					x	
FAIRWY	10.4	x		x		x	x
FERYRT	10.3						x
FLODOC	4.6.6.2	x	x, x*	x		x	x
FNCLNE	4.8.16	x		x			x
FOGSIG	12.5	x	x				x
FORSTC	4.8.17	x		x		x, Note 4	x
FRPARE	11.2.3						
FSHFAC	11.9.1	x		x		x	x
FSHGRD	11.9.4					x	x
FSHZNE	11.2.6	x	x				
GATCON	4.6.6.4	x		x			
GRIDRN	4.6.6.6	x	x*	x			x
HRBARE	9.1.1	x		x			
HRBFAC	4.6.1	x		x		x	x
HULKES	4.6.8		x*				x

1	2	3	4	5	6	7	8	
S-57 Object class	Clause	Examination Required	Attribution	Enumerates	New Geo Primitive(s)	New Attributes	New Enumerates	
ICEARE	11.13.1	x		x			x	
ICNARE	11.13.3		Will not convert to S-101.					
ISTZNE	10.2.1.7							
LAKARE	4.7.8					x		
LNDARE	4.1	x		x				
LNDELV	4.7.2						x	
LNDMRK	4.3 4.8.15 11.7.2 11.7.4	x		x		x, Note 4	x	
LNDRGN	4.7.1	x	x, x*	x			x	
LIGHTS	12.8.1 12.8.5.6 12.8.6.1	x	x	x		x		
LITFLT	12.4.2	x	x*	x		Note 2	x	
LITVES	12.4.2	x	x*	x			x	
LOCMAG	3.1.2	x	x			x		
LOGPON	11.13.2	x		x		x		
LOKBSN	4.6.6.5		x*					
MAGVAR	3.1.1		x*					
MARCUL	11.9.2	x		x			x	
MIPARE	11.3.1					x		
MORFAC	4.6.7.1	x		x		x	x	
M_ACCY	2.2.4.1					x		
M_COVR	2.2.6 2.8.1	x	x			x		
M_CSCL	2.2.6	x	x			x		
M_HOPA	2.1.1		Will not convert to S-101.					
M_NPUB	2.5	x	x			x		
M_NSYS	12.2	x		x				
M_QUAL	2.2.3.1	x	x			x		
M_SDAT	2.1.3							
M_SREL	2.2.3.2	x	x	x		x	x	
M_VDAT	2.1.2							
NAVLNE	10.1.1							
OBSTRN	6.2.2	x	x, x*			x	x	
OFSPLF	11.7.2	x	x*	x		x	x	
OSPARE	11.7.4	x	x	x		x	x	
OILBAR	4.8.19						x	
PILBOP	13.1.2	x	x, x*			x	x	
PILPNT	4.6.7.2				x	x		

1	2	3	4	5	6	7	8
S-57 Object class	Clause	Examination Required	Attribution	Enumerates	New Geo Primitive(s)	New Attributes	New Enumerates
PIPARE	11.6.4	x		x			x
PIPOHD	11.6.3					x	
PIPSOL	11.6.1	x		x		x	x
PONTON	4.6.7.3	x	x, x*		x		x
PRCARE	10.2.1.8						x
PRDARE	4.8.13	x		x			x
PYLONS	4.8.18	x		x		x	x
RADLNE	12.11.2						x
RADRNG	12.11.1						
RADRFL	12.12					x	
RADSTA	12.11.3		x*			x	
RAILWY	4.8.2	x		x			x
RAPIDS	4.7.7.1						
RCRTCL	10.2.4	x		x			x
RCTLPT	10.2.5						
RDOCAL	12.13	x	x				x
RDOSTA	12.9	x	x, x*	x		x	
RECTRC	10.1.1	x	x	x		x	
RESARE	11.1	x	x			x	x
RETRFL	12.7						
RIVERS	4.7.6	x	x	x			
ROADWY	4.8.8	x		x			x
RSCSTA	13.3				x	x	
RTPBCN	12.10						
RUNWAY	4.8.12	x		x			x
SBDARE	7.1		x*			x	
SEAARE	5.5 8 10.2.3 10.2.6 10.4 10.5.3	x					x
SILTNK	4.8.15	x		x		x, Note 4	x
SISTAT	13.4				x		
SISTAW	13.4				x		
SLCONS	4.5.2	x		x			x
SLOTOP	4.7.5	x		x			x
SLOGRD	4.7.4	x		x			x
SMCFAC	4.6.5						
SOUNDG	5.3 5.5	x	x	x		x	x

1	2	3	4	5	6	7	8
S-57 Object class	Clause	Examination Required	Attribution	Enumerates	New Geo Primitive(s)	New Attributes	New Enumerates
SNDWAV	7.2.1						
SPLARE	11.12						x
SPRING	7.2.3						
STSLNE	11.2.4						
SUBTLN	11.3.2					x	
SWPARE	5.6		x*			x	
TESARE	11.2.4	x	x	x			
TIDEWY	7.2.4						
TOPMAR	12.3.1 12.4.1 12.4.2 12.6	Note 2					
TSELNE	10.2.1.3						x
TSEZNE	10.2.1.4						x
TSSBND	10.2.1.2						x
TSSCRS	10.2.1.5						
TSSLPT	10.2.1.1						x
TSSRON	10.2.1.6						
TUNNEL	4.8.3	x		x		x	
TWRTPT	10.2.6	x		x			x
T_HMON	3.2		Will not convert to S-101.				
T_NHMN	3.2		Will not convert to S-101.				
T_TIMS	3.2		Will not convert to S-101.				
TS_FEB	3.3.1		x*				
TS_PAD	3.3.5					x	
TS_PNH	3.3.4		Will not convert to S-101.				
TS_PRH	3.3.3		Will not convert to S-101.				
TS_TIS	3.3.2		Will not convert to S-101.				
UNSARE	5.8.1						
UWTROC	6.1.2	x	x, x*	x		x	x
VEGATN	4.7.11	x		x			x
WATFAL	4.7.7.2						x
WATTUR	6.4						
WEDKLP	7.2.2						
WRECKS	6.2.1		x*			x	x

Table A.1

## A-2 Allowable S-101 enumerate value changes

Table A.2 below provides an indication of the changes in the allowable values that may be populated for enumerate type attributes in S-101 when converting S-57 datasets to S-101. The Table has been derived from IHO Publication S-58 – *ENC Validation Checks*, Check 2000.

Within the Table, the following conventions apply:

- Colour:
  - Black text, with the exception of text within “squared” brackets ([ ]), indicates a direct one-for-one relationship between the allowable S-57 object/attribute/enumerate encoding combinations as listed in S-58 Check 2000 and the corresponding allowable feature/attribute/enumerate encoding combinations in S-101.
  - **Red** text indicates differences between the allowable S-57 object/attribute/enumerate encoding combinations as listed in S-58 Check 2000 and the corresponding allowable feature/attribute/enumerate encoding combinations in S-101. These may be new allowable values in S-101; or values permitted in S-57 but not permitted in S-101 (indicated by double strike-through) that as such will not be converted.
  - **Blue** text indicates new enumerate values introduced in S-101 for which there is no direct corresponding enumerate value in S-57.
  - **Grey** text indicates S-57 object/attribute/enumerate encoding combinations that will convert to S-101, but not on a direct one-for-one basis. General conversion conventions are indicated within “squared” brackets ([ ]) in the “Allowable Attribute Values” column.
- **Attribute** column: Where an attribute that is listed in S-58 Check 2000 is not listed in Table A.2, this indicates that all instances of encoding of this attribute in S-57 will convert one-to-one directly to the corresponding encoding combinations in S-101.
- **Object** column: Where an Object class that is listed against an attribute in S-58 Check 2000 is not listed in Table A.2, this indicates that all instances of encoding of the attribute for this Object class in S-57 will convert one-to-one directly to the corresponding encoding combination in S-101. Where no Object class is listed against an attribute in Table A.2, this indicates that all instances of the encoding of this attribute will be converted as indicated in the “Allowable Attribute Values” column (that is, some values will convert one-to-one while some values will not convert or will convert but not one-for-one); or there are new values available for consideration in S-101.
- **Allowable Attribute Values** column: Values will (or will not) be converted in accordance with the colour conventions described above. Values listed against the S-57 attribute itself indicate the full list of allowable values in S-101 (as included in S-101 DCEG Sections 27 and 28). Values listed against the associated S-57 Object class indicate the allowable constricted S-101 attribute list for this object/attribute combination. It is important for Data Producers to note that allowable S-57 object/attribute/enumerate encoding combinations indicated in Table A.2 with red double strike-through text will not convert to S-101. Values shown in red (not struck-through) or blue colour may be considered for additional manual encoding in S-101 as required.

Attribute	Object	Allowable Attribute Values
BCNSHP		1-2-3- <del>4</del> -5-6-7 [Value 4 converts to new value 11 for attribute <b>nature of construction</b> ]
CATAIR		1-2-3-4-5-6-8- <b>9</b>
CATACH		1-2-3-4-5-6-7-8-9-10- <b>14-15</b>
CATCBL		1-3-4-5-6- <b>7-8</b>
	<b>CBLARE</b>	1-4- <del>5</del> - <b>7-8</b> [Value 4 converts to new value 8]
	<b>CBLSUB</b>	1-4- <del>5</del> - <b>6-7-8</b> [Values 4 converts to new value 8]

Attribute	Object	Allowable Attribute Values
CATCOA	COALNE	1-2-3-4-5-6-7-8-9-10-11 [See new binding of attribute <b>nature of surface</b> to <b>Coastline</b> – clause 4.5.1]
<del>CATCTR</del>		<del>1-2-3-4-5-6-7</del> [No equivalent attribute in S-101]
	<del>CTRPNT</del>	<del>1-2-3-4-5-6-7</del> [No equivalent feature in S-101. Values 1 and 5 convert to new values for <b>category of landmark</b> – see clause 4.3]
CATCON		1-2-3-4
CATCOV		1-2 [M_COVR having CATCOV = 1 converts to <b>Data Coverage</b> – see clause 2.2.6]
CATCRN		2-3-4-5-6
CATDIS		1-2-3-4 [Converts to new Boolean attribute <b>distance mark visible</b> . Value 1 converts to <i>False</i> and values 2-4 convert to <i>True</i> – see clause 4.4]
CATFRY		1-2-3-5
CATFOR		1-2-3-4-5-6-8-9
CATHAF		1-3-4-5-6-7-8-9-10-11-12-13-14-15
CATHLK		1-2-3-4-5-6-7
CATLND		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21
CATLMK		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27 [Value 19 converts to new Feature type <b>Wind Turbine</b> – see clause 4.15]
CATLIT		1-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20 [Values 1 and 16 convert to new Feature type <b>Light Sector</b> , complex attribute <b>directional character</b> . Values 6 and 7 convert to new features <b>Light Air Obstruction</b> and <b>Light Fog Detector</b> respectively – see clause 12.8]
CATOBS		1-2-3-4-5-6-7-8-9-10-12-13-14-15-16-17-18-19-20-21-22-23 [Value 7 converts to new Feature type <b>Foul Ground</b> – see clause 6.2.2]
CATOFF		1-2-3-4-5-6-7-8-9-10-11
CATPLE		1-3-4-5-6-7
CATPIP	PIPSOL	2-3-4-5-6-7

Attribute	Object	Allowable Attribute Values
CATPRA		1-2-3-4-5-6-7-8-9-10- <del>11</del> -12
	OSPARE	<del>1-2-5</del> 8-9 [category of production area is not bound to <b>Offshore Production Area</b> . Values 8 and 9 convert to new attribute <b>category of offshore production area</b> – see clause 11.7.4]
	PRDARE	1-2-3-4-5-6-7-8-9-10- <del>11</del> -12
CATROS		<del>1-2-3-4-5-6-7-8-9</del> 10-11- <del>12-13</del> -14- <del>19-20</del>
CATTRK		1-2 [Converts to new Boolean attribute <b>based on fixed marks</b> ]
CATREA		1-4-5-6-7-8-9-10-12-14-18-19-20-21-22-23-24-25- <del>26-27-28-29-30-31-32</del> [Value 26 converts to new value 32]
CATSEA		2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54- <del>55-56</del>
CATSLC		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17- <del>20-22</del>
CATSLO		1-2-3-4-5-6-7
	SLOTOP	1-2- <del>3-4-5-6-7</del>
CATSPM		1-2-3-4-5-6-7-8-9-10-11-12- <del>13</del> -14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56- <del>57-58-60-61-62-63</del>
	BCNSPP	1-2-3-4-5-6-7-8- <del>9</del> -10-11-12- <del>13</del> -14- <del>15</del> -16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56- <del>57-58-60-61-62-63</del>
	BOYSPP	1-2-3-4-5-6-7-8-9-10-11-12- <del>13</del> -14-15- <del>16</del> -17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-39-40- <del>41-42-43-44</del> -45-46-47-48-49-50-51-52-53-54-55-56- <del>57-58-59-60-61-62-63</del>
	DAYMAR	1-2-3-4-5-6-7-8- <del>9</del> -10-11-12- <del>13</del> -14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56- <del>57-58-60-61-62-63</del>
CATTSS		1-2 [Converts to new Boolean attribute <b>IMO adopted</b> for new Feature type <b>Traffic Separation Scheme</b> – see clause 10.2.1]
CATVEG		<del>4-3-4-5-6-7-10-11-12</del> -13-14-15-16-17-18-19-20-21-22 [Values 7 and 21 convert to new value 23 for attribute <b>category of obstruction</b> – see clause 4.7.11]
CATWED		1-2-3-4 [Value 3 converts to new Feature type <b>Seagrass</b> – see clause 7.2.2]
COLOUR		1-2-3-4-5-6-7-8-9-10-11-12-13
	COALNE	1-2-3-4- <del>5-6-7-8-9-10</del> -11- <del>12</del> -13

Attribute	Object	Allowable Attribute Values
	<del>NEWOBJ</del>	<del>1-2-3-4-5-6-7-8-9-10-11-12-13</del> [colour is not a valid attribute for <b>Virtual AIS Aid to Navigation</b> ]
	RETRFL	1-2-3-4-5-6-7-8-9-10-11-12-13
	<del>SBDARE</del>	<del>1-2-3-4-5-6-7-8-9-10-11-12-13</del> [colour is not a valid attribute for <b>Seabed Area</b> ]
	SLOTOP	1-2-3-4- <del>5</del> -6-7-8- <del>9-10</del> -11- <del>12</del> -13
	SLOGRD	1-2-3-4- <del>5</del> -6-7-8- <del>9-10</del> -11- <del>12</del> -13

COLPAT		1-2-3-4-5-6
	<del>NEWOBJ</del>	<del>1-2-3-4-5-6</del> [colour pattern is not a valid attribute for <b>Virtual AIS Aid to Navigation</b> ]
	<del>TOPMAR</del>	<del>1-2-3-4-5-6</del> [colour pattern is not a valid sub-attribute for complex attribute <b>topmark</b> ]

CONDTN		1-2-3-4-5
	FLODOC	1-2- <del>3</del> -5
	FORSTC	1-2- <del>5</del>
	<del>NEWOBJ</del>	<del>1-2-3-4-5</del> [condition is not a valid attribute for <b>Virtual AIS Aid to Navigation</b> ]
	OSPARE	1-2- <del>3-4</del> -5
	RAILWY	1-2- <del>3</del> -5
	ROADWY	1-2- <del>3</del> -5
	TUNNEL	1-2- <del>3</del> -5

CONRAD		1-2 [Converts to new Boolean attribute <b>radar conspicuous</b> ]
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CONVIS		1-2- <del>3</del>
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EXPSOU		1-2-3
	MARCUL	1-2- <del>3</del>
	<del>SOUNDG</del>	<del>1-2-3</del> [exposition of sounding is not a valid attribute for <b>Sounding</b> ]
	UWTROC	1-2- <del>3</del>

FUNCTN		2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42- <del>44-45-46-47-48</del>
	BUISGL	2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42- <del>44-45-46-47-48</del>
	LNDMRK	2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42- <del>44-45-46-47-48</del>

LITCHR	LIGHTS	1-2-3-4-5-6-7-8- <del>9-10</del> -11-12-13-14-15-16-17-18-19- <del>20</del> -25-26-27-28-29
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Attribute	Object	Allowable Attribute Values
LITVIS		1-2-3-4-5-6-7-8-9
	LIGHTS	1-2- <del>3-4-5-6-7-8</del> [for <b>Light All Around</b> ] 1-2-3-4-5-6- <del>7-8-9</del> [for <b>Light Sectored</b> ] 1-2-3-4-5-6-7-8-9 [for <b>Light Air Obstruction</b> ] <del>4-2-3-4-5-6-7-8</del> [ <b>light visibility</b> is not a valid attribute for <b>Light Fog Detector</b> ]

MARSYS		1-2-9- <del>10-11</del>
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NATCON		1-2-3-4-5-6-7-8- <del>9-11-12</del>
	BCNCAR	1-2-6-7-8- <del>9-11</del> [Value 11 is populated from BCNSHP = 4]
	BCNISD	1-2-6-7-8- <del>9-11</del> [Value 11 is populated from BCNSHP = 4]
	BCNLAT	1-2-6-7-8- <del>9-11</del> [Value 11 is populated from BCNSHP = 4]
	BCNSAW	1-2-6-7-8- <del>9-11</del> [Value 11 is populated from BCNSHP = 4]
	BCNSPP	1-2-6-7-8- <del>9-11</del> [Value 11 is populated from BCNSHP = 4]
	BRIDGE	1-2- <del>4-5-6-7-8-9-11</del>
	BUISGL	1-2-6-7-8-12
	BOYCAR	6-7-8- <del>9-11</del>
	BOYINB	<del>6-7-8-9-11</del>
	BOYISD	6-7-8- <del>9-11</del>
	BOYLAT	6-7-8- <del>9-11</del>
	BOYSAW	6-7-8- <del>9-11</del>
	BOYSPP	6-7-8- <del>9-11</del>
	DAMCON	1-2-3- <del>4-5-6-7-9</del>
	DAYMAR	1-2-4-6-7-8- <del>9-11</del>
	DYKCON	1-2-3-4-5-6-7- <del>9</del>
	FNCLNE	1-2-3-6-7- <del>9-11</del>
	FORSTC	1-2-3-6-7- <del>9</del>
	GATCON	1-2-6-7- <del>9</del>
	GRIDRN	1-2-6-7- <del>9-11</del>
	HRBFAC	1-2-3-6-7- <del>9</del>
	LNDMRK	1-2-3-6-7-8- <del>9-11-12</del>
	LITFLT	6-7- <del>9-11</del>
	LITVES	6-7- <del>9</del>
	MORFAC	1-2-6-7- <del>9</del>
	<del>OBSTRN</del>	<del>1-2-3-6-7-9</del> [ <b>nature of construction</b> is not a valid attribute for <b>Obstruction</b> ]
	<del>OFSPLE</del>	<del>1-2-6-7-9</del> [ <b>nature of construction</b> is not a valid attribute for <b>Offshore Platform</b> ]
	<del>PONTON</del>	<del>1-2-6-7-9</del> [ <b>nature of construction</b> is not a valid attribute for <b>Pontoon</b> ]
	PYLONS	1-2-6-7- <del>9-11</del>
	ROADWY	<del>1-2-4-5-6-9</del>
	RUNWAY	1-2-4-5-6-7- <del>9</del>

Attribute	Object	Allowable Attribute Values
	SILTNK	1-2-6-7-8- <del>9</del>
	SLCONS	1-2-3-4-5-6-7-8- <del>9</del> -11

NATSUR		1-2-3-4-5-6-7-8-9-11-14-17-18
	SLOTOP	<del>1-2-3</del> -4-5-6-7- <del>8</del> -9-11- <del>14-17-18</del>
	SLOGRD	<del>1-2-3</del> -4-5-6-7- <del>8</del> -9-11- <del>14-17-18</del>
	UWTROC	<del>9</del> -14- <del>18</del>

NATQUA		1-2-3-4-5-6-7-8-9-10
	<del>LNDRCN</del>	<del>1-2-3-4-5-6-7-8-9-10</del> [nature of surface – qualifying terms is not a valid attribute for Land Region]
	<del>OBSTRN</del>	<del>1-2-3-4-5-6-7-8-9-10</del> [nature of surface – qualifying terms is not a valid attribute for Obstruction]
	<del>UWTROC</del>	<del>4-8-9-10</del> [nature of surface – qualifying terms is not a valid attribute for Underwater/Awash Rock]

PRODCT		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22- <del>23-24-25</del>
	CONVYR	4-5-6- <del>7</del> -10-11-12-13-14-15-16-17- <del>21</del> -22- <del>25</del>
	OBSTRN	1-2-3-8- <del>23</del>
	OFSPLF	1-2- <del>3-18-19-23</del>
	OSPARE	1-2-4-6-10-14- <del>23</del>
	PIPARE	1-2-3-7-8-18-19- <del>20</del>
	PIPSOL	1-2-3-7-8-9-18-19- <del>20-22</del>
	PRDARE	1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22- <del>23-25</del>
	SILTNK	1-2-3- <del>5</del> -7-8-9- <del>13</del> -14- <del>16</del> -18-19-20-21-22- <del>24</del>

QUASOU		1-2-3-4- <del>5</del> -6-7-8-9-10-11 [Value 5 converts to new Feature type <b>Depth – No Bottom Found</b> ]
	BERTHS	1-2- <del>3-4</del>
	DWRTCL	1-2-3-4- <del>6-7</del>
	DWRTPT	1-2-3-4- <del>6-7</del>
	<del>DEPARE</del>	<del>1-2-3-4</del> [quality of vertical measurement is not a valid attribute for <b>Depth Area</b> ]
	FAIRWY	1-2- <del>3-4-6</del>
	RCRTCL	1-2-3-4- <del>6</del>
	RECTRC	1-2- <del>3-4</del> -6
	SOUNDG	1-3-4- <del>5</del> -8-9- <del>10-11</del>
	<del>SWPARE</del>	<del>1-3-4-5-8-9-10-11</del> [quality of vertical measurement is not a valid attribute for <b>Swept Area</b> ]
	TWRTPT	1-2-3-4- <del>6</del>
	M_SREL	1-2-3-4- <del>5</del> -6-7-8-9-10-11

Attribute	Object	Allowable Attribute Values
RESTRN		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27- <del>39</del>
	ACHARE	2-3-4-5-6-8-9-10-11-12-13-15-16-17-18-19-20-21-23-24-27- <del>39</del>
	CBLARE	1-2-3-4-5-6-7-8-9- <del>10</del> -11-12-13- <del>14</del> -16-17-18- <del>19</del> -20- <del>21</del> - <del>22</del> -23-24-25-27- <del>39</del>
	DRGARE	1-2-3-4-5-6- <del>7</del> -8-11-12-13-16-17-18-19-20-21- <del>22</del> -23-25-27- <del>39</del>
	DMPGRD	1-2-3-4-5-6-7-8-9-10-11-12-13- <del>16</del> -17-18-19-20-21-22-23-24-25-27
	FAIRWY	1-2-3-4-5-6-8-9-10-11-12-13-15-16-17-18-19-20-21-22-23-24-25-27- <del>39</del>
	<del>IGNARE</del>	<del>1-2-3-4-5-6-7-8-9-10-11-12-13-16-17-18-19-20-21-22-23-24-25-26-27</del> [No equivalent feature in S-101]
	ISTZNE	1-2-3-4-5-6-8-9-10-11-12-13- <del>16</del> - <del>17</del> -18-19-20-21-22-23-24-25-27
	MARCUL	1-2-3-4-5-6- <del>7</del> -8-9-10-11-12-13- <del>14</del> -15-16-17-18-19-20-21-22-23-24-25-27
	MIPARE	1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17-18-19-20-21-22-23-24-25- <del>26</del> -27- <del>39</del>
	<del>NEWOBJ</del>	<del>1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27</del> [restriction is not a valid attribute for Virtual AIS Aid to Navigation]
	OSPARE	1-2-3-4-5-6-7-8-9-10-11-12-13- <del>14</del> -15-16-17-18-19-20-21-22-23-24-25- <del>26</del> -27- <del>39</del>
	PIPARE	1-2-3-4-5-6-7-8-9-10-11-12-13- <del>14</del> -15-16-17-18-19-20-21-22-23-24-25- <del>26</del> - <del>27</del> - <del>39</del>
	PRCARE	1-2-3-4-5-6-8-9-10-11-12- <del>13</del> - <del>14</del> -16-17-18-19-20-21-22-23-24-25-27
	RESARE	1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27- <del>39</del>
	SPLARE	1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17-18-19-20-21-22-23-24-25-27- <del>39</del>
	TESARE	<del>1-2-3-4-5-6-7-8-9-10-11</del> -12- <del>13-16</del> -17-18-19-20-21-22-23-24- <del>25-26-27</del>

SIGGEN		1-2-3-4- <del>5</del> -6
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STATUS		1-2-3-4-5-6-7-8-9-11-12-13-14-15-16-17-18- <del>28</del>
	AIRARE	1-2-4-5-6-7-8-12-14- <del>16-17</del>
	BERTHS	1-2- <del>3</del> - <del>5</del> - <del>6</del> - <del>7</del> - <del>8</del> -9-12- <del>14</del>
	BUISGL	<del>1-4-6</del> -7-8-12-13-14- <del>16-17</del>
	CBLOHD	1-4-5-7-12- <del>28</del>
	CBLSUB	1-4-13- <del>18</del>
	CAUSWY	1- <del>7</del> -8-12-14
	CHKPNT	1-2-5-7-9-12- <del>16-17</del>
	CONZNE	<del>4</del> [status is not a valid attribute for Contiguous Zone]
	CONVYR	<del>1-4-6</del> -12
	DWRTPT	1-3-6-9- <del>28</del>
	FAIRWY	1-3-6-7-9- <del>28</del>
	FNCLNE	1- <del>7</del> -12- <del>13</del>
	FERYRT	1-2-4-5-6-7-8-9- <del>14</del>
	FSHFAC	1-4-5-6-7-8-12- <del>16-17-18-28</del>
	FSHGRD	1-5-6-7-8-14-16-17- <del>28</del>
	GRIDRN	1-4-6-8-14- <del>16-17-28</del>
	HRBARE	1-4-6-8-14- <del>16-17</del>

Attribute	Object	Allowable Attribute Values
	ICEARE	1- <del>2</del> -5- <del>16</del> - <del>17</del> -18
	<del>IGNARE</del>	<del>1-2-5-6-7-16-17</del> [No equivalent feature in S-101]
	LNDARE	<del>6-7-8-12-14-16-17</del> -18
	LNDMRK	1-2-4-5-7-8-12-13-14- <del>16</del> - <del>17</del>
	LOGPON	1-2- <del>4</del> -5-6-7-8
	MARCUL	1-2-4-5-6-7-8-14-16-17- <b>28</b>
	MORFAC	1-2-3-4-5-6-7-8- <del>9</del> -12-14-18
	NEWOBJ	1- <del>2-3-4-5-6-7-8-9-11-12-13-14-15-16-17-18</del> [Converts to <b>status</b> on new Feature type Virtual AIS Aid to Navigation]
	OBSTRN	1-4-5-7-8-13-18- <b>28</b>
	OFSPLF	1-2-4-7-8-12- <del>16</del> - <del>17</del> - <b>28</b>
	OSPARE	1-4-7-8-12- <b>28</b>
	OILBAR	1-2-4- <del>5</del> -7-8
	PILBOP	1-2- <del>3</del> -5-6-9-16-17- <b>28</b>
	PRCARE	1-9- <b>28</b>
	PRDARE	<del>4-4-8-12</del>
	RADLNE	1-2- <del>3</del> -4-7
	RAILWY	1-4-6-12- <del>13</del> - <del>14</del>
	RESARE	1-2-3-4-5-6-7-9-18- <b>28</b>
	RIVERS	<del>1-2-5-8-14</del>
	ROADWY	1- <del>2</del> -4-6- <del>7</del> -8-12- <del>13</del> -14
	RUNWAY	1-2-4-5-6- <del>7</del> -8-12-14
	SLCONS	1-2-3-4-6-7-8- <del>9</del> -12- <del>13</del> -14- <del>16</del> - <del>17</del> - <b>28</b>
	SILTNK	<del>4-4</del> -12-13
	<del>T</del> S_PRH	<del>4-2-5-7-18</del> [No equivalent feature in S-101]
	<del>T</del> S_PNH	<del>4-2-5-7-18</del> [No equivalent feature in S-101]
	<del>T</del> S_TIS	<del>4-2-5-7-18</del> [No equivalent feature in S-101]
	<del>T</del> _HMON	<del>5</del> [No equivalent feature in S-101]
	<del>T</del> _NHMN	<del>5</del> [No equivalent feature in S-101]
	<del>T</del> _TMS	<del>5</del> [No equivalent feature in S-101]
	<del>T</del> OPMAR	<del>4-5-7-8-12-14</del> [ <b>status</b> is not a valid sub-attribute for complex attribute <b>topmark</b> ]
	TSELNE	1-3-9- <b>28</b>
	TSSBND	1-3-9- <b>28</b>
	TSSLPT	1-3-6-9- <b>28</b>
	TSEZNE	1-3-9- <b>28</b>
	TUNNEL	1-3-4-6-8-14- <del>16</del> - <del>17</del>
	UWTROC	<del>13</del> -18
SURTYP		1-2-4-5-6- <del>7</del> -8-9-10-11-12-13

Attribute	Object	Allowable Attribute Values
TECSOU		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17 [Value 7 converts to new value 15 and value 14 converts to new value 17]
	DWRTCL	1- <del>2</del> -3- <del>5</del> -6-7-8-9- <del>44</del> -13-15-16-17
	DWRTPT	1- <del>2</del> -3- <del>5</del> -6-7-8-9- <del>44</del> -13-15-16-17
	DRGARE	1-2-3-6-7-8-9-11-13-15-16-17
	OBSTRN	1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17
	RCRTCL	1- <del>2</del> -3-6-7-8-9- <del>44</del> -13-15-16-17
	RECTRC	1-2-3-6-7-8-9- <del>44</del> -13-15-16-17
	SOUNDG	1-2-3- <del>4</del> -5-6-7-8-9- <del>10</del> - <del>11</del> - <del>12</del> -13-14-15-16-17
	<del>SWPARE</del>	<del>6-8-13</del> [technique of vertical measurement is not a valid attribute for Swept Area]
	TWRTPT	1- <del>2</del> -3- <del>5</del> -6-7-8-9- <del>40</del> - <del>44</del> -13-15-16-17
	UWTROC	1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17
	WRECKS	1-2-3-4-5-6-7-8-9-10-11-12-13-15-16-17
	<del>M_QUAL</del>	<del>1-2-3-4-5-6-7-8-9-10-11-12-13</del> [technique of vertical measurement is not a valid attribute for Quality of Bathymetric Data. May be converted to technique of vertical measurement on a Quality of Survey feature]

<del>T_ACWL</del>		[No equivalent attribute in S-101]
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<del>T_MTOP</del>		[No equivalent attribute in S-101]
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TOPSHP		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33 [Converts to sub-attribute <b>topmark/daymark shape</b> on new complex attribute <b>topmark</b> ]
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VERDAT		1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30- <del>44</del>
	BRIDGE	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del> [Converts to <b>vertical datum</b> on new Feature types <b>Span Fixed</b> or <b>Span Opening</b> ]
	CBLOHD	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>
	CONVYR	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>
	CRANES	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>
	GATCON	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>
	LIGHTS	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del> [Converts to <b>vertical datum</b> on Feature types <b>Light All Around</b> , <b>Light Sector</b> , <b>Light Fog Detector</b> or <b>Light Air Obstruction</b> ]
	PIPOHD	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>
	M_SDAT	1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-19-22-23-24-25-26-27- <del>44</del>
	M_VDAT	3-16-17-18-19-20-21-24-25-26-28-29-30- <del>44</del>

WATLEV		1-2-3-4-5-6-7
	GRIDRN	1- <del>2</del> -3-4-5
	LNRGN	1- <del>2</del> -4-6

Attribute	Object	Allowable Attribute Values
	MORFAC	1-2-3-4-5-6- <del>7</del>
	<del>NEWOBJ</del>	<del>1-2-3-4-5-6-7</del> [water level effect is not a valid attribute for Virtual AIS Aid to Navigation]
<del>HORDAT</del>		[No equivalent attribute in S-101]
QUAPOS		<del>1-2-3-4-5-6-7-8-9-10-11</del>
	M_SREL	<del>1-2-3-4-5-6-7-8-9-10-11</del>

Table A.2

### A-3 Enhanced S-101 encoding

Table A.3 below provides a summary of additional manual encoding that may be considered for converted S-101 ENC datasets post-conversion in order to produce “full capability” S-101 ENCs. However, for new enumerate values introduced in S-101, see Table A.2 above.

NOTE: The additional encoding summarised below is not a requirement in order to produce “S-57 equivalent” S-101 datasets.

S-101 Feature type	S-57 Object	Remarks
Various	Various	File formats .HTM and .XML added as new allowable file formats in S-101 for attribute <b>file reference</b> in addition to the .TXT format allowable in S-57.
<b>Archipelagic Sea Lane</b>		New S-101 Feature type. See clause 10.5.3 and S-101 DCEG clause 15.27.
<b>Berth</b>	<b>BERTHS</b>	New S-101 attributes <b>horizontal clearance length</b> , <b>horizontal clearance width</b> and <b>maximum permitted draught</b> . See clause 4.6.2 and S-101 DCEG clause 8.13.
<b>Bridge</b>	<b>BRIDGE</b>	Attributes <b>height</b> and <b>status</b> added. See S-101 DCEG clause 6.5. See also new S-101 features <b>Span Fixed</b> and <b>Span Opening</b> (clause 4.8.10 and S-101 DCEG clauses 6.6 and 6.7)
<b>Building</b>	<b>BUISGL</b>	Attributes <b>vertical clearance fixed</b> (VERCLR) and <b>vertical datum</b> (VERDAT) added; new S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 6.2.
<b>Cable Overhead</b>	<b>CBLOHD</b>	New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 6.9.
<b>Canal</b>	<b>CANALS</b>	Attribute <b>horizontal width</b> (HORWID) added. See S-101 DCEG clause 8.8.
<b>Cargo Transhipment Area</b>	<b>CTSARE</b>	Attribute <b>restriction</b> (RESTRN) added. See S-101 DCEG clause 16.9.
<b>Caution Area</b>	<b>CTNARE</b>	Attributes <b>condition</b> (CONDTN), <b>status</b> (STATUS) and <b>pictorial representation</b> (PICREP) added. See S-101 DCEG clause 16.10.
<b>Coast Guard Station</b>	<b>CGUSTA</b>	New allowable geometric primitive Surface. Attribute <b>communication channel</b> (COMCHA) added. See S-101 DCEG clause 22.3.
<b>Coastline</b>	<b>COALNE</b>	Attribute <b>nature of surface</b> (NATSUR) added. See clause 4.5.1 and S-101 DCEG clause 5.3.
<b>Collision Regulations Limit</b>		New S-101 Feature type. See clause 11.13.5 and S-101 DCEG clause 16.9.
<b>Contact Details</b>		New S-101 Information Feature type. See S-101 DCEG clause 24.1.
<b>Crane</b>	<b>CRANES</b>	New allowable geometric primitive Surface.
<b>Dam</b>	<b>DAMCON</b>	Attributes <b>status</b> (STATUS) and <b>water level effect</b> (WATLEV) added. See S-101 DCEG clause 8.11.
<b>Data Coverage</b>	<b>M_COVR</b>	New S-101 attribute <b>minimum display scale</b> . See clause 2.2.6 and S-101 DCEG clause 3.4.
<b>Daymark</b>	<b>DAYMAR</b>	Attribute <b>pictorial representation</b> (PICREP) added. See S-101 DCEG clause 20.13.
<b>Deep Water Route</b>		New S-101 Feature type. See clause 10.2.1.8 and S-101 DCEG clause 15.17.
<b>Deep Water Route Centreline</b>	<b>DWRTPT</b>	New S-101 attribute <b>IMO adopted</b> . See clause 10.2.2.2 and S-101 DCEG clause 15.13.
<b>Deep Water Route Part</b>	<b>DWRTPT</b>	New S-101 attribute <b>IMO adopted</b> . See clause 10.2.2.1 and S-101 DCEG clause 15.14.
<b>Discoloured Water</b>		New S-101 Feature type. See clause 6.5 and S-101 DCEG clause 13.8.

S-101 Feature type	S-57 Object	Remarks
Dock Area	DOCARE	New S-101 attributes <b>horizontal clearance length</b> , <b>horizontal clearance width</b> and <b>maximum permitted draught</b> . See clause 4.6.6.3 and S-101 DCEG clause 8.18.
Dredged Area	DRGARE	New S-101 attribute <b>maximum permitted draught</b> . See S-101 DCEG clause 5.5.
Dry Dock	DRYDOC	New S-101 attributes <b>horizontal clearance length</b> , <b>horizontal clearance width</b> and <b>maximum permitted draught</b> . See clause 4.6.6.1 and S-101 DCEG clause 8.15.
Dumping Ground	DMPGRD	New S-101 attribute <b>date disused</b> . See S-101 DCEG clause 16.6.
Dyke	DYKCON	Attribute <b>visual prominence</b> (CONVIS) added. See S-101 DCEG clause 8.5.
Fairway	FAIRWY	New S-101 attribute <b>maximum permitted draught</b> . See S-101 DCEG clause 10.4.
Fairway System		New S-101 Feature type. See clause 10.4 and S-101 DCEG clause 15.8.
Fishing Facility	FSHFAC	Attribute <b>condition</b> (CONDTN) added. See S-101 DCEG clause 13.9.
Fishing Ground	FSHGRD	Attribute <b>restriction</b> (RESTRN) added. See S-101 DCEG clause 16.17.
Floating Dock	FLODOC	New allowable geometric primitive Point. New S-101 attributes <b>horizontal clearance length</b> , <b>horizontal clearance width</b> and <b>maximum permitted draught</b> . See clause 4.6.6.2 and S-101 DCEG clause 8.16.
Fortified Structure	FORSTC	Attribute <b>status</b> (STATUS) added. See S-101 DCEG clause 7.5.
Harbour Facility	HRBFAC	Attributes <b>product</b> (PRODCT), <b>restriction</b> (RESTRN) and <b>pictorial representation</b> (PICREP) added. See S-101 DCEG clause 22.7.
Information Area		New S-101 Feature type. See clause 2.5 and S-101 DCEG clause 16.11.
Lake Area	LAKARE	Attribute <b>status</b> (STATUS) added. See S-101 DCEG clause 5.10.
Land Region	LNDRGN	New allowable geometric primitive Curve.
Landmark	LNDMRK	New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 7.2. See also new S-101 Feature type <b>Wind Turbine</b> (see clause 4.8.15 and DCEG clause 7.4).
Light All Around	LIGHTS	Attributes <b>signal generation</b> (SIGGEN) and <b>vertical length</b> added. See clause 12.8.1 and S-101 DCEG clause 19.2.
Light Fog Detector	LIGHTS	Attribute <b>vertical length</b> added. See clause 12.8.1 and S-101 DCEG clause 19.4.
Light Sectored	LIGHTS	Attribute <b>signal generation</b> (SIGGEN) added; New S-101 attribute <b>sector line length</b> . See clause 12.8.6.1 and S-101 DCEG clause 19.3.
Local Magnetic Anomaly	LOCMAG	New S-101 attribute <b>magnetic anomaly value minimum</b> . See S-101 DCEG clause 4.2.
Log Pond	LOGPON	Complex attribute <b>periodic date range</b> (PEREND/PERSTA) added. See S-101 DCEG clause 16.20.
Marine Pollution Regulations Area		New S-101 Feature type. See clause 11.16 and S-101 DCEG clause 16.27.
Military Practice Area	MIPARE	Attribute <b>nationality</b> (NATION) added. See S-101 DCEG clause 16.7.
Mooring Trot		New S-101 Feature type. See clause 9.2.5 and S-101 DCEG clause 8.21.
Mooring/Warping Facility	MORFAC	Attribute <b>quality of vertical measurement</b> (QUASOU) added. See S-101 DCEG clause 8.14.
Nautical Information		New S-101 Information Feature type. See clause 2.4 and S-101 DCEG clause 24.4.

S-101 Feature type	S-57 Object	Remarks
Non-Standard Working Day		New S-101 Information Feature type. See S-101 DCEG clause 24.3.
Obstruction	OBSTRN	New S-101 mandatory attribute <b>display uncertainties</b> ; new S-101 attribute <b>maximum permitted draught</b> . See clause 6.2.1 and S-101 DCEG clause 13.5.
Offshore Platform	OFSPLF	Attribute <b>water level effect</b> (WATLEV) added. See S-101 DCEG clause 14.1.
Pile	PILPNT	New allowable geometric primitives Curve and Surface. Attributes <b>status</b> (STATUS) and <b>pictorial representation</b> (PICREP) added. See S-101 DCEG clause 8.4.
Pilot Boarding Place	PILBOP	New S-101 attributes <b>category of preference</b> , <b>destination</b> and <b>pilot movement</b> . See S-101 DCEG clause 13.1.2.
Pilotage District		New S-101 Feature type. See clause 13.1.2 and S-101 DCEG clause 22.1.
Pipeline Overhead	PIPOHD	New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 6.10.
Pipeline Submarine/On Land	PIPSOL	Attributes <b>restriction</b> (RESTRN) and <b>pictorial representation</b> (PICREP) added. New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 14.4.
Pontoon	PONTON	Attribute <b>pictorial representation</b> (PICREP) added. New allowable geometric primitive Point.
Precautionary Area	PRCARE	Attributes <b>feature name</b> (NOBJNM, OBJNAM) and <b>IMO adopted</b> (CATTSS) added. See S-101 DCEG clause 15.17.
Pylon/Bridge Support	PYLONS	Attribute <b>status</b> (STATUS) added. See S-101 DCEG clause 6.11. New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 14.4.
Quality of Bathymetric Data	M_QUAL	New S-101 attributes <b>category of temporal variation</b> , <b>data assessment</b> , <b>feature detection</b> (complex) and <b>full seafloor coverage achieved</b> ; attribute <b>technique of vertical measurement</b> (TECSOU) prohibited; attribute <b>survey date end</b> (SUREND) mandatory; capability to encode degrading quality over time; capability to encode overlapping features in accordance with varying quality of bathymetric data in the water column. See clause 2.2.3.1 and S-101 DCEG clause 3.7.
Quality of Non-Bathymetric Data	M_ACCY	Attributes <b>horizontal position uncertainty</b> (HORACC), <b>survey date range</b> (SUREND, SURSTA) and <b>vertical uncertainty/uncertainty fixed</b> (VERACC) added; new S-101 attributes <b>category of temporal variation</b> and <b>orientation uncertainty</b> . See S-101 DCEG clause 3.3.
Quality of Survey	M_SREL	Attribute <b>technique of vertical measurement</b> (TECSOU) added; new S-101 attributes <b>features detected</b> (complex), <b>full seafloor coverage achieved</b> , <b>measurement distance maximum</b> and <b>measurement distance minimum</b> . See clause 2.2.3.2 and S-101 DCEG clause 3.10.
Radar Reflector	RADRFL	Complex attributes <b>fixed date range</b> (DATEND/DATSTA) and <b>periodic date range</b> (PEREND/PERSTA) added. See S-101 DCEG clause 20.17.
Radar Station	RADSTA	Attribute <b>call sign</b> (CALSGN) added. See S-101 DCEG clause 15.32.
Radio Station	RDOSTA	New S-101 attribute <b>frequency shore station receives</b> . See clause 12.9 and S-101 DCEG clause 21.4.
Range System		New S-101 Feature type. See clause 10.1.2 and S-101 DCEG clause 15.6.
Rescue Station	CGUSTA	New allowable geometric primitive Surface. Attribute <b>communication channel</b> (COMCHA) added. See S-101 DCEG clause 22.6.
Restricted Area Navigational	RESARE	New S-101 attribute <b>vessel speed limit</b> . See clause 11.1 and S-101 DCEG clause 17.8.
Seabed Area	SBDARE	New S-101 attribute <b>underlying layer</b> . See S-101 DCEG clause 12.1.
Seagrass		New S-101 Feature type. See clause 7.2.2 and S-101 DCEG clause 12.3.

S-101 Feature type	S-57 Object	Remarks
Service Hours		New S-101 Information Feature type. See S-101 DCEG clause 24.2.
Signal Station Traffic	SISTAT	New allowable geometric primitive Surface.
Signal Station Warning	SISTAW	New allowable geometric primitive Surface.
Silo/Tank	SILTNK	New S-101 attribute <b>multiplicity of features</b> . See S-101 DCEG clause 7.3.
Sounding	SOUNDG	New S-101 mandatory attribute <b>display uncertainties</b> . See clause 5.3 and S-101 DCEG clause 11.3. See also new S-101 Feature type <b>Depth – No Bottom Found</b> (see clause 5.3 and S-101 DCEG clause 11.8).
Spatial Quality		New S-101 Information Feature type. See S-101 DCEG clause 24.5.
Submarine Transit Lane	SUBTLN	Attribute <b>nationality</b> (NATION) added. See S-101 DCEG clause 16.24.
Text Placement		New S-101 Cartographic Feature type. See S-101 DCEG clause 23.1.
Traffic Separation Scheme		New S-101 Feature type. See clause 10.2.3 and S-101 DCEG clause 15.24.
Tunnel	TUNNEL	Attribute <b>vertical datum</b> (VERDAT) added. See S-101 DCEG clause 6.15.
Two-Way Route		New S-101 Feature type. See clause 10.2.6 and S-101 DCEG clause 15.11.
Underwater/Awash Rock	UWTROC	New S-101 mandatory attribute <b>display uncertainties</b> . See clause 6.1.2 and S-101 DCEG clause 13.4.
Update Information		New S-101 Meta Feature. See S-101 DCEG clause 3.11.
Vessel Traffic Service		New S-101 Feature type. See clause 12.13 and S-101 DCEG clause 22.2.
Wreck	WRECKS	New S-101 mandatory attribute <b>display uncertainties</b> . See clause 6.2.1 and S-101 DCEG clause 13.5.

Table A.3