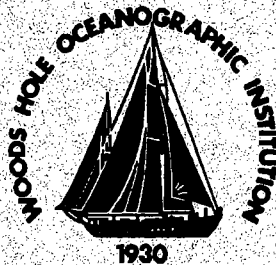


WHOI-91-42

Copy 2

**Woods Hole
Oceanographic
Institution**



**United States Electronic Chart Display and
Information System (ECDIS) Test-Bed Project:
System Requirements Specification.**

edited by:

Carolyn K. Ocel and David J. Scott

August 1991

Technical Report

Funding was provided by the U.S. Coast Guard, the American Petroleum Institute, American Telephone and Telegraph, Exxon Shipping Company, and the Marine Spill Response Corporation. In-kind contributions are coming from the National Ocean Service (NOAA), Raytheon Marine Company, RACAL Marine Electronics, Ltd., COMSAT Maritime Services, and American President Lines.

Approved for public release; distribution unlimited.

DOCUMENT
LIBRARY
Woods Hole Oceanographic
Institution

WHOI-91-42

**United States Electronic Chart Display and
Information System (ECDIS) Test-Bed Project:
System Requirements Specification.**

edited by:

Carolyn K. Ocel and David J. Scott

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

August 1991


Technical Report

Funding was provided by the U.S. Coast Guard, the American Petroleum Institute, American Telephone and Telegraph, Exxon Shipping Company, and the Marine Spill Response Corporation. In-kind contributions are coming from the National Ocean Service (NOAA), Raytheon Marine Company, RACAL Marine Electronics, Ltd., COMSAT Maritime Services, and American President Lines.

Reproduction in whole or in part is permitted for any purpose of the United States Government. This report should be cited as Woods Hole Oceanog. Inst. Tech. Rept., WHOI-91-42.

Approved for public release; distribution unlimited.

Approved for Distribution:



James M. Broadus
Marine Policy Center



Preface

In 1989 the Maritime Safety Committee (MSC) of the International Maritime Organization (IMO) adopted a provisional performance Standard for ECDIS (MSC/Circ. 515). This standard defines an electronic chart display and information system (ECDIS) that is the legal equivalent of a paper chart, and that fulfills the requirement imposed on all vessels (reg. V/20 of SOLAS 1974) to carry up-to-date nautical charts covering intended voyages.

The U.S. Electronic Chart Display and Information System (ECDIS) Test-Bed Project began as a collaborative effort between the Radio Technical Commission for Maritime Services (RTCM) and the Woods Hole Oceanographic Institution (WHOI) in 1990. The project responds to the International Maritime Organization (IMO) call to member states to evaluate its Provisional Performance Standards for ECDIS. Since 1990 the U.S. ECDIS Test-Bed Project has grown in participation through sponsorship and in-kind contributions from government and private organizations, through collaboration with organizations in other nations, and through contractual arrangements with private companies.

The central objective of the ECDIS Test-Bed Project is to assemble an experimental ECDIS unit that meets or exceeds the IMO standard, for evaluation on ships at sea. The first part of the project focussed on translating the IMO Provisional Performance Standard into an ECDIS system requirement specification, describing in an engineering context what an ECDIS must do to meet the standard. This task began with a document written by Mr. Mortimer Rogoff, of Digital Directions Co., and was carried to full detail and documentation by Ms. Carolyn K. Ocel and Mr. David J. Scott, of Intergraph Corporation. Their work was reviewed by members of the Consultative Group, the advisory body to our Project. The result of this process is contained in this report.

Details of this ECDIS System Requirement Specification (SRS) will no doubt be disputed, as ambiguities, inherent contradictions, and priorities of various interested parties become manifest. This is an expected part of the standard setting process and we welcome it. Written comments on this SRS are particularly welcome and should be addressed to me. Subsequent stages of the project involve preparation of the system design document; software development and hardware integration; system testing and acceptance; and sea trials.

Introduction of ECDIS technology into maritime transportation represents a breakthrough in maritime safety, environmental protection and, probably, cost savings in ship operation. Applications of this enabling technology will reach into vessel traffic monitoring and control, maritime law enforcement (e.g., fisheries), marine resources survey and management, ocean research, and other applications.

The ECDIS Test-Bed Project is funded by the U.S. Coast Guard, the American Petroleum Institute, American Telephone and Telegraph, Exxon Shipping Company, and the Marine Spill Response Corporation. In-kind contributions are coming from the National Ocean Service (NOAA), Raytheon Marine Company, RACAL Marine Electronics, Ltd., COMSAT Maritime Services, and American President Lines.

Arthur G. Gaines, Jr.
ECDIS General Program Manager
Marine Policy Center
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

TABLE OF CONTENTS

I. Introduction	1
II. Applicable Documents	3
III. Executive Summary	5
IV. Requirements Definition	7
1. ELECTRONIC NAVIGATION CHART (ENC) DATA MANAGEMENT	8
2. GENERAL REQUIREMENTS FOR ECDIS UPDATING	11
3. ELECTRONIC NAVIGATION CHART (ENC) UPDATE	14
4. MANAGEMENT OF SUPPLEMENTARY DATA	24
5. UPDATES TO NAVIGATION PUBLICATIONS DATA	33
6. RADIO WARNING DATA MANAGEMENT.	39
7. SYSTEM ELECTRONIC NAVIGATION CHART (SENC) GENERATION	41
8. SYSTEM ELECTRONIC NAVIGATION CHART (SENC) DISPLAY	44
9. SYSTEM ELECTRONIC NAVIGATION CHART (SENC) MANIPULATION	76
10. ROUTE PLANNING	80
11. ROUTE MONITORING	93
12. HISTORY TRACKING	103
13. CALCULATIONS, MEASUREMENTS, AND COMPUTATIONS.	105
14. INDEXES, CATALOG, AND LIBRARY MANAGEMENT	114
15. USER INTERFACE	119
16. ON-BOARD SYSTEMS INTERFACES	121
17. SYSTEM INITIALIZATION	139
18. SYSTEM BACKUP/RESTORE	147
19. SYSTEM ACCESS/SECURITY	149

August 1, 1991

ECDIS SRS/Version 2.2

20. POWER SUPPLY	151
21. MALFUNCTIONS.	152
V. Document History	154
APPENDIX A: Notes on Test-bed TBRs	155
APPENDIX B: Requirements Index	161
APPENDIX C: Glossary of Terms and Acronyms	185
APPENDIX D: SRS Comment Form	188
APPENDIX E: Mapping of Default Display Objects to IMO List of Default Display Items	189

**UNITED STATES
ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS)
TEST-BED PROJECT**

SYSTEM REQUIREMENT SPECIFICATION (SRS)

Version 2.2

August 1, 1991

EDITED BY:

**Carolyn K. Ocel
David J. Scott
Intergraph Corporation
2051 Mercator Drive
Reston, VA 22091**

I. Introduction

A.1 Scope

The Electronic Chart Display and Information System (ECDIS) System Requirements Specification (SRS) fulfills the following functions within the United States ECDIS Test-Bed Project:

- o Enumerates requirements that describe functionality required within the U.S. ECDIS Test-Bed System to test all critical elements of the IMO Provisional ECDIS Standard ("Provisional Performance Standards for Electronic Chart Display Systems (ECDIS)", Maritime Safety Committee Circular 515, International Maritime Organization, dated April 13, 1989.)
- o Enumerates requirements that describe functionality desired within the U.S. ECDIS Test-Bed System to test elements of ECDIS systems not embodied within the above mentioned IMO standard but considered critical to the U.S. evaluation of their potential to support safe navigation.
- o Supports the design and development of the U.S. ECDIS Test-Bed System.
- o Supports multi-organization U.S. coordination of the specification.
- o Traces ECDIS requirements to their source.
- o Provides commentary on requirements as appropriate.

A.2 Audience

The intended users of this SRS are:

- o Organizations and individuals coordinating the U.S. evaluation of the ECDIS standard
- o Organizations and individuals conducting the evaluation of this document
- o Organizations developing the U.S. ECDIS Test-Bed System
- o Organizations supporting the U.S. test of ECDIS standard
- o Interested U.S. and international parties

A.3 Organization

This SRS is organized, structured, and maintained as described in the following paragraphs.

A.3.1 Document Organization

The ECDIS SRS is organized into five (5) sections as described below:

- o Section I contains introductory material for the ECDIS SRS.
- o Section II lists documents utilized in the development of the ECDIS SRS.
- o Section III provides an executive summary of the ECDIS program and the U.S. ECDIS Test-Bed Project.
- o Sections IV details U.S. ECDIS Test-Bed System functional, interface, and performance requirements.
- o Section V provides a chronological document history.

A.3.2 Requirement Definition

The requirements contained in section IV of this SRS are a collaborative effort involving many different organizations and individuals involved in the specification and definition of ECDIS. Requirements have been constructed by gathering statements from these sources and previous bodies of ECDIS work. In addition, requirements are drawn from the supporting standards as appropriate. All sources utilized in development of the SRS are detailed in section II.

A.3.3 Requirement Structure

ECDIS Test and Demonstration System requirements are defined in this SRS in a hierarchy representing levels of abstraction or detail. Requirements are broken down until the system is defined at the lowest level of abstraction and highest level of specificity required to support development.

To assure the complete capture of ECDIS requirements, each requirement is tracked to its source. This is done by annotating each requirement as follows:

- o For requirements extracted directly from the IMO ECDIS standard or other applicable ECDIS related standards and documents, the requirement is referenced to its specific source document by utilizing the annotation "[2.X, page N, paragraph M]" following the requirement statement. In this construct, "X" is the position of the document in the "Applicable Documents" section of the SRS, "N" is the page number of the source document from which the requirement was extracted, and "M" is the paragraph number in which the requirement appeared. In cases when a specific SRS requirement may be traced to multiple source documents, all references are included in the annotation and separated by semi-colons. (e.g. - [2.1, page 5, paragraph 3.6; 2.2, page 10, paragraph 4.5])
- o In cases when a requirement is directly derived from a statement made in a source document, the same annotation described above is used, with the addition of term "derived," as follows: "[Derived, 2.X, page N, paragraph M]".
- o For those requirements derived in the process of developing this SRS without the benefit of an explicit source, no annotation is provided.

August 1, 1991

ECDIS SRS/Version 2.2

A.3.4 Notes on Test-bed TBRs

During the development of the SRS, there were occasions in which the authors or evaluators felt it necessary to provide an explanatory comment or clarification regarding a particular U.S. ECDIS Test-Bed System requirement. These comments and clarifications are included in Appendix A to this SRS and referenced within the body of the SRS using the notation "(see note M)"; where M denotes the note number as it appears within appendix A.

A.3.5 Items "To Be Resolved" (TBR)

During the development of the SRS, circumstances arise in which the exact specification detail required to complete a requirement statement is unknown or unavailable. In these circumstances, items are marked as "(TBR)" indicating they are "to be resolved" at later date.

A.3.6 Requirements Index

Appendix B contains an index to all ECDIS requirements stated in section IV.

A.3.7 Glossary of Terms

Appendix C contains a glossary of terms relevant to the material contained in this document.

A.3.8 Requirements Comment Form

Appendix D contains a form that may be used to provide comments on requirements enumerated this document.

A.3.9 Mapping of Default Display Objects to IMO Default Display Items

Appendix E contains the mapping of default display items listed in the IMO Provisional Standard to the IHO object catalogue to the extent possible.

A.3.10 Document Revision

Revisions to this document are annotated with a two level version numbering scheme (N.M); N representing the major number and M representing the minor number. Addition of new material or changes will be noted as follows:

- o New material will be indicated by a vertical "change bar" in the left margin of the text.
- o Material to be deleted will show a "strike through" in version N.M+1 and will be removed completely in version N.M+2 of the SRS.

Section V contains a revision history of the SRS.

II. Applicable Documents

The following documents were utilized in the development of the requirements detailed in this SRS.

August 1, 1991

ECDIS SRS/Version 2.2

- 2.1 "Provisional Performance Standards for Electronic Chart Display Systems (ECDIS)," Maritime Safety Committee Circular 515, International Maritime Organization, dated April 13, 1989.
- 2.2 "Provisional Specifications for Chart Content and Display of ECDIS," Special Publication No. 52, International Hydrographic Organization - COE Working Group, May 1990.
- 2.3 "Report of the IHO (COE) Working Group on Updating the Electronic Chart," Special Publication No. 52, Appendix 1 International Hydrographic Organization, Committee on ECDIS Working Group, June, 1990.
- 2.4 "Provisional Presentation Standards for ECDIS," Appendix 2 to IHO Special Publication No. 52, International Hydrographic Organization - COE Working Group on Colours and Symbols, June 1990, Revised October 1990.
- 2.5 "RTCM Provisional Standards For Electronic Chart Display and Information Systems," RTCM Paper 120-89/SC 109-71/BD-190, undated.
- 2.6 "The ECDIS Test and Demonstration Project in the United States," Mortimer Rogoff, August 9, 1990.
- 2.7 "Provisional Test Plan for the United States ECDIS Test and Demonstration Project," Mortimer Rogoff, December, 1990.
- 2.8 "Statement of Work for ECDIS Test and Demonstration Project," Draft for Comment, Mortimer Rogoff, January 29, 1990.
- 2.9 "U.S. ECDIS Test Bed Project Guidance Document," Mortimer Rogoff, January, 1991.
- 2.10 "RTCM Recommended Standards for Updating Electronic Charts," First Draft, June 17, 1988.
- 2.11 "IHO DX-90: Specifications for the Exchange of Digital Hydrographic Data - 1990," Version 1.3, Working Draft as of September 19, 1990, Committee on the Exchange of Digital Data; International Hydrographic Organization.
- 2.12 "IHO DX-90: Object Catalog, Release 1.0, Working Draft as of May, 1990, Committee on the Exchange of Digital Data; International Hydrographic Organization.
- 2.13 "International Chart Series INT 1 Symbols, Abbreviations, Terms Used on Charts," Deutsches Hydrographisches Institut, Hamburg, 1989.
- 2.14 "Standard for Interfacing Marine Electronic Navigational Devices," Version 1.5, December 1987, January 1990 printing, National Marine Electronics Association.
- 2.15 "Amendments of March 1991 to 'Provisional Presentation Standards for ECDIS' (Appendix 2 to IHO SP 52)", IHO Colours and Symbols Working Group.

August 1, 1991

ECDIS SRS/Version 2.2

- 2.16 Notes by the Government of Canada on "MSC/Circ 515 (13 April 1989) Provisional Performance Standards for ECDIS", presented at meeting of IMO/IHOHGE, March 1991.
- 2.17 "Updating for the Electronic Chart Display System" created for Special Committee 109 of RTCM by the Working Group on Updating, undated.
- 2.18 "System Requirements Specification (SRS) Comments on "TO BE RESOLVED" (TBR) items", Memorandum by Mortimer Rogoff, July 1, 1991.

III. Executive Summary

The Maritime Safety Committee (MSC) of the International Maritime Organization (IMO) adopted a provisional performance standard for ECDIS in 1989 (MSC/Circ. 515). This standard defines an electronic chart and display system (ECDIS) that is the legal equivalent of a paper chart, thus fulfilling the requirement imposed on all vessels (regulation V/20 of SOLAS 1974) to carry up-to-date nautical chart(s) that cover the routes of intended voyages.

Among the provisions of the IMO Provisional Standard is one that asks member governments to make trials and assess its provisions in preparation for the issue of a final version of the standard, tentatively set for 1993.

The U.S. ECDIS Test-Bed Project is a coordinated activity, currently underway in the United States, that will lead to the construction and operation of an ECDIS test facility. This project is being performed in response to direction from the IMO. The facility will be used in trials conducted in a number of geographic areas on board government and other vessels. The equipment and computer programs utilized in the test facility are intended to have sufficient capacity and levels of performance to be able to test all of the ECDIS features required by the Provisional Standard for ECDIS, and to test additional features not specified in the standard, but which may prove to be useful. A report and recommendations will be issued at the end of the trials, partly to supply an evaluation to IMO, and to assist in the preparation of national rules concerning the use of ECDIS in the United States.

The approach being taken to facilitate the ECDIS trials in the United States is based on the philosophy that existing ECDIS or ECDIS-like equipment will not be used; rather, a system is being constructed from graphics workstation and digital radar components whose performance exceeds the requirements of the Provisional Standard. The goal is not to produce a new production prototype, but to provide an experimental facility that tests the features displayed to the user without particular regard to the producibility of the system that creates the displays (or prematurely defined performance requirements).

The U.S. ECDIS Test-Bed Project in the United States was first described in a proposal prepared by the Radio Technical Commission for Maritime Services (RTCM) during 1989. The Woods Hole Oceanographic Institution (WHOI) joined with RTCM in this matter and agreed to serve as the Project Administrator for purposes of assembling financial contributions from government and industry, and to provide project management and administration.

During 1989 and 1990, a Statement of Work and proposed budget for the project was prepared, and became the basis for its funding and for the selection of vendors to supply the necessary equipment and computer programs. Contributions were sought, and are being received from both government and industry sources. These include the United States Coast Guard, the

August 1, 1991

ECDIS SRS/Version 2.2

National Ocean Service, the American Petroleum Institute, American Telephone and Telegraph, and the Exxon Shipping Company.

The objectives of the Test and Demonstration Project can be stated as follows:

- o To construct and install a facility placed on board ship for testing, demonstrating and evaluating the provisions of the IMO Provisional Standard for ECDIS. In addition, to test, demonstrate and evaluate ECDIS features not contained in the IMO Provisional Standard, or which are mentioned as options.
- o To use as observers and participants in the trials, various members of the maritime community so as to obtain broad exposure of the use of ECDIS in various locations and under various types and conditions of maritime operations. Participants will include masters, mates, pilots, hydrographers, Coast Guard officers and other government officials, representatives of shipping companies, yachtsmen, fisherman, insurance underwriters, etc.
- o To provide the National Ocean Service (NOS) with a facility to evaluate the electronic chart displays produced from their chart database, and to assess changes that might be desirable in the content or format of that database to meet the needs of ECDIS.
- o To provide the Coast Guard with data, test results, and reports from which recommendations can be created and comments written concerning the United States evaluation of the IMO Provisional ECDIS Standard.
- o To provide the Coast Guard with data and at-sea experience useful in preparing regulations for the use of ECDIS in United States waters by foreign and domestic shipping.
- o To provide the maritime electronics industry with an ECDIS model that demonstrates features of the IMO Provisional Standard; also, to provide the industry with copies of the software for use in their own demonstrations.
- o To provide shipping companies with the ability to replicate the shipboard test facility and to install a similar system on their own vessels.
- o To provide the basis for future simulation, test, and training operations concerning the use of ECDIS in maritime operations.

The tentative program schedule calls for completion of the shipboard system before the end of 1991, with trials taking place in a number of harbors during much of 1992. Reports will be written in time for submission to IMO for evaluation of the Provisional Performance Standard due for final issue in 1993. [Reference 2.6]

IV. Requirements Definition

This section of the SRS contains functional, interface and performance requirements for the ECDIS system.

NOTE

REQUIREMENT TITLES WHICH ARE UNDERLINED IDENTIFY REQUIREMENTS WHICH ARE TO BE INCLUDED IN THE PHASE II DELIVERY OF ECDIS.

1. ELECTRONIC NAVIGATION CHART (ENC) DATA MANAGEMENT

1.1 ENC Loading

1.1.1 Input from Distribution Media

ECDIS shall provide the capability to read ENC data from 5 1/4" diskettes from the Hydrographic Authority and convert it to the internal storage format. [Derived, 2.10, page 7, paragraph 2.2]

(see note 194)

1.1.2 Use of IHO DX-90 Exchange Standard

ECDIS shall provide the capability to translate ENC data, structured and formatted as described in IHO DX-90 standard, to internal format, and then back to HO format.

1.1.3 Feature/Attribute Data Loading

ECDIS shall provide the capability to process ENC data consisting of features and attributes as specified in the IHO Object Catalogue. [Derived, 2.2, page 9, paragraph 5.3; page 10, paragraph 5.5]

1.1.4 ENC Data Dictionary Loading

ECDIS shall provide the capability to process ENC data dictionaries as described in the IHO Object Catalogue. [Derived, 2.2, page 9, paragraph 5.3; page 10, paragraph 5.5]

1.1.5 Meta-Data Loading

ECDIS shall provide the capability to process ENC meta-data (descriptive data) as described in the IHO DX-90 specification. [Derived, 2.2, page 9, paragraph 5.3; page 10, paragraph 5.5]

1.1.6 Verification Mechanism

1.1.6.1 Load Verification

ECDIS shall provide the capability to verify that ENC data has been loaded into the system. [2.1, page III, paragraph 3.6]

1.1.6.2 Display Verification

ECDIS shall provide the capability to verify that ENC data is being displayed without corruption on the EC display. (2.1. page III. paragraph 3.6)

1.1.7 Validation of Translations

ECDIS shall provide the capability to validate that ENC data has been translated to internal format, and then back to the HO format with no loss of precision and no change in

information content of the original data. [Derived, 2.2, page 12, paragraph 6.2.5; 2.10, page 7, paragraph 2.2]

1.1.8 Maintenance of ENC Access

ECDIS shall provide the capability to access the original ENC data at any time after the initial load and processing of the data to aid in verification and validation. [Derived, 2.2, page 12, paragraph 6.2.5]

1.1.9 Conformance of ENC to HO Standard

ECDIS shall provide the capability to ensure that a converted data set is certified to meet the same HO standards as the data contained on the master EC disk. [2.10, page 7, paragraph 2.2]

1.2 Use of IHO Cell Structure

ECDIS shall provide the capability to process and manage HO supplied ENC data in the following cell structure (TBR): [Derived, 2.2, page 14, paragraph 6.5]

Level:	Cell size:
World	8 degr x 8 degr
General	4 degr x 4 degr
Coastal	1 degr x 1 degr
Approach	30 min x 30 min
Harbour	15 min x 15 min
Plan	7.5 min x 7.5 min

(see note 212)

1.2.1 Use of IHO Cell Numbering System

ECDIS shall provide the capability to address, index, and manage ENC cells referenced via the IHO cell numbering system. [Derived, 2.2, page 14, paragraph 6.6]

1.2.2 Maintenance of IHO Cell Characteristics

If the IHO cell structure is modified internally, ECDIS shall maintain all cell dependent characteristics of the ENC data. [Derived, 2.2, page 12, paragraph 6.2.4]

1.3 ENC Coordinate System

ECDIS shall provide the capability to process positional data in the ENC stored in latitude and longitude coordinates.

1.4 ENC Horizontal Datum

ECDIS shall provide the capability to process ECDIS ENC data adjusted to the WGS-84 datum. [Derived, 2.2, page 5, paragraph 3.1]

August 1, 1991

ECDIS SRS/Version 2.2

1.5 ENC Vertical Datum

ECDIS shall provide the capability to process ECDIS ENC data adjusted to multiple vertical datums. [Derived, 2.2, page 5, paragraph 3.2]

1.6 (deleted)

1.6.1 (requirement combined with requirement 1.1.7)

1.6.2 (requirement moved to 1.1.9)

1.7 ENC Accuracy (moved from Part 5, Sec 3.1)

ECDIS shall be capable of meeting the accuracy requirements of the IHO with respect to ENC data. [2.1, page IV, paragraph 7.3]

2. GENERAL REQUIREMENTS FOR ECDIS UPDATING

2.1 Type of Updates

ECDIS shall be capable of processing updates for the ENC^s, as described in section 3, and for supplementary information related to the ENC^s. Supplementary information includes navigation publications, informational articles and general notices not related to a navigation document, as described in section 4.

2.2 Source of Updates

ECDIS shall be capable of accepting updates from three sources: global NTMs, local NTMs, and radio broadcasts.

2.3 Mode of Update

A portion of the global updates shall be performed automatically; however, the bulk of the updating process shall be interactive.

2.3.1 Automatic Update Processing

2.3.1.1 Format of NTM Correction Files

ECDIS shall be capable of reading digital NTM files in IHO DX-90 format and converting them to internal storage format. [2.1, page V, paragraph 11.2; Derived 2.10, page 9, paragraph 2.4.3]

2.3.1.1.1 Translation Verification

ECDIS shall provide the capability to translate the ENC update data to internal format, and then back to the HO format without any change in the resultant data. [Derived, 2.2, page 12, paragraph 6.2.5]

2.3.1.2 Integration of Digital Updates

ECDIS shall provide the capability to fully integrate corrections, provided in digital form, with the HO provided ENC data, while not overwriting the ENC data. The system shall use the master EC files and the master change files to produce a single file of chart data in internal format (System Electronic Navigation Chart) for each chart affected by the corrections. [2.10, page 10, paragraph 2.4.3; 2.1, page V, paragraph 11.2]

2.3.1.3 Automatic Application of Digital Updates

ECDIS shall provide the capability to integrate digital corrections with no operator intervention. [2.10, page 8, paragraph 2.4.1]

2.3.1.4 Application of Digital Updates to the SENC Display

ECDIS shall provide the capability to automatically process and apply ENC updates to the SENC displayed information. [2.1, page V, paragraph 11.2]

2.3.1.5 Timing of Automatic Updates

ECDIS shall provide the capability to perform automatic updates at the appropriate time and for the appropriate interval to provide an up-to-date SENC file to support the ECDIS display. [2.10, page 10, paragraph 2.4.3]

2.3.1.5.1 Default Time of Application for Automatic Updates

ECDIS shall by default implement an automatic update when received. [2.3, page 16, paragraph 7.7; 2.10, page 10, paragraph 2.4.3]

2.3.1.6 (deleted)

2.3.2 Interactive Update Processing

2.3.2.1 Application of Updates Interactively

ECDIS shall provide the capability to enter ENC updates interactively. [2.1, page V, paragraph 11.3; 2.3, page 11, paragraph 6.2.3.2]

2.3.2.2 Interactive Update Overlay

ECDIS shall provide the capability to overlay interactive corrections with ENC data to provide an up-to-date SENC ECDIS display. The overlay must be distinguishable from the original ENC data and the corrections entered automatically by electronic means. [2.4, page 28, paragraph 4.2.2; 2.10, page 10, paragraph 2.4.3; 2.10, page 8, paragraph 2.4.1]

2.3.2.2.1 (Combined with 2.3.2.2)

2.3.2.3 Verification of Interactive Updates

ECDIS shall provide the capability to verify interactively entered ENC updates prior to the final acceptance of the data. [2.1, page V, paragraph 11.3; 2.3, page 16, paragraph 7.11]

2.3.2.4 Interactive Update User Interface

ECDIS shall provide special features (TBR) to assist the mariner in ensuring that the data is entered correctly. [2.3, page 16, paragraph 7.11]

2.3.2.5 (moved to 3.8.6)

2.3.2.6 Storage of Interactive Updates

ECDIS shall provide the capability to store interactive updates separate from the integrated SENC containing automatic updates. [2.10, page 10, paragraph 2.4.3]

2.4 Update Distribution Media

