MODEL COURSE 1.27

OPERATIONAL USE OF ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)

2012 Edition

Electronic edition

IMO INTERNATIONAL MARITIME ORGANIZATION

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Contents

Foreword

Since its inception the International Maritime Organization (IMO) has recognized the importance of human resources to the development of the maritime industry and has given the highest priority to assisting developing countries in enhancing their maritime training capabilities through the provision or improvement of maritime training facilities at national and regional levels. IMO has also responded to the needs of developing countries for postgraduate training for senior personnel in administrations, ports, shipping companies and maritime training institutes by establishing the world Maritime University in Malmö, Sweden, in 1983.

Following the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW), a number of IMO Member Governments had suggested that IMO should develop model training courses to assist in the implementation of the Convention and in achieving a more rapid transfer of information and skills regarding new developments in maritime technology. IMO training advisers and consultants also subsequently determined from their visits to training establishments in developing countries that the provision of model courses could help instructors improve the quality of their existing courses and enhance their implementation of the associated Conference and IMO Assembly resolutions.

In addition, it was appreciated that a comprehensive set of short model courses in various fields of maritime training would supplement the instruction provided by maritime academies and allow administrators and technical specialists already employed in maritime administrations, ports and shipping companies to improve their knowledge and skills in certain specialized fields. With the generous assistance of the Government of Norway, IMO developed model courses in response to these generally identified needs and now keeps them updated through a regular revision process taking into account any amendments to the requirements prescribed in IMO instruments and any technological developments in the field.

These model courses may be used by any training institution and, when the requisite financing is available, the Organization is prepared to assist developing countries in implementing any course.

K. SEKIMIZU
Secretary-General

Introduction

■ Purpose of the model courses

The purpose of the IMO model courses is to assist maritime training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course program to present instructors with a rigid "teaching package" which they are expected to "follow blindly". Nor is it the intention to substitute audio-visual or "programmed" material for the instructor's presence. As in all training endeavours, the knowledge, skills and dedication of the instructor are the key components in the transfer of knowledge and skills to those being trained through IMO model course material.

Because educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country, the model course material has been designed to identify the basic entry requirements and trainee target group for each course in universally applicable terms, and to specify clearly the technical content and levels of knowledge and skill necessary to meet the intent of IMO conventions and related recommendations.

■ Use of the model course

To use the model course the instructor should review the course plan and detailed syllabus, taking into account the information provided under the entry standards specified in the course framework. The actual level of knowledge and skills and the prior technical education of the trainees should be kept in mind during this review, and any areas within the detailed syllabus which may cause difficulties because of differences between the actual trainee entry level and that assumed by the course designer should be identified. To compensate for such differences, the instructor is expected to delete from the course, or reduce the emphasis on, items dealing with knowledge or skills already attained by the trainees. He should also identify any academic knowledge, skills or technical training which they may not have acquired.

By analysing the detailed syllabus and the academic knowledge required to allow training in the technical area to proceed, the instructor can design an appropriate preentry course or, alternatively, insert the elements of academic knowledge required to support the technical training elements concerned at appropriate points within the technical course.

Adjustment of the course objectives, scope and content may also be necessary if in your maritime industry the trainees completing the course are to undertake duties which differ from the course objectives specified in the model course.

Within the course plan the course designers have indicated their assessment of the time that should be allotted to each learning area. However, it must be appreciated that these allocations are arbitrary and assume that the trainees have fully met all entry requirements of the course. The instructor should therefore review these assessments and may need to re-allocate the time required to achieve each specific learning objective.

■ Lesson Plans

Having adjusted the course content to suit the trainee intake and any revision of the course objectives, the instructor should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching material proposed for use in the course. Where no adjustment has been found necessary in the learning objectives of the detailed syllabus, the lesson plans may simply consist of the detailed syllabus with keywords or other reminders added to assist the instructor in making his presentation of the material.

■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until the instructor is satisfied that the trainee has attained each specified learning objective. The syllabus is laid out in learning-objective format and each objective specifies what the trainee must be able to do as the learning outcome.

■ Implementation

For the course to run smoothly and to be effective, considerable attention must be paid to the availability and use of:

- Properly qualified instructors
- Support staff
- Rooms and other spaces
- Equipment
- Textbooks, technical papers
- Other reference material

Thorough preparation is the key to successful implementation of the course. IMO has produced “Guidance on the Implementation of IMO Model Courses,” which deals with this aspect in greater detail and is included as an attachment to this course.

Part A: Course Framework

■ Scope

This model course intends to provide the knowledge, skill and understanding of ECDIS and electronic charts to the thorough extent needed to safely navigate vessels whose primary means of navigation is ECDIS. The course emphasizes both the application and learning of ECDIS in a variety of underway contexts.

The course is designed to meet the STCW requirements in the use of ECDIS, as revised by the 2010 Manila Amendments, specifically as these apply to Tables A-II/1, A-II/2 and A-II/3, and also to revised guidelines pertaining to training and assessment in the operational use of ECDIS in Table B-I (paragraphs 36 through 66), assessment in navigational watchkeeping, and evaluation of competence, both in Table B-II.

It should be understood that this is a generic course which requires a structured and complementary on-board ship specific ECDIS familiarization for each shipboard ECDIS system on which the navigating officer serves.

■ Objective

Those who successfully complete this course should be able to demonstrate sufficient knowledge, skill and understanding of ECDIS navigation and electronic charts to undertake the duties of a navigational watch officer defined by STCW Code, as amended. This knowledge, skill and understanding should include Column 1 ECDIS competencies of Tables A-II, but is not limited to:

- Knowledge of the capability and limitations of ECDIS operations, and all indicated sub-topics
- Proficiency in operation, interpretation, and analysis of information obtained from ECDIS, and all indicated sub-topics
- Management of operational procedures, system files and data, and all indicated sub-topics

■ Entry Standards

It is assumed that trainees undertaking this course have accomplished some formal instruction in Terrestrial Navigation, have at minimum some familiarization with visual navigation, have accomplished a period of supervised bridge watch-keeping duties, and have prior completion of basic Radar/ARPA (MC 1.07). Trainees should also have considerable familiarization with personal computing operating systems, keyboards and mice or trackballs.

■ Course Certificate, diploma or document

Documentary evidence should be issued to those who have successfully completed this course indicating that the holder has completed training in the navigational use and operation of Electronic Chart Display and Information Systems (ECDIS) based on this model course.

■ Course delivery

The outcome of this course may be achieved through various methods, including simulation-based classroom and laboratory training, or in-service training, or combinations of these methods, such that each trainee is provided access to an ECDIS with ENC data for all required hours of practice and assessment in a controlled visual underway navigational environment.

Methods of distance learning or computer-based training may be used to supplement the familiarization stages of this course, but should not be substituted for the underway assessment of proficiency.

■ Course intake limitations

The maximum number of trainees should depend on the facilities and equipment available, bearing in mind the scope and objectives of this course.

The instructor – trainee ratio should be limited to 1:12. When a class size exceeds 12 trainees, an assistant instructor is required.

■ Staff requirements

The following are the minimum qualifications recommended for instructors delivering a course that follows the IMO Model Course 1.27. The instructor in charge should:

.1 hold relevant certificate of competency in the deck department or other qualification or experience at the discretion of the administration approving the course;

.2 have successfully completed an approved ECDIS course;

.3 have completed type specific familiarization relevant to the equipment used for training;

.4 have a detailed knowledge of the requirements of SOLAS chapters V/2, V/19, and V/20-27, as amended;

.5 have an up-to-date knowledge of the IMO ECDIS Performance Standards currently in force and knowledge of relevant STCW requirements and guidance;

.6 have an up-to-date knowledge of ENCs.

.7 be fully aware of current ENC data transfer standards and presentation libraries of the IHO, methods of ENC licensing and updating and current IMO recommendations on ECDIS software and other issues;

.8 have a current relevant teaching qualification or have successfully completed a Train-The-Trainer course, including the application of simulators in training and meets the requirements of STCW regulation I/6 and I/12.

Assistant instructors should have relevant knowledge of ECDIS operation.

■ Teaching Facilities and equipment

ECDIS simulation equipment must meet all applicable performance standards set out in Regulation I/12 of the STCW Convention and also should meet the guidance in Section B-I/12, as amended.

An example of equipment set up for ECDIS training has been provided in appendix 6.

ECDIS Classroom/Lab.

The lecture portion of the course can take place in any suitable classroom with adequate desk/seating space for all trainees. Standard classroom facilities must be available such as whiteboard/chalkboard, appropriate projection system, etc.

The practical demonstration and assessment portion of the course must take place in a space equipped to provide a suitable ECDIS simulator work station for each individual trainee. The necessity of mounting display monitors on the desk surfaces requires careful placement of all equipment and projection screens to maintain good visibility for all trainees.

In addition to the trainee work stations there must be an instructor station with dedicated projection system that will allow projection of the exercises and lecture materials. It is strongly recommended that there be display(s) networked to the instructor station, thereby allowing display(s) of ARPA and ECDIS information (or other training material) for the benefit of the trainees.

Note that the lecturing may take place in the same room as the simulation if the space is suitable. This would require adequate visibility around/over the workstations to the whiteboard/chalkboard and projection screens, and adequate work space for taking notes and written examinations.

■ Teaching aids (A)

A1 Instructor Manual (Part D of the course)
A2 Audiovisual aids: Video/DVD player, visual presentation, document projector, etc.
A3 Simulator providing ownship functionality in an underway navigational context
A4 ECDIS workstation including ENC data, deriving inputs from simulation or live sensors
A5 Electronic Navigational Chart (ENC) data, various, including permits, and update files
A6 Raster Navigational Charts (RNC) including permits and updates

■ Bibliography (B)

B1 NMEA Interface Standard 0183 v.3.01 (Severna Park, MD, National Marine Electronic Association, 1/2002)
B2 Facts about electronic charts and carriage requirements, 2nd Ed. (Finnish Maritime Administration: Primar Stavanger and IC-ENC, 5/2007)
B3 Gale, H. (2009) From Paper Charts to ECDIS. London: Nautical Institute
B4 Bole, et al. (2005) The Radar/ARPA Manual, 2nd ed., Chapter 10 “Ancillary Equipment”. Burlington, MA: Elsevier

B5 American Practical Navigator (Bowditch, Pub. No. 9), 2002 Ed., Chapter 14 “Electronic Charts”
B6 Simulator reference manual (Manufacturer, Date)
B7 User’s manual accompanying the ECDIS software utilized during the training course
B8 IEC 61174 – Maritime navigation and radiocommunication equipment and systems – Electronic chart display and information system (ECDIS) – Operational and performance requirements, methods of testing and required test results, Edition 3.0, International Electrotechnical Commission
B9 IHO S-66, Facts about electronic charts and carriage requirements, Edition Jan 2010
B10 IHO S-61, Product specifications for Raster Navigational Charts, Edition 1.0
B11 IHO S-52 Specifications for chart content and display aspects of ECDIS, 5th ed., as amended (IHB, 12/2001)
B12 IHO S-100 Universal Hydrographic Data Model, Ed. 1.0.0 (Monaco: IHB, 1/2010)
B13 IHO S-57, Electronic Navigational Chart (ENC), Edition 3.1

■ Electronic media (E)

E1 ECDIS, Seagull CBT, CD #64
E2 AIS, Seagull CBT, CD #109 v.A, 8/2003
E3 ECDIS Training Course, Videotel CBT #871, 5/2008

■ IMO references (R)

R1 Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), as amended
R2 1974 SOLAS Convention, Regulations V/19, V/20 and V/27, as amended 2009, IMO Res. MSC 282(86)
R3 Revised ECDIS Performance Standards, MSC.232(82), IMO, 12/2006
R4 ECDIS Performance Standards, IMO Resolution A.817(19) as adopted 11/1995, including Appendices 1 – 5, Appendix 6 as adopted 11/1996 Res. MSC.64(67), and Appendix 7 as adopted 12/1998 Res. MSC.86(70)
R5 IMO MSC.1/Circ.1391, Operating anomalies identified within ECDIS
R6 IMO SN.1/Circ.266/Rev. 1, Maintenance of Electronic Chart Display and Information System (ECDIS) Software
R7 Guidelines for Voyage Planning, IMO Res. A.893(21)
R8 COLREGS – International Regulations for Preventing Collisions at Sea, 1972, as amended

■ Textbooks (T)

T1 Norris, A. (2010) ECDIS and Positioning. London: The Nautical Institute
T2 Weintrit, A. (2009) The Electronic Chart Display and Information System (ECDIS): An Operational Handbook. Gydnia: Gydnia Maritime University, Poland, Balkema Book, CRC Press, Taylor & Francis Group
T3 Hecht, et al. (2011) The Electronic Chart, Fundamentals, Functions, Data and other Essentials A Textbook for ECDIS Use and Training (3rd Revised Edition) Lemmer, The Netherlands: Geomares Publishing
T4 The ECDIS Manual, ECDIS Ltd, Witherby Seamanship International, Edition 2012

Part B: Course Outline and Timetable

■ Overview

The following section presents the topics of the 40-hour ECDIS course in a simplified outline format. The 37 topics are organized into 5 general Subject Areas. The total hours are allocated in the following manner:

Practice & Lecture	Independent ECDIS navigation	Evaluation
29.0 hrs	**8.0 hrs**	**3.0 hrs**

The duration allocated to each topic is presented in the Course Timetable, and is repeated in Part C – Detailed Teaching Syllabus, and in Part D – Lesson Plans and Exercises. The Learning Objectives for each topic are presented generally in Part C, and with full detail in Part D.

As defined in Part A – Course Framework, the Classroom setting should provide one workstation for each trainee, and all workstations should be networked to the simulation instructor and server.

■ Course Outline

Subject Area and topics	Hours
Elements of ECDIS	9.5
1. Course introduction & familiarization plan	
2. Purpose of ECDIS	
3. Value to navigation	
4. Correct & incorrect use	
5. Workstation start, stop & layout	
6. Vessel position	
7. Position source	
8. Basic navigation	
9. Heading & drift vectors	
Ex.1 Simulator exercise – open sea (basic integrated navigation)	
10. Understanding chart data	
11. Chart quality & accuracy	
12. Chart organization	

Subject Area and topics	Hours
Watchkeeping with ECDIS 13. Sensors 14. Ports & data feeds 15. Chart selection 16. Chart information 17. Changing the settings 18. Chart scaling 19. Information layers Ex.2 Simulator exercise – coastal waters (chart display settings) 20. System & position alarms 21. Depth & contour alarms	9.0
ECDIS Route Planning and Monitoring 22. Vessel manoeuvring characteristics 23. Route planning by table 24. Route planning by chart 25. Track limits 26. Checking plan for safety Ex.3 Simulator exercise – coastal & restricted waters (navigation alarms & route scheduling) 27. Additional Navigational Information 28. Route schedule 29. User charts in route planning	9.0
ECDIS Targets, Charts & System 30. ARPA/Radar overlay 31. AIS functions 32. Procuring & installing chart data 33. Installing chart corrections Ex.4 Simulator exercise – restricted waters (advanced integrated navigation with ECDIS) 34. System reset & backup 35. Archiving ECDIS data and data logging	6.5
ECDIS Responsibility & Assessment 36. Responsibility 37. Effective navigation with ECDIS Ev.1 Written evaluation Ev.2 Simulator exercise – coastal & restricted waters (underway ECDIS navigation assessment)	6.0
Total	**40.0**

■ Course Timetable

Day/ Period	1st Period (2.0 hours)	2nd Period (2.0 hours)	3rd Period (2.0 hours)	4th Period (2.0 hours)
Day 1	**Elements of ECDIS** 1. Course introduction & familiarization plan 2. Purpose of ECDIS 3. Value to navigation 4. Correct & incorrect use	5. Workstation start, stop & layout 6. Vessel position 7. Position source	8. Basic navigation 9. Heading & drift vectors 10. Understanding chart data	Ex.1 Simulator exercise – open sea (basic integrated navigation)
Day 2	11. Chart quality & accuracy 12. Chart organization **Watchkeeping with ECDIS** 13. Sensors 14. Ports & data feeds	15. Chart selection 16. Chart information	17. Changing the settings 18. Chart scaling 19. Information layers	Ex.2 Simulator exercise – coastal waters (chart display settings)
Day 3	20. System & position alarms 21. Depth & contour alarms	**ECDIS Route Planning and Monitoring** 22. Vessel manoeuvring characteristics 23. Route planning by table	24. Route planning by chart 25. Track limits 26. Checking plan for safety	Ex.3 Simulator exercise – coastal & restricted waters (navigation alarms & route scheduling)
Day 4	27. Additional Navigational Information 28. Route schedule 29. User charts in route planning	**ECDIS Targets, Charts & System** 30. ARPA/Radar overlay 31. AIS functions	32. Procuring & installing chart data 33. Installing chart corrections	Ex.4 Simulator exercise – restricted waters (advanced integrated navigation with ECDIS)
Day 5	34. System reset & backup 35. Archiving ECDIS data and data logging	**ECDIS Responsibility & Assessment** 36. Responsibility	37. Effective navigation with ECDIS Ev.1 Written evaluation	Ev.2 Simulator exercise – coastal & restricted waters (underway ECDIS navigation assessment)

Note: Teaching staff should note timetables are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by instructors to suit individual groups of trainees depending on their experience and ability and on the equipment and staff available for training.

Part C: Detailed Teaching Syllabus

The detailed teaching syllabus has been written in learning objective format in which the objective describes what the trainee should do to demonstrate that knowledge has been transferred. All objectives are understood to be prefixed by the words, “The expected learning outcome is that the trainee…”.

In order to assist the instructor, reference publications are shown against the learning objectives in addition technical material and teaching aids, which the instructor may wish to use when preparing course material. The material listed in the course framework has been used to structure the detailed teaching syllabus; in particular:

Teaching aids (indicated by A);
Bibliography (indicated by B);
Electronic media (indicated by E);
IMO references (indicated by R); and
Textbooks (indicated by T)

will provide valuable information to instructors. The abbreviations used are:

add.:	addendum
app.:	appendix
art.:	article
ch.:	chapter
encl.:	enclosure
p.:	page
pa.:	paragraph
reg.:	regulation
sect.:	section
tab.:	table

■ Note

Throughout the course, safe working practices are to be clearly defined and emphasized with reference to current international requirements and regulations. It is expected that the institution implementing the course will insert references to national and/or regional requirements and regulations as necessary.

■ Learning Objectives

Subject Areas and topics have been outlined in Part B. In Part C, the Learning Objectives associated with each topic are provided, along with teaching aids and references. In Part D, the topics are referred to as Lesson Plans, and the Learning Objectives are further described in sufficient detail for the development of an ECDIS Instructor’s Manual. The Learning Objectives are presented in a verb-based manner to facilitate outcomes-driven learning and skills development. All Learning Objectives are understood to be prefixed by the phrase: “The expected learning outcome is that the trainee is able to . . . .”.

Bear in mind that the overarching competencies to be developed throughout the course are the “use of ECDIS to maintain the safety of navigation” (STCW, A-II/1, A-II/3, Operational Level) and “maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making” (STCW, A-II/2, Management Level). The ECDIS instructor should strive to present all of the Learning Objectives in or as close to the contexts of underway navigation as possible. Through practice and understanding of these Learning Objectives as tasks to master and apply, the trainee achieves the desired competence and which the instructor may assess in the scored final underway evaluation.

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
Elements of ECDIS (9.5 hours)		
1. Course introduction & familiarization plan (0.5 hour) 1.1. General introductions 1.2. Administration 1.3. Familiarization with ECDIS learning environment	A1 A3 A4	T3 ch.1 B6 B7
2. Purpose of ECDIS (0.5 hour) 2.1. Introduce revised IMO Performance Standards for ECDIS (June 2006, Resolution MSC.232(82)) 2.2. Differentiate between display options 2.3. Identify information types and areas on navigation display 2.4. Apply presentation of ECDIS data	A1 A2 A3 A4 A5	R3 T1 ch.3 & 10.3 T3 ch.2 B4 ch.10.2 B5 ch.14
3. Value to navigation (0.5 hour) 3.1. Recognize factors that characterize and modify chart presentation 3.2. Recognize factors that characterize and modify the data quality 3.3. Manually change scale, area & position of ownship 3.4. Evaluate the route monitoring mode of ECDIS operation 3.5. Explain the value of ECDIS to navigation	A1 A2 A3 A4 A5	T1 ch.6.8 T1 ch.8.5 T3 ch.11.1 & 11.2 B4 ch.11.2.2 & 11.2.3 & 11.3
4. Correct & incorrect use (0.5 hour) 4.1. Use ECDIS within the prevailing navigation situation 4.2. Recognize ways to avoid over-reliance on ECDIS 4.3. Proficiency in the use of ECDIS includes assessing the integrity of the system and all data at all times	A1 A2 A3 A4 A5	T1 ch.8.7 T3 ch.11.3.2 & 7.5 & 8.1.1 B2 B3
5. Workstation start, stop & layout (0.5 hour) 5.1. Perform standard ECDIS workstation start 5.2. Interpret the ECDIS start windows for sensors requested, sensors found, and selected chart data initializing 5.3. Examine alarms (if any) and determine initial conditions of ECDIS readiness for navigation	A1 A2 A3 A4 A5	T1 ch.1 T3 ch.7.3 B7
6. Vessel position (0.5 hour) 6.1. Review user interface methods 6.2. Review display of vessel's position 6.3. Examine position information in the display panels 6.4. Determine a position fix on the ECDIS chart display panel	A1 A2 A3 A4 A5	T1 ch.6.7 B7
7. Position source (1.0 hour) 7.1. Review basics of GNSS 7.2. Coordinate GNSS antenna position settings 7.3. Select position system 7.4. Determine fix quality (status) of GNSS	A1 A2 A3 A4 A5	T1 ch.2 T3 ch.7.5.5 & 8.1.1 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
8. Basic navigation (1.0 hour) 8.1. Activate display categories and information layers 8.2. Monitor vessel safety 8.3. Activate route monitoring features	A1 A2 A3 A4 A5	T1 ch.6.2 B7
9. Heading & drift vectors (0.5 hour) 9.1. Activate vessel's motion vectors 9.2. Obtain vessel's course and speed from the positioning system 9.3. Interpret the movement of the vessel 9.4. Recognize the effects of gyro error 9.5. Graphically monitor ownship's approach to isolated dangers by means of a guard ring	A1 A2 A3 A4 A5	T1 ch.8.1 R3 R4 B7
Ex.1 Simulator exercise – open sea (basic integrated navigation) (2.0 hours)	A3, A4, A5	
10. Understanding chart data (1.0 hour) 10.1. Define the relevant terminology of ECDIS 10.2. Describe the differences between electronic chart systems and ECDIS 10.3. Describe the various electronic chart data formats 10.4. Explain the relationship between ECDIS data and the information presented on the display 10.5. Explain that only information stored as objects with corresponding attributes in the database is available for display 10.6. Describe the chart data selected for display	A1 A2 A3 A4 A5 A6	T1 ch.1 & 4 T3 ch.4 & 7.2 & 6 B5 ch.14 B7 B10
11. Chart quality & accuracy (0.5 hour) 11.1. Explain what the accuracy of chart data is dependent upon 11.2. Explain the problems in ECDIS associated with variant datums 11.3. Assess all errors, inaccuracies and ambiguities caused by improper data management 11.4. Explain the need and requirement that electronic chart data must be systematically updated for safe navigation 11.5. Demonstrate issues pertaining to computer monitor display resolution	A1 A2 A3 A4 A5	T1 ch.9 T3 ch.5 B7
12. Chart organization (0.5 hour) 12.1. Introduce the organization of chart data distribution 12.2. Demonstrate the loading (retrieval) of ECDIS data	A1 A2 A3 A4 A5	T1 ch.6.3 T3 ch.10 & 7.2.2 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
Watchkeeping with ECDIS (9.0 hours)		
13. Sensors (0.5 hour) 13.1. Explain the performance limits of devices for position, course over ground, heading, speed, depth, radar, and AIS 13.2. Explain the need for selecting sensor data displayed in ECDIS that is appropriate, unambiguous and accurate 13.3. Evaluate the impairment of ECDIS performance when sensor performance deteriorates or fails 13.4. Explain and analyse various sensor alarms and indications	A1 A2 A3 A4 A5	T1 ch.2.16 & 6.1 & 6.5.1 T3 ch.8 B7
14. Ports & data feeds (0.5 hour) 14.1. Select between primary and secondary position source 14.2. Observe automatic change over to secondary position source 14.3. Explain the data reference system of each connected sensor 14.4. Identify the data port assigned to each connected sensor 14.5. Monitor, identify and to a limited extent decode the data stream for each attached sensor 14.6. Assess the plausibility of sensor input values to ECDIS 14.7. Assess the impact on displayed information when a sensor port is improperly selected	A1 A2 A3 A4 A5	T1 ch.8.2 & 8.3 B4 ch.10.4 B7
15. Chart selection (0.5 hour) 15.1. Demonstrate the variety of methods that chart data can be loaded and changed 15.2. Assess the inaccuracies and ambiguities caused by improper selection of a chart for display 15.3. Display updates in order to review content and to establish their inclusion in the SENC 15.4. Explain and analyse the data and chart alarms resulting from over-scaling 15.5. Explain and analyse the data and chart alarms resulting from use of a non-WGS84 datum	A1 A2 A3 A4 A5	T1 ch.6.4 & 9.1 T3 ch.5.3 & 7.2 B7 B8
16. Chart information (1.0 hour) 16.1. Select the task panel and apply the functions suitable for position monitoring, route monitoring, route creation and editing, trial manoeuvre, creating and accessing user-defined layers 16.2. Obtain information on charted objects 16.3. Demonstrate how the presentation of navigation marks is changed according to ownship position 16.4. Demonstrate errors of interpretation by the incorrect selection of display categories	A1 A2 A3 A4 A5 A6	T1 ch.6.4.6 T3 ch.7.2 B7 B10

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
17. Changing the settings (1.0 hour) 17.1. Manually test the major functions of hardware, keyboard, mouse/trackball, sensor data, and chart data 17.2. Check and/or select preferred operational settings in the primary task panels and on the primary information panel 17.3. Evaluate alarm and function status indications 17.4. Demonstrate errors of interpretation by the incorrect selection of safety values 17.5. Adjust track length and precision 17.6. Evaluate the range of information recorded in the log table (voyage recording)	A1 A2 A3 A4 A5	T1 ch.6.3 & 8.6 T3 ch.7.6 B7
18. Chart scaling (0.5 hour) 18.1. Demonstrate scaling of electronic chart display 18.2. Apply the automatic changing of chart scale ratio 18.3. Apply additional chart scale information 18.4. Recognize interpretation errors due to scaling	A1 A2 A3 A4 A5	T1 ch.6.4 T3 ch.7.2.4 B7
19. Information layers (1.0 hour) 19.1. Observe effect on information layers and status indications when chart data is loaded and when chart area is underscaled 19.2. Review and apply appropriate day/night palette, display category, and scale 19.3. Select information options in display category of “All other information” 19.4. Differentiate between information layers, user chart layers, and event graphic 19.5. Respond to the indicators representing the loss of displayed information	A1 A2 A3 A4 A5	T1 ch.6.5 & 6.9 & 7.3 T3 ch.7.5.6 & 7.2.1 & 7.3.2 B7
Ex.2 Simulator exercise – coastal waters (chart display settings) (2.0 hours)	A3, A4, A5	
20. System & position alarms (0.5 hour) 20.1. Identify and respond to alarms for primary and secondary positioning systems 20.2. Identify and respond to chart related alarms 20.3. Identify and respond to ECDIS alarms from autopilot in Track Control	A1 A2 A3 A4 A5	T1 ch.8.3 T3 ch.7.5.3 B7
21. Depth & contour alarms (1.5 hours) 21.1. Describe route monitoring alarms 21.2. Identify depth-related information 21.3. Set the safety values for route monitoring 21.4. Set the limits pertaining to safe water	A1 A2 A3 A4 A5	T1 ch.8.4 & 6.5 T3 ch.7.5 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
ECDIS Route Planning and Monitoring (9.0 hours)		
22. Vessel manoeuvring characteristics (0.5 hour) 22.1. Determine methods of alert for wheel over when approaching waypoints 22.2. The navigator must verify positioning especially when ECDIS is connected to autopilot	A1 A2 A3 A4 A5	T1 ch.8.5 T3 ch.7.5 & 8.3 B7
23. Route planning by table (1.0 hour) 23.1. Retrieve a stored route plan 23.2. Approve an existing route for planning, safety review and monitoring 23.3. Select the sea areas and the required waters for planning the whole passage 23.4. Construct a route plan by inputting waypoint data alphanumerically into a route-planning table 23.5. Adjust the route plan by editing, adding and deleting waypoints inside the table 23.6. Adjust curved track planning and wheel over indication 23.7. Establish procedures to name, link, rename, archive, retrieve and delete route files	A1 A2 A3 A4 A5	T1 ch.7.1 & 7.5 T3 ch.7.4 B7
24. Route planning by chart (2.0 hours) 24.1. Select the sea areas and the required waters for planning the whole passage 24.2. Construct a route by inputting waypoints directly on the ECDIS display 24.3. Adjust the route by graphically editing waypoints 24.4. Obtain track courses and distances from the chart 24.5. Obtain relevant route planning information	A1 A2 A3 A4 A5	T1 ch.7.2 & 7.3 T3 ch.7.4 B7
25. Track limits (0.5 hour) 25.1. Review the alarm settings used as vessel is proceeding along a monitored route 25.2. Modify the setting of XTE in a previously saved route	A1 A2 A3 A4 A5	T1 ch.6.5.3 & 8.3 T3 ch.7.5 B7
26. Checking plan for safety (0.5 hour) 26.1. Check a previously created and saved route for crossing dangers of navigation according to the setting of cross-track distance 26.2. Check the route as it is being created for dangers as listed above 26.3. Assess a route plan based on a safety check	A1 A2 A3 A4 A5	T1 ch.7.4 & 7.7 T3 ch.7.4 B7
Ex.3 Simulator exercise – coastal & restricted waters (navigation alarms & route scheduling) (2.0 hours)	A3, A4, A5	
27. Additional Navigational Information (0.5 hour) 27.1. Discuss various hydro-meteorological data that could be available in the ECDIS database (tides, currents, weather, etc.)	A1 A2 A3 A4 A5	T3 ch.7.5 & 7.7 & 15.1 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
28. Route schedule (0.5 hour) 28.1. Observe any deviation from the route schedule setting in use as vessel is proceeding along a route 28.2. Determine expected passage times 28.3. Observe calculations of progress along the planned route 28.4. Using the ETA application in ECDIS, calculate time or speed at a selected waypoint on a monitored route	A1 A2 A3 A4 A5	T1 ch.7.5 T3 ch.7.5 & 7.7 B7
29. User charts in route planning (1.5 hours) 29.1. Review the ECDIS function for creating mariner's notes (User Chart) 29.2. Determine effective policy regarding User Charts 29.3. Select User Chart for display 29.4. Use the graphic editor for creating and modifying a User Chart 29.5. Create, save and move an anchor circle guard zone on a User Chart	A1 A2 A3 A4 A5	T1 ch.7.3 T3 ch.7.3 B7
ECDIS Targets, Charts & System (6.5 hours)		
30. ARPA/Radar overlay (0.5 hours) 30.1. Examine sensor setup requirements for ARPA targets 30.2. Determine speed and heading inputs used in ARPA target data calculations 30.3. Access target information display 30.4. Interpret target symbol features 30.5. Operate the user interface controls for radar overlay 30.6. Demonstrate sources of image offset 30.7. Determine source of ECDIS-tracked target data calculations 30.8. Make corrections to own ship's position, using a reference point captured by ARPA.	A1 A2 A3 A4 A5	T1 ch.8.4.3 T3 ch.8.2.3 & 8.5 B7 T1 ch.8.4.4 T3 ch.8.2.1 & 8.2.2 & 11.1.5
31. AIS functions (0.5 hour) 31.1. Describe what the connection of an Automatic Identification System (AIS) to ECDIS enables 31.2. Examine sensor setup requirements for AIS targets 31.3. Determine alarms and other settings for AIS targets 31.4. Access target information display options 31.5. Interpret AIS target symbol features	A1 A2 A3 A4 A5	T1 ch.8.4.5 & 6.9 T3 ch.8.4 B4 ch.10.3 B7
32. Procuring & installing chart data (1.5 hours) 32.1. Review chart data structure, terminology, and installation procedures 32.2. Review chart format requirements for ECDIS 32.3. Examine data distribution sources for ENC 32.4. Examine data distribution sources for SENC conversions 32.5. Examine licence structure for various formats, and practise installation 32.6. Extract information on installation history	A1 A2 A3 A4 A5	T1 ch.4.4 T3 ch.9.2 & 9.3 & 9.4 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
33. Installing chart corrections (1.0 hour) 33.1. Explain why electronic chart data is maintained with up-to-date corrections 33.2. Add or modify a chart object using Manual Correction task 33.3. Examine production licence options for accessibility of automatic updates 33.4. Install various automatic update formats using various methods 33.5. Extract information on update history 33.6. Apply Temporary and Preliminary Corrections and Navigational Warnings.	A1 A2 A3 A4 A5	T1 ch.4.5 & 6.3 T3 ch.10 B7
Ex.4 Simulator exercise – restricted waters (advanced integrated navigation with ECDIS) (2.0 hours)	A3, A4, A5	
34. System reset & backup (0.5 hour) 34.1. Explain the intent of regulations on ECDIS back-up arrangements 34.2. Discuss back-up procedures in standalone ECDIS failure event 34.3. Discuss networked back-up procedures in (Master) ECDIS failure event 34.4. Discuss troubleshooting routines in ECDIS 34.5. Recognize consequences to navigation safety while troubleshooting 34.6. Recognize consequences to data storage while ECDIS workstation is down	A1 A2 A3 A4 A5	T1 ch.8.7 & 8.8 T3 ch.11.3 & 11.4 B7
35. Archiving ECDIS data and data logging (0.5 hour) 35.1. Discuss ECDIS data management to work with files associated with ECDIS operations 35.2. Discuss ECDIS data management to transfer selected data files between storage media 35.3. Examine requirements and functions of logbook task in ECDIS 35.4. Examine display functions of ownship track and tracks of AIS, and ARPA targets 35.5. Perform various hard copy print outs	A2 A4 A1 A3 A5	T1 ch.8.6 T3 ch.7.6 & 13.9 B7

Knowledge, Understanding and Proficiency	Teaching Aid	Reference
ECDIS Responsibility & Assessment (6.0 hours)		
36. Responsibility (2.0 hours)	A1	R1
36.1. Review COLREGS	A2	R3
36.2. Review SOLAS, as amended		B11
36.3. Review IMO approval of equipment and installations		B12
36.4. Review IMO carriage requirements		B13
36.5. Review national ECDIS carriage regulations (if applicable)		R7
36.6. Review STCW Code, as amended		T1 ch.5
36.7. Review flag state (maritime) implementation		T3 ch.13.4
36.8. Review IMO training Guidance (and providing review of course)		
36.9. Review ISM and IMO requirements of ship owners & operators		
36.10. Review IHO relevant regulations.		
36.11. Review the need to ensure that ECDIS software is kept up to date.		
37. Effective navigation with ECDIS (1.0 hour)	A1	T1 ch.10.2
37.1. Describe bridge functions incorporating ECDIS	A2	T3 ch.7.3 & 8.1 & 11.2 & 16
37.2. Re-examine sample bridge operating procedures addressing ECDIS		R5, R6
37.3. Define safe and practical navigation with ECDIS		
37.4. Knowledge of the anomalies that ECDIS is susceptible to		
Ev.1 Written evaluation (1.0 hour)		
Ev.2 Simulator exercise – coastal & restricted waters (underway ECDIS navigation assessment) (2.0 hours)	A3, A4, A5	

Part D: Instructor Manual

■ Guidance for instructors

The course outline and timetable (Part B) provide guidance on the time allocation for the course material, but the instructor is free to modify this if it is deemed necessary. The detailed teaching syllabus (Part C) must be studied carefully and, where appropriate, lesson plans or lecture notes compiled with Part D providing the basis from beginning to end of the course. Evaluation and assessment guidance are provided in Part E.

The lesson plans and exercises of this part are meant to provide the ECDIS navigation instructor with the material for a course instruction manual. Specifically, the Learning Objectives presented in the previous parts of the Model Course document are fleshed out in considerable detail in Part D. The details of this part reflect the views of the course developers with respect to methodology and organization as well as what they consider relevant and important in light of their experience as instructors and as navigator who have succeeded in applying ECDIS to bridge watchkeeping. Although the lessons, exercises, and assessment methods should be of value initially, each instructor should develop his/her own methods and ideas, recognize and refine what is successful, and discard that which does not work satisfactorily. It is particularly important for the instructor to adapt content to the specific ECDIS being utilized in the training environment. Despite the ECDIS Performance Standards, there is limited commonality among type-approved ECDIS units. Adaptation is also advised for review of flag state regulations, as appropriate.

As noted in the foregoing parts, this 40-hour course is comprised of 40 Lesson Plans, 4 practice exercises, and a final underway assessment exercise. These are divided according to the five primary stages of the course:

1 Elements of ECDIS (9.5 hours)

2 Watchkeeping with ECDIS (9.0 hours)

3 ECDIS Route Planning (9.0 hours)

4 ECDIS Charts, Targets & System (6.5 hours)

5 ECDIS Responsibility (6 hours)

Preparation and planning are the most important criteria in effectively presenting this course. Availability and proper use of course materials is also essential for maximum efficacy in conveying the subject to trainees. The capabilities and limitations of the teaching facilities in use may dictate that the learning objectives be adjusted but it is suggested that this be kept to a minimum.

Due to the considerable challenges and complexities faced by trainees learning to navigate safely using ECDIS, it is vital for the instructor to recognize that successful underway assessments require as much hands-on practice as possible. As discussed in the Introduction to the navigational use of ECDIS (2010 Edition), lecturing and demonstration and the opportunity for individual use applies to nearly all learning objectives in nearly all topics. It will be necessary for instructors to prepare for the presentation of specific learning objectives in the context of underway scenarios for both classroom demonstration and practice, and for the independent navigation environment. The development of other materials, such as

a compilation on a CD of handy reference material, is also strongly suggested. An index of useful files and documents is provided in the "Appendices for the Instructor" part of this course.

■ Lesson Plans: Elements of ECDIS (9.5 hours)

1. Introduction & familiarization plan (0.5 hour)
2. Purpose of ECDIS (0.5 hour)
3. Value to navigation (0.5 hour)
4. Correct & incorrect use (0.5 hour)
5. Work station start, stop & layout (0.5 hour)
6. Vessel position (0.5 hour)
7. Position source (1.0 hour)
8. Basic navigation (1.0 hour)
9. Heading & drift vectors (0.5 hour)
10. Understanding chart data (1.0 hour)

Ex.1 Simulator Exercise – Open sea (basic integrated navigation) (2.0 hours)

11. Chart quality & accuracy (0.5 hour)
12. Chart organization (0.5 hour)

1. Introduction & familiarization plan (0.5 hr)

The instructor explains the goals of the 40-hour course; and the trainee becomes familiar with the layout of the ECDIS equipment at the workstations and on the bridge simulator (Refs: T3 ch.1; B6; B7).

1.1. General introductions:

- Define the goals of the course and course certification,
- Verify that all trainees have basic computer skills (objective assessment),
- Explain the course structure and attendance requirements,
- Explain the evaluation process,
- Explain that trainees will achieve an understanding of type-approved ECDIS in general, and proficiency specifically in the use of system in use in the course.

1.2. Administration:

- Issue study guides and other reference material,
- Review course syllabus.

1.3. Familiarization with ECDIS learning environment:

- Work station power-up and ECDIS software start and stop,

- Use the projector to show how you will demonstrate ECDIS functions,
- Explain how to get information from the ECDIS User Manuals,
- Explain Help structure within ECDIS software package, and
- Briefly tour classroom and lab used for ECDIS navigation training to see navigation and control equipment.

2. Purpose of ECDIS (0.5 hr)

The instructor explains the main characteristics of ECDIS data display, and recognizes which information is constantly displayed by ECDIS and which is selectable (Refs: R3; T1 ch.3 & 10.3; T3 ch.2; B4 ch.10.2; B5 ch.14).

2.1. Introduce revised IMO Performance Standards for ECDIS (June 2006, Resolution MSC.232(82)):

- ECDIS definition,
- Capability of displaying all chart information necessary for safe and efficient navigation,
- Swiftly enables positioning, route monitoring and route planning,
- Provides appropriate alarms and indications.

2.2. Differentiate between display options:

- Electronic navigational chart (ENC) and system ENC (SENC),
- Standard display and display base,
- Display of information other than ENC data.

2.3. Identify information types and areas on navigation display:

- Electronic chart area, Information area, Task panels, other menu options,
- Automatic displays for monitoring ship's safety including position, gyro heading, speed log, time, and safety values, course over ground and speed over ground.

2.4. Apply presentation of ECDIS data:

- Major rules of presentation library,
- Automatic presentation, such as scale, display category, day/night, etc.,
- Modes, such as true motion and North-up.

3. Value to navigation (0.5 hr)

The trainee recognizes that safe navigation with ECDIS requires the selection and analysis of displayed information that is relevant to the prevailing situation (Refs: T1 ch.6.8; T1 ch.8.5; T3 ch.11.1 & 11.2; B4 ch.11.2.2 & 11.2.3 & 11.3).

3.1. Recognize factors that characterize and modify chart presentation:

- Projection, colours, symbols,
- Assessment of differences.

3.2. Recognize factors that characterize and modify the data quality:

- Accuracy, resolution, completeness,
- Assessment of differences.

3.3. Manually change scale, area & position of ownship:

- Chart (or sea) area and scale,
- Position of ownship relative to display edge

3.4. Evaluate the route monitoring mode of ECDIS operation:

- Route monitoring mode,
- Navigation mode.

3.5. Explain the value of ECDIS to navigation:

- Ownship position with respect to route, shipping lanes, acquired targets, depth contours, soundings, and predicted tides and currents,
- Multi-chart loading, scaling, on-chart object information,
- Centralized information station for navigational bridge team, including ERBL, user layers, radar target tracking, SAR, Navtex, AIS, climate, and port information.

4. Correct & incorrect use (0.5 hr)

The trainee assesses the role of ECDIS within the totality of the navigation process (Refs: T1 ch.8.7; T3 ch.11.3.2 & 7.5 & 8.1.1; B2; B3).

4.1. Use ECDIS within the prevailing navigation situation:

- Name the principles of navigation and operational guidance for officers in charge of a navigational watch (STCW, SOLAS),
- Review the many areas of bridge operations to which ECDIS may be applied,
- Situational awareness includes the functioning of navigational aids and the reliability of sensors,
- ECDIS is a powerful and comprehensive navigational system yet its use does not eliminate the need to verify the information using other means
- A navigational watch is not to be performed on only one system (mostly unavoidable in this simulation and proficiency training).

4.2. Recognize ways to avoid over-reliance on ECDIS:

- A system malfunction and data inaccuracy is always a potential,

- The displayed hydrographic data are not more reliable than the survey data they are based on,
- The displayed sensor data are not more reliable than the respective originating sensor system,
- Errors/inaccuracies in one subsystem may degrade others and can potentially render ECDIS useless.

4.3. Proficiency in the use of ECDIS includes assessing the integrity of the system and all data at all times.

- However, such use should be integrated into standing a normal watch including a competent visual lookout, and the continued maintenance of good situational awareness.
- One method of accomplishing this it to go to the ECDIS with a single purpose or query within a strict and brief time limit, rather than to browse or surf menus and information panels. Keeping to a 7-second glance as a scanning technique helps produce an integrative role for ECDIS.
- Another method is to overcome the problem of partial use – the less thoroughly the ECDIS is used and applied, the less willing the users become to apply ECDIS to navigation, resulting in less familiarity and less trust.

5. Workstation start, stop & layout (0.5 hr)

The trainee analyses and assesses the proper functioning of ECDIS during the booting-up process and normal operation (Refs: T1 ch.1; T3 ch.7.3; B7).

5.1. Perform standard ECDIS workstation start:

- Recognize that some sensor feeds may need to be off or disconnected from ECDIS workstation com ports, and that the ECDIS workstation is subject to all normal limitations of hardware, operating system, and memory
- ECDIS is a navigation aid and has:
  - Potential limitations in hard drive storage, RAM size, power supply interruptions, hardware malfunctions, overall system lockup, etc.,
  - Operating system (typically Windows) boot-up procedures and internal tests,
  - A pre-programmed “dongle” installed in the parallel printer port which enables the registration and use of the ECDIS manufacturer’s products,
  - The potential to fail due to incorrect use of OS and ECDIS software.

5.2. Interpret the ECDIS start windows for sensors requested, sensors found, and selected chart data initializing:

- Recognize the significance of the ECDIS Activator Key (dongle) and associated licence files

- The ECDIS software boots up (loads) with:
  - A small indicator window against the desktop background, then
  - A full screen panel indication of initialization, then
  - The ECDIS basic display with alarm indicators (if any) requiring acknowledgement.

5.3. Examine alarms (if any) and determine initial conditions of ECDIS readiness for navigation

- The ECDIS initialization screen indicates on-line tests:
  - For date/time, position, heading, and speed log,
  - Displays “Received” when these inputs match expected protocols (“Received” status is not a check on data accuracy),
  - Displays “Aborted” when these inputs are missing or corrupt,
  - Boot-up without inputs will continue, with alarms on ECDIS display,
  - ENC data will be loaded from the chart files as licensed.

6. Vessel position (0.5 hr)

The trainee operates basic navigational functions and settings pertaining to vessel position information (Refs: T1 ch.6.7; B7).

6.1. Review user interface methods:

- Mouse/trackball and device buttons,
- Keyboard and hotkeys,
- Control of standard cursor and free mouse cursor,
- Use of cursor and ERBL on the display.

6.2. Review display of vessel’s position:

- Shift the vessel on the display in navigation mode,
- Vessel’s symbols,
- Vessel’s GNSS position information (details reviewed in Lesson 07),
- Track of vessel’s position (details reviewed in Lesson 08),
- Vessel’s motion vectors (details reviewed in Lesson 09).

6.3. Examine position information in the display panels:

- System (tidal height, current, sounding, set and drift at position),
- Route (vessel position on the route),
- Pilot (position relative to next WP as per route schedule data).

6.4. Determine a position fix on the ECDIS chart display panel:

- Manually draw and move bearing lines (LOPs),
- Manually mark position on the display.

7. Position source (1.0 hr)

The trainee recognizes the principal features of GNSS as the primary vessel position source (Refs: T1 ch.2; T3 ch.7.5.5 & 8.1.1; B7).

7.1. Review basics of GNSS:

- Satellite constellation, theory, atmospheric interference,
- Signal quality indication, HDOP, data age, station ID,
- Accuracy (2drms probability).

7.2. Coordinate GNSS antenna position settings:

- Set GNSS antenna locations from amidships and off centreline (Consistent Common Reference Point – CCRP)
- Switch on primary and secondary position sources by assigning ports for NMEA/ IEC 61162 data feed

7.3. Select position system:

- Primary Position Sensor
- Secondary Position Sensor
- Auto change (automatic switching to dead reckoning position).

7.4. Determine fix quality (status) of GNSS:

- Position information,
- Alarms and indications of disruptions of GNSS data feed,
- Tracking the discrepancy between Primary Position Sensor and Secondary Position Sensor,
- Monitoring the GNSS data port,
- Check ship's position by a second independent means.

8. Basic navigation (1.0 hr)

The trainee operates many of the basic navigational functions and settings (Refs: T1 ch.6.2; B7).

8.1. Activate display categories and information layers:

- Base, Standard, All and Custom,
- Spot soundings limit (depths <= safe setting are displayed as bold),

- Channel limits, fairways, landmarks, special areas, warnings,
- Message “Layers Lost” when any are turned off.

8.2. Monitor vessel safety:

- Recognize position, gyro, speed log, COG, SOG, time,
- Set a safe depth value from sea level with regards to Isolated Dangers,
- Set a safe depth contour,
- Identify contours shown in Base Display,
- Identify other Base Display information that cannot be turned off.

8.3. Activate route monitoring features:

- Track, log, drift summary, sensor status, target tracks, scale, route information, contours, isolated dangers, special areas, alarm limits,
- Activate day/night colour sets, track display, scale bar, vessel symbol,
- Set voyage recording (Logbook) track period, precision, colour, history, routing information, filters.

9. Heading & drift vectors (0.5 hr)

The trainee operates basic navigational functions and settings pertaining to ownship’s heading vector, course over ground vector, and guard ring (Refs: T1 ch.8.1; R3; R4; B7).

9.1. Activate vessel’s motion vectors:

- Turn either or both vectors on or off,
- Alignment of vessel contour,
- Set vector length.

9.2. Obtain vessel’s course and speed from the positioning system:

- COG & SOG may be from position system or from ARPA reference,
- HDG is true or undefined (manual entry only when in DR),
- LOG may be bottom, water, ARPA, or position system referenced.

9.3. Interpret the movement of the vessel:

- The graphical difference between the COG/SOG and the HDG/LOG vectors is the drift angle,
- Display of drift angle reveals vessel momentum in a turn,
- Drift angle in steady state reveals sum of wind and current on vessel.

9.4. Recognize the effects of gyro error:

- Drift angle results from gyro data without any provision for correction,
- Gyro precession due to high-speed turns produces an unreliable HDG display on ECDIS.

9.5. Graphically monitor ownship's approach to isolated dangers by means of a guard ring or equivalent ECDIS function

Ex. 1. Simulator exercise – open sea (2.0 hours)

The trainee operates specific functions constituting task groups for route monitoring in an open sea area, and obtains all relevant information for basic safe integrated navigation.

- Demonstrate the following tasks on ECDIS while navigating safely in an open sea setting with non-threatening ARPA targets:
  - Monitor sea area,
  - Use the pre-defined route as set by the instructor,
  - Check position with pre-defined fix,
  - Select pre-defined user layers,
  - Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations.
- Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations.

Instructor guidelines

- Conduct simulation exercise according to exercise description:
  - Set simulation parameters,
  - Provide trainees with a pre-defined route,
  - Brief and debrief trainees,
  - Assess accomplishment of tasks according to exercise description.

Expected outcomes:

- Familiarize with the use of ECDIS
- Navigate with ECDIS
- Monitor SOG and COG

10. Understanding chart data (1.0 hr)

The trainee describes the types of electronic charts, and explains the characteristics of ECDIS data or system electronic navigational chart (SENC) (Refs: T1 ch.1 & 4; T3 ch.4 & 7.2 & 6; B5 ch.14; B7).

10.1. Define the relevant terminology of ECDIS.

10.2. Name the differences between electronic chart systems and ECDIS:

- Different ECDIS systems,
- ECDIS and ECS,
- Vector and raster charts.

10.3. Describe the various electronic chart data formats:

- Vector data,
- Raster data.

10.4. Explain the relationship between ECDIS data and the information presented on the display:

- ECDIS database and its structure,
- ENC data and the SENC,
- How manual updates are stored in the database,
- Steps and responsibilities during ENC creation.

10.5. Explain that only information stored as objects with corresponding attributes in the database is available for display.

10.6. Describe the chart data selected for display.

11. Chart quality & accuracy (0.5 hr)

The trainee assesses all errors, inaccuracies and ambiguities in the SENC caused by improper data management (Refs: T1 ch.9; T3 ch.5; B7).

11.1. Explain what the accuracy of chart data is dependent upon:

- Accuracy of survey and all hydrographic data,
- Shifting of buoys,
- Coverage and completeness of chart data.

11.2. Explain the problems in ECDIS associated with variant datums:

- Different reference systems used for positioning (time, direction, speed),
- The effects of datum (horizontal, vertical),
- Different geodetic coordinate systems.

11.3. Assess all errors, inaccuracies and ambiguities caused by improper data management.

11.4. Explain the need and requirement that electronic chart data must be systematically updated for safe navigation.

11.5. Demonstrate issues pertaining to computer monitor display resolution:

- Potential distortions in chart scale,
- The amount of information that appears on the screen,
- Display adapter and the Desktop Area Setting,
- Troubleshooting display problems.

12. Chart organization (0.5 hr)

The trainee handles ECDIS data at the workstation (this knowledge will be expanded upon and exercised in Lessons 15, 33 & 34) (Refs: T1 ch.6.3; T3 ch.10 & 7.2.2; B7).

12.1. Introduce the organization of chart data distribution:

- Explain the organization of chart data by the processes of procurement (downloading), installation (also applies to updates), selection of chart type (format), initialization, and loading (autoload by position) (reviewed again in Lesson 33)
- Demonstrate the chart data manager application associated with the type approved ECDIS
- Describe the chart data file structure associated with the type approved ECDIS

12.2. Demonstrate the loading (retrieval) of ECDIS data:

- Automatically from the directory of available chart data for the vessel's position
- Automatically from the directory of available chart data for the cursor location
- Manually by chart (cell) name from the directory of available data

■ Lesson Plans: Watchkeeping with ECDIS (9.0 hours)

13. Sensors (0.5 hour)
14. Ports & data feeds (0.5 hour)
15. Chart selection (0.5 hour)
16. Chart information (1.0 hour)
17. Changing the settings (1.0 hour)
18. Chart scaling (0.5 hour)

Ex.2 Simulator Exercise – Coastal (chart display settings) (2.0 hours)

19. Information layers (1.0 hour)
20. System & position alarms (0.5 hour)
21. Depth & contour alarms (1.5 hours)

13. Sensors (0.5 hr)

The trainee describes the performance limits of sensors and assesses their impact on the safe use of ECDIS (Refs: T1 ch.2.16 & 6.1 & 6.5.1; T3 ch.8; B7).

13.1. Explain the performance limits of devices for position, course over ground, heading, speed, depth, radar, and AIS, especially concerning:

- Availability,
- Accuracy,
- Integrity.

13.2. Explain the need for selecting sensor data displayed in ECDIS that is appropriate and unambiguous, and accurate.

13.3. Evaluate the impairment of ECDIS when sensor performance deteriorates.

13.4. Explain and analyse various sensor alarms and indications:

- Activated when ECDIS receives no data from the external output device,
- Where sensor alarms and indications are displayed as they occur,
- Use Alarm button or free cursor on 2nd-line message to disable the sound and message from the display,
- Alarm submenu function remains orange parameter returns to set limits, or when function is deliberately turned off,
- Correct response is to check the operation and connection of the relevant sensor.

14. Ports & data feeds (0.5 hr)

The trainee recognizes and selects data ports, and assesses sensor input values (Refs: T1 ch.8.2 & 8.3; B4 ch.10.4; B7).

14.1. Select between primary and secondary position source.

14.2. Observe automatic change over to secondary position source.

14.3. Explain the data reference system of each connected sensor:

- Geodetic system,
- Antenna position,
- Transducer position,
- Clock or time source.

14.4. Identify the data port assigned to each connected sensor.

14.5. Monitor, identify and to a limited extent decode the data stream for each attached sensor:

- Select a sensor and monitor the data stream (live or simulated),
- Generally recognize the sentence syntax associated with the sensor,
- Where possible, associate data with displayed navigational information.

14.6. Assess the plausibility of sensor input values to ECDIS.

14.7. Assess the impact on displayed information when a sensor port is improperly selected.

15. Chart selection (0.5 hr)

The trainee demonstrates manual and automatic selection of charts, and explains the potential error of the ECDIS display due to improper chart selection (Refs: T1 ch.6.4 & 9.1; T3 ch.5.3 & 7.2; B7).

15.1. Demonstrate the variety of methods that chart data can be loaded and changed:

- Automatically
- Manually for the presently loaded route
- Manually from the total portfolio
- Manually displayed by the cursor position
- During the activity of the operator using the graphics cursor (further detail is provided in Lessons 23 & 24 on Route Planning and in Lesson 29 on User Charts)

15.2. Assess the inaccuracies and ambiguities caused by improper selection of a chart for display:

- When ownship position is on display, chart data list is sorted by scale
- When ownship position is not on display (viewing elsewhere), chart data list is sorted by name (alpha)
- ECDIS displays largest scale data (smallest area) on the topmost layer, but the user may prioritize by format, especially ENC to keep ECDIS in the ECDIS mode
- Automatic chart loading may be switched on or off or held to a user-selected chart (fixed)

15.3. Display updates in order to review content and to establish their inclusion in the SENC:

- Review their contents
- Determine that they have been included in the SENC

15.4. Explain and analyse the data and chart alarms resulting from overscaling (zooming in) and underscaling (zooming out).

15.5. Explain and analyse the data and chart alarms resulting from use of a non-WGS 84 geodetic datum.

16. Chart information (1.0 hr)

The trainee matches presentation to situation, and demonstrates how to get the information about the chart and chart objects (Refs: T1 ch.6.4.6; T3 ch.7.2; B7).

16.1. Apply the functions suitable for position monitoring, route monitoring, route creation and editing, trial manoeuvre, creating and accessing user-defined layers:

- Continuous positioning while monitoring navigation,
- Trial manoeuvres,
- Route planning and scheduling,
- Creating User Charts,
- Other functions

16.2. Obtain information on charted objects:

- For vector charts,
- For raster charts, information is available only for the same frame size of a matching vector chart as described above

16.3. Demonstrate how the presentation of navigation marks is changed according to ownship's position.

16.4. Demonstrate errors of interpretation by the incorrect selection of display categories.

17. Changing the settings (1.0 hr)

The trainee demonstrates how to verify the operational settings and to assess that the navigational process is safe (Refs: T1 ch.6.3 & 8.6; T3 ch.7.6; B7).

17.1. Manually test the major functions of hardware, keyboard, mouse/trackball, sensor data, and chart data.

17.2. Check and/or select preferred operational settings in the relevant task panels and on the primary information panel:

- Primary task panels
- Primary information panel
- Ship, Alarm, Chart, Logbook, ARPA
- Configuration, Add Information (user layers), Route

17.3. Evaluate alarm and function status indications:

- Alarms, time, position update, heading and speed log
- Route keeping, heading vectors, chart scale, track, logbook functions

17.4. Demonstrate errors of interpretation by the incorrect selection of safety values:

- Safety depth; Safety contour
- Least depth alarm; anti-grounding alarms
- Alarms for sailing along a route

17.5. Adjust track length and precision.

17.6. Evaluate the range of information recorded in the log table (voyage recording):

- Check navigational conditions (ownship progress, charts displayed, etc.)
- Check routing events (including manual notations)
- Check system events
- Display additional data groups

18. Chart scaling (0.5 hr)

The trainee demonstrates the use of chart scaling and explains and avoids interpretation errors due to scale (Refs: T1 ch.6.4; T3 ch.7.2.4; B7).

18.1. Demonstrate scaling of electronic chart display:

- (Scale) and select scale value,
- With chart autoload switched on, use zoom function
- (Zoom) and use cursor to draw quadrangle around area to view

18.2. Use to display electronic chart on the same scale as the original paper chart.

18.3. Apply additional chart scale information:

- Horizontal screen span,
- Display of chart scale, scale bar, and bold-thin scale angle,
- Calculated range (distance) across screen display for scale in use,
- Warning messages associated with scale choice

18.4. Recognize interpretation errors due to scaling:

- Overscale of the display will spread out chart and user information with the possible loss of familiar cues for estimating distance
- Underscale of the display may cause some information to be hidden
- Underscale with SCAMIN off will result in unacceptable clutter due to data density
- Verify the selection of the appropriate scale

19. Information layers (1.0 hr)

The trainee demonstrates understanding and proficient use of information layers (Refs: T1 ch.6.5 & 6.9 & 7.3; T3 ch.7.5.6 & 7.2.1 & 7.3.2; B7).

19.1. Observe effect on information layers and status indications when chart data is loaded and when chart area is underscaled:

- Determine native scale of chart data as it is loaded,
- Observe function of SCAMIN on and off when a chart area is underscaled (zoomed too far out)
- Observe indication of scale value
- Layers additional to ENC must not be excessive so as to obscure the standard display

19.2. Review and apply appropriate display mode:

- Day or night presentation,
- Scale,
- Display category

19.3. Practise selecting information options in display category of "All other information".

19.4. Differentiate between information layers, User Chart layers, and Event graphic:

- Information layers (chart display categories) and User Chart layers,
- The addition and removal of own chart entries such as manual corrections and voyage planning notes,
- The addition of Event on the display and notations made in Logbook

19.5. Respond to the indicators representing the loss of displayed information:

- Layers Lost,
- Position Dropped

Ex. 2. Simulator exercise – open sea (2.0 hours)

The trainee operates specific functions constituting task groups for route monitoring in an open sea area, and obtains all relevant information for basic safe integrated navigation.

- Demonstrate the following task groups on ECDIS while navigating safely in an open sea setting with non-threatening ARPA targets:
  - Monitor sea area,
  - Use pre-defined route as set by the instructor,
  - Check position with pre-defined fix,
  - Select pre-defined user layers,
  - Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations.

Instructor guidelines

- Conduct simulation exercise according to exercise description:
  - Set simulation parameters
  - Provide pre-defined route to the trainee
  - Practise remote monitoring of trainees' ECDIS use
  - Brief and debrief trainees
  - Assess accomplishment of tasks according to exercise description

Expected outcomes:

- Navigate with ECDIS
- Individual watchkeeping
- Appropriate selection of user layers and alarms
- Successful fix of manual position

20. System & position alarms (0.5 hr)

The trainee explains the status indications and alarms pertaining to system and position, and demonstrates the proper responses (Refs: T1 ch.8.3; T3 ch.7.5.3; B7).

20.1. Identify and respond to alarms for primary and secondary positioning systems, such as:

- Primary (Secondary) Failure,
- Prim. (Sec.) Diff. Mode Loss,
- Prim/Sec Pos Diverge,
- Echo Ref. Loss,
- Primary (Secondary) Data not WGS84,
- Primary (Secondary) Unreliable Position

20.2. Identify and respond to chart related alarms, such as:

- Off Chart,
- No Official Data,
- Datum Unknown,
- AG (Anti-grounding) Monitoring Off

20.3. The instructor should particularly emphasize which alarms have user settings and teach a sensible approach to establishing suitable settings. In particular, going over the alarm/indicator setting controls for "approaching an area with special conditions" is highly important as incorrect settings cause very frequent alarms that distract the operator.

21. Depth & contour alarms (1.5 hrs)

The trainee explains the status indications and alarms pertaining to depth and contours in route planning and monitoring, and demonstrates the proper responses (Refs: T1 ch.8.4 & 6.5; T3 ch.7.5; B7).

21.1. Describe route monitoring alarms, such as:

- Crossing a safety contour
- Prohibited or other area
- Track error allowance (XTE)
- Waypoint arrival circle
- Safety Contour changed

21.2. Identify depth-related information, such as:

- Safe water depth
- Charted obstruction
- Depth sounder related alarms
- Depth from sounder
- Depth value of Safety Contour

21.3. Set the safety values for route monitoring:

- Safety Contour will only utilize an existing depth contour in the chart data
- Set the value for a Safety Contour to represent preferred underkeel clearance
- Set the value for Safety Depth
- Set the value for spot sounding display category

21.4. Set the limits pertaining to safe water, such as:

- Apply the ENC option of four shades
- Shallow Contour should be set to represent nothing less than ownship's deep draft
- Navigational Danger
- Depth sounder limit
- Set an advance time for approaching the set safety contour
- In tidal waters, it is sometimes necessary to navigate in waters less deep than the safety contour. Emphasis should be placed on using all other information mode.

■ Lesson Plans: ECDIS Route Planning and Monitoring (9.0 hours)

22. Vessel manoeuvring characteristics (0.5 hour)
23. Route planning by table (1.0 hour)
24. Route planning by chart (2.0 hours)
25. Track limits (0.5 hour)
26. Checking plan for safety (0.5 hour)
27. Additional Navigational Information (0.5 hour)
28. Route schedule (0.5 hour)
29. User charts in route planning (1.5 hours)

Ex.3 Simulator Exercise – Coastal waters (2.0 hours)

22. Vessel manoeuvring characteristics (0.5 hr)

The trainee demonstrates the use of ship's particulars in the display of route planning and maneuvering information, and explains the possible errors of interpretation (Refs: T1 ch.8.5; T3 ch.7.5 & 8.3; B7)

22.1. Determine methods of alert for wheel over when approaching waypoints, such as:

- Turn radius manoeuvring characteristics of ownship apply to curved track in ECDIS route planning
- Arrival circle centred on waypoint with circumference intersecting wheel over point on ECDIS route

22.2. Discuss the need for the navigator to verify positioning especially when ECDIS is connected to autopilot:

- Generally, only the "observed position" is controlled
- Where an ECDIS curved predictor is provided, caution to be exercised as it may only project a momentary rate of turn, rather than sophisticated hydrodynamic calculations, and therefore have limited accuracy

23. Route planning by table (1.0 hr)

The trainee operates all specific functions and obtains all relevant information for route planning by table (Refs: T1 ch.7.1 & 7.5; T3 ch.7.4; B7).

23.1. Retrieve a stored route plan:

- For use in route monitoring
- For planning and review
- Rename as working route to allow ad hoc changes while underway
- Obtain track courses and distances from list of waypoints as displayed in the table.

23.2. Approve an existing route for planning, safety review and monitoring:

- Apply systematic methods of examination
- Utilize appropriate chart data intended for use along the route
- Set alarm parameters
- Adjust cross track zones
- Scale in on charts for safety check analysis
- Check route for date dependent data

23.3. Select the sea areas and the required waters for planning the whole passage.

23.4. Construct a route plan by inputting waypoint data alphanumerically into a route-planning table.

23.5. Adjust the route plan by editing, adding and deleting waypoints inside the table.

23.6. Review curved track planning and wheel over indication:

- Ownship manoeuvring characteristics,
- Requirements of planning a safe passage including waypoint spacing

23.7. Establish procedures to name, link, rename, archive, retrieve and delete route files:

- Naming, linking and re-naming techniques for Route files
- Archiving route plans
- Deleting route plans

24. Route planning by chart (2.0 hrs)

The trainee operates all specific functions and obtains all relevant information for route planning graphically by chart (Refs: T1 ch.7.2 & 7.3; T3 ch.7.4; B7).

24.1. Select the sea areas and the required waters for planning the whole passage.

24.2. Construct a route by inputting waypoints directly on the ECDIS display.

- It is advisable to rough-in the route legs at first (using rhumb line and great circle)
- Fine-tune the waypoint positions, track zones and turn radii using practical navigation considerations, such as for radar and visual navigation, traffic patterns, and ENC data quality indicators (Zone of Confidence)

24.3. Adjust the route by graphically editing waypoints.

24.4. Obtain track courses and distances from the chart:

- Cursor position,
- Selection of route segment

24.5. Obtain relevant route planning information, such as:

- Ocean wind, wave and surface current information,
- Tidal heights and currents,
- Sailing directions (port information),
- For special situations (anchoring, chart data quality, special areas, pilotage, quarantine, etc.)

25. Track limits (0.5 hr)

The trainee operates all specific functions and obtains all relevant information for setting track limits in route planning (Refs: T1 ch.6.5.3 & 8.3; T3 ch.7.5; B7).

25.1. Review the alarm settings used as vessel is proceeding along a monitored route:

- Deviation of the current course angle as set in the planned route,
- XTE (cross track error) exceeds the value set in the route data table,
- Guard vector for crossing safety contour,
- Guard vector for entering special purpose areas,
- Guard ring for crossing an isolated danger.

25.2. Modify the setting of XTE in a previously saved route:

- Re-check the route for crossing dangers of navigation according to the setting of XTE zones,
- Observe the alarm triggering while proceeding along the modified route leg,
- Examine results graphically on appropriate scale chart data.

26. Checking plan for safety (0.5 hr)

The trainee operates all specific functions and obtains all relevant information for checking a route for the presence of dangers to navigation (Refs: T1 ch.7.4 & 7.7; T3 ch.7.4; B7).

26.1. Check a previously created and saved route for crossing dangers of navigation according to the setting of cross-track distance:

- Safety contours,
- Isolated dangers,
- Limits of Special Purpose Areas.

26.2. Check the route as it is being created for dangers as listed above:

- Use Safety Check while adding a waypoint and leg along a route
- Use Safety Check while modifying an existing leg or waypoint

26.3. Assess a route plan based on a safety check:

- Consider all predictable hazards along the track and assess if it is reliably safe,
- Assess which route should finally be taken,
- Assess which areas and points of the passage are critical.
- Besides using the function for safety checks, the largest scale ENC must be manually checked as there are cases of ECDIS alarm not activating for isolated dangers.

27. Additional Navigational Information (0.5 hr)

27.1. Discuss various hydro-meteorological data that could be available in the ECDIS database, such as:

- Tide
- Current
- Climatological
- Weather
- Wind
- Ice

28. Route schedule (0.5 hr)

The trainee operates all specific functions and obtains all relevant information for route scheduling (Refs: T1 ch.7.5; T3 ch.7.5 & 7.7; B7).

28.1. Observe any deviation from the route schedule setting in use as vessel is proceeding along a route.

28.2. Determine expected passage times:

- Use route schedule table for proceeding along a route,
- Apply effects of surface and tidal currents in calculations,

- Calculate schedule from starting ETD and ETA's for waypoints,
- Calculate schedule from starting ETD and Log speeds for waypoints,
- Edit input data as required

28.3. Observe calculations of progress along the planned route:

- Load a route and the route schedule created for that route,
- Monitor the route,
- Display route monitoring data on ECDIS information panel,
- Display schedule information on ECDIS information panel

28.4. Using the ETA application in ECDIS, calculate time or speed at a selected waypoint on a monitored route:

- Speed to make good (STG) for the indicated waypoint (and display),
- Estimated time of arrival (ETA) at any waypoint

29. User charts in route planning (1.5 hrs)

The trainee operates all navigational functions pertaining to own (user) chart entries and the use of planning notes (Refs: T1 ch.7.3; T3 ch.7.3; B7).

29.1. Review the ECDIS function for creating mariner's notes (User Chart):

- A User Chart is vector editor for creating added graphic and textual layers with specified attributes in the SENC,
- Display of User Chart objects is superimposed (layered) on any chart data without changing it,
- There can be many User Charts maintained in the system directory, but usually only one or two displayed at a time,
- Voyage planning notes and objects called into one layer may be merged into a file called into the other layer, and resaved with or without a new name, to construct a composite file,
- A User Chart may also consist of a symbol providing a link to extensive notes and hyperlinked files including photos and documents

29.2. Determine effective policy regarding User Charts:

- Purpose of particular file or chart or layer (correction, note, reference, etc.)
- Content with regard to visible data and links to data files,
- Naming with regard to purpose and geographic location

29.3. Select User Chart for display:

- Load and unload various user charts already stored in the appropriate directory,
- Select specific information layers for display,
- Save, re-save, and re-name user charts (observe naming techniques)

29.4. Use the graphic editor for creating and modifying a User Chart:

- Add the many various types of new objects in the required position with care as pertains to use of scale,
- Edit objects and information,
- Move objects,
- Merge user charts

29.5. Create, save and move an anchor circle guard zone on a User Chart:

- An anchor circle can include a "danger" attribute triggered by the ECDIS Consistent Common Reference Point (CCRP)
- The diameter should represent the maximum swing circle of the vessel
- The User Chart anchor circle should be positioned on the vessel's hawse pipe at the moment the anchor is let go
- Anchor Guard Zone functions provided on ECDIS (as on GNSS units) generally do not reference the position of the vessel's anchor or the vessel's swing circle

Ex. 3. Simulator exercise – coastal & restricted waters (2.0 hours)

The trainee operates specific functions constituting task groups for route monitoring in an open sea area, and obtains all relevant information for basic safe integrated navigation.

- Demonstrate the following task groups on ECDIS while navigating safely in coastal setting with non-threatening ARPA targets:
  - Monitor sea area,
  - Use route created by trainee including route schedule,
  - Select user layers created by trainee
  - Validate own ship's position by alternate means,
  - Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations.
  - Assess environmental conditions such as tide, current, wind, waves,
  - Modify the selected route as instructed, check for safety, adjust route schedule.

Instructor guidelines

- Conduct simulation exercise according to exercise description:
- Set simulation parameters
- Monitoring of trainees' ECDIS use
- Brief and debrief trainees
- Assess accomplishment of tasks according to exercise description

Expected outcomes:

- Navigate with ECDIS
- Individual watchkeeping
- Appropriate selection of user layers and alarms
- Route successfully monitored
- Radar/ARPA overlay used
- Successful modification of the route
- Successful creation of route taking into account ship's draft and under keel clearance

■ Lesson Plans: ECDIS Targets, Charts & System (6.5 hours)

30. ARPA/Radar overlay (0.5 hour)
31. AIS functions (0.5 hour)
32. Procuring & installing chart data (1.5 hours)
33. Installing charts data (1.0 hour)

Ex.4 Simulator Exercise – Restricted waters (advanced integrated navigation with ECDIS) (2.0 hours)

34. System reset & backup (0.5 hour)
35. Archiving ECDIS data and data logging (0.5 hour)

30. ARPA/Radar overlay (0.5 hr)

The trainee demonstrates the use of ARPA operations in ECDIS (Refs: T1 ch.8.4.3; T3 ch.8.2.3 & 8.5; B7).

30.1. Examine sensor setup requirements for ARPA targets:

- The identity of associated com port(s) and baud rate matched to ARPA output
- Correct location of sensor reference (Consistent Common Reference Point)
- It is possible that ships fitted with ECDIS prior 01st January 2009 may not have ARPA overlay feature.

30.2. Determine speed and heading inputs used in ARPA calculations.

30.3. Access target information display:

- Cursor (mouse over)
- Target table, with sorting options for data fields
- Target name field in table may provide direct display link on chart

30.4. Interpret target symbol features:

- Identify by number from ARPA, or by writing an alias into target table
- Vector and green circle at radar-determined position
- Alarm may be set when both CPA and TCPA approach limitations are exceeded
- Vector length the same as set for ownship
- Target tracks are saved in daily files, and selectable for viewing on display

30.5. Operate the user interface controls for radar overlay.

- Target tracking
- Image recording
- The overlay image can be removed from the display by a single interface option

30.6. Demonstrate sources of image offset:

- A mismatch can develop between chart and radar data,
- Sensor position setup,
- Input of radar data (such as from transceiver problems)heading misalignment,
- Position sensor error,
- Uncharted and/or incorrectly charted objects, and chart datum error

30.7. Determine source of ECDIS-tracked target data calculations:

- ECDIS speed and heading inputs are used in ECDIS-tracked target data calculations
- Radar motion vector may be through the water rather than over ground
- CPA & TCPA are derived from the ECDIS independently from the radar

30.8 Make corrections to own ship’s position, using a reference point captured by ARPA:

- Corrections to own ship's position, using a reference point captured by ARPA/ RADAR
- Position check using known object(s) utilizing radar navigation techniques

31. AIS functions (0.5 hr)

The trainee demonstrates the use of Automatic Identification Systems in ECDIS (Refs: T1 ch.8.4.5 & 6.9; T3 ch.8.4; B4 ch.10.3; B7).

31.1. Describe what the connection of an Automatic Identification System (AIS) to ECDIS enables:

- Receiving identification and navigation information on other targets transmitting on AIS,
- Analysis of target's motion over ground
- Potential control from ECDIS of ownship's Static and Voyage data
- Data string consists of considerable amount of encapsulated data,
- Data string is transmitted by VHF data link (VDL) with typical line of sight range limitations
- It is possible that ships fitted with ECDIS prior 01st January 2009 may not have AIS sensor input.

31.2. Examine sensor setup requirements for AIS targets:

- Identity of associated com port(s) and baud rate matched to AIS interface
- Correct location of sensor reference (Consistent Common Reference Point)

31.3. Determine alarms and other settings for AIS targets:

- Alarms and other settings for AIS targets are set in ECDIS target panel
- CPA & TCPA calculations on AIS targets are derived from ECDIS speed and heading inputs

31.4. Access target information display options:

- Cursor
- Target table, with sorting options for data fields
- Target name field in table may provide direct display link on chart

31.5. Interpret AIS target symbol features:

- Position of symbol represents the target's transmitted (D)GNSS antenna position
- An AIS target is displayed graphically as a green isosceles triangle with heading of vessel (if transmitted), including flag showing direction of turn
- Additional vector from ECDIS calculation of COG, with length the same as set for ownship
- Divergence of COG/SOG vector from heading indicator represents target's drift angle
- Target is processed for collision avoidance by the ECDIS on the same principles as tracked targets

- Identifier is MMSI number until static information is established then name and call sign can be displayed (by writing an Alias into Table)
- ARPA tracking on ECDIS can be correlated with an existing AIS target
- Alarm can be set when both CPA and TCPA approach limitations are exceeded
- Target tracks are saved in daily files, and selectable for viewing on display

32. Procuring & installing chart data (1.5 hrs)

The trainee installs chart license software and chart data of various formats (Refs: T1 ch.4.4; T3 ch.9.2 & 9.3 & 9.4; B7).

32.1. Review chart data structure, terminology, and installation procedures:

- SENC, and various formats
- The operator procures, installs/updates, selects; the ECDIS unit initializes, loads (introduced in Lesson 12)

32.2. Review chart format requirements for ECDIS:

- ECDIS requires the use of charts in official formats issued by the properly authorized government hydrographic offices.
- These are currently S 57 specified ENCs (manufactured by the respective regional Hydrographic Offices); S-101 ENC product specification is currently being developed; S-100 IHO universal hydrographic data model has been developed recently to enable the easier integration of hydrographic data and applications into geospatial solutions, and will eventually replace S-57

32.3. Examine data distribution sources for ENC:

- Regional/global coordinating centres (RENC) such as Primar (hosted by the Norwegian HO) and IC-ENC (hosted by the UKHO) are engaged in the distribution of ENC data.
- These centres accumulate chart databases from participating hydrographic offices, ensure quality standards are met, and provide the data to distributers for procurement by end users.

32.4. Examine data distribution sources for SENC conversions:

- The S 57/ENCs distributed by a SENC service from ENC providers Primar, IC-ENC and NOAA have been converted to CD8 SENC format for simplified installation and updating.
- The process of converting S-57 (ENC) format charts to SENC format is subject to DNV and IHO requirements.

32.5. Examine licence structure for various formats, and practise installation:

- Licence/permit structure depends on the chart data format
- Licence/permit installation generally occurs through the chart data management associated with the ECDIS

32.6. Extract information on installation history:

- Installation history is retained during installation
- History includes the addition and deletion of individual charts/cells
- History file is generally accessible through the chart data management utility associated with the ECDIS

33. Installing chart corrections (1.0 hr)

The trainee applies manual and automatic updates (corrections) to electronic charts, and assesses the importance of updating (Refs: T1 ch.4.5 & 6.3; T3 ch.10; B7).

33.1. Explain why electronic chart data is maintained with up-to-date corrections:

- The safety of navigation requires data that is maintained with up-to-date corrections
- The responsibility of seaworthiness as defined by SOLAS requires charts for the intended voyage that are up to date

33.2. Add or modify a chart object using Manual Correction task or appropriate ECDIS function:

- Using the Manual Correction task in ECDIS, a chart object layer may be added or modified
- The manual correction may include attributes and links, may be concealed, may be made time-active, and may be deleted

33.3. Examine production licence options for accessibility of automatic updates:

- Chart data licensing options may include services for automatic updating
- Sometimes referred to as maintenance in reference to proprietary chart data

33.4. Install various automatic update formats using various methods:

- Using chart managing utility associated with the ECDIS program, install the following depending on availability:
  - Procured or downloaded ENC updates
  - Procured or downloaded RNC update patch files
  - Procedure for applying T&P notices and navigational warnings. The overlay of the T&P Notice/Navigational warning is designed to be displayed as an additional information layer on top of a standard ECDIS chart display.

- Explain that caution must be exercised when performing chart and other updates. These should not be done during transits through restricted waters or high traffic areas and should preferably be conducted prior commencement of voyage.

33.5. Extract information on update history

- Installation history is retained during updating
- History includes the addition and deletion of individual charts/cells
- History file is generally accessible through the chart data management utility associated with the ECDIS

Ex. 4. Simulator exercise – restricted waters (2.0 hours)

The trainee obtains all relevant information for safe navigation and operates specific functions for collision avoidance while route monitoring in restricted waters.

- Demonstrate the following task groups on ECDIS while navigating safely in a restricted waters setting with multiple targets in specified waters:
  - Monitor sea area
  - Use route created by trainee including route schedule
  - Select user layers created by trainee
  - Validate own ship's position by alternate means when there is loss of one or more sensor inputs
  - Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations
  - Comply with COLREGS
  - Use of Man Overboard (MOB) function

Instructor guidelines

- Conduct simulation exercise according to exercise description:
  - Set simulation parameters
  - Monitoring of trainees' ECDIS use
  - Brief and debrief trainees
  - Assess accomplishment of tasks according to exercise description
  - Simulate loss of one or more sensor inputs
  - Simulate a Man Overboard situation
  - Use dead reckoning

Expected outcomes:

- Navigate with ECDIS
- Individual watchkeeping
- Successful route planning

- Route monitoring
- Successfully fixing of position using alternate means
- Successful recovery of Man Overboard.

34. System reset & backup (0.5 hr)

The trainee performs basic troubleshooting and uses the back-up system in the case of ECDIS failure (Refs: T1 ch.8.7 & 8.8; T3 ch.11.3 & 11.4; B7).

34.1. Explain the intent of regulations on ECDIS back-up arrangements:

- The regulations on ECDIS back-up arrangements intend that backup is ensured through electronic and/or paper chart options
- The installation of a duplicate set of ECDIS equipment combined in a single computer network where each ECDIS workstation is connected to the navigational sensors and assigned “Master” or “Slave” status, guarantees interchangeability without loss of data in case of failure of one of the systems
- The availability of an updated paper chart collection is required where a single set of ECDIS equipment is installed (standalone), or when ENC coverage for the intended route is unavailable, such as when raster or proprietary chart data is provided instead of ENC data
- The purpose of the backup arrangement is to preserve the safety of navigation in the event of degradation or loss of the ECDIS as the primary means of navigation

34.2. Discuss back-up procedures in standalone ECDIS failure event:

- Charts include the planned route
- Regular plotting of ship’s position when navigating within restricted waters

34.3. Discuss networked back-up procedures in (Master) ECDIS failure event:

- Includes prior equalizing of route, chart data and user data

34.4. Discuss troubleshooting routines in ECDIS, such as for:

- Damaged initialization and configuration files,
- Integrity of cables and com ports integrity,
- Sensor assignment and configuration

34.5. Recognize consequences to navigation safety while troubleshooting:

- Includes track display, autopilot functions and other systems deriving data feed from ECDIS

34.6. Recognize consequences to data storage while ECDIS workstation is down:

- Despite continuous functioning of sensors, the consequence while ECDIS workstation is down is that all data storage ceases

- There will be a gap graphically on the display upon restoration of ECDIS workstation and a corresponding gap in electronic logbook data

35. Archiving ECDIS data and Data logging (0.5 hrs)

35.1. Discuss ECDIS data management to work with files associated with ECDIS operations:

- Select many groups of navigational data files (logbook, ownship tracks, target tracks, user charts, routes, ship model, system log, S57 log)

35.2. Discuss ECDIS data management to transfer selected data files between storage media:

- Recognize ECDIS directory structure for file retrieval and storage
- Recognize which files can be copied or moved to other directories or drives

35.3. Review requirements and functions of logbook task in ECDIS, such as:

- Voyage recording consists of 24-hour data files, changing dates at GMT midnight
- A complete status check of all alarm functions and many setup conditions upon date change
- Collection of all fields upon:
  - Waypoint and Watch change (basic),
  - Manually triggered Event,
  - Screen coordinates change due to display reset (true and relative motion) and scale change
  - Change in chart data displayed
  - Change in alarm status and condition
- Chart data field includes displayed chart number (if ENC, also source, edition, date and cell)
- Does not include Route or Route Schedule used in monitoring

35.4. Review display functions of ownship track and tracks of AIS, ARPA and overlay targets:

- Includes position and heading data up to every second, but possibly less frequent depending on the ECDIS and its settings
- Ownship track history from alternate date may be displayed instead of current date – creating ambiguity if unintentional
- No matter what track date is displayed, current track for six minutes will be displayed
- Targets tracked on ARPA, radar overlay and AIS (as connected sensors) will be included in track file

■ Lesson Plans: ECDIS Responsibility & Assessment (6.0 hours)

36. Responsibility (2.0 hours)

37. Effective navigation with ECDIS (1.0 hour)

Ev. 1 Written evaluation (1.0 hour)

Ev. 2 Simulation evaluation – coastal & restricted waters (2.0 hours)

36. Responsibility (2.0 hrs)

The trainee describes the essential legal aspects and responsibilities in the use of ECDIS (Refs: R1; R3; B11; B12; R7; T1 ch.5; T3 ch.13.4).

36.1. Review COLREGS

- There is no specific mention of ECDIS (or position fixing or AIS) in the COLREGS, yet.
- However, ECDIS use is implied in the phrase “all available means” (Lookout (5), Risk of Collision (7)) occurring in Conduct of Vessels in Any Condition of Visibility – Rules 4-10

36.2. Review SOLAS, as amended

- Operating ECS and ECDIS without complete or updated chart data has been considered a contributing factor in several recent casualties. SOLAS V/2, V/19 & V/27 regulations address:
  - The carriage of charts
  - The equivalency of ENC format vector charts and paper charts
  - The non-equivalency of any other format
- SOLAS V/19 was amended in June 2009 to mandate ECDIS carriage requirement on ships (see MSC.282(86))

36.3. Review IMO approval of equipment and installations

- Equipment and installations are specified in IEC 61174 ed. 3.0, ECDIS operational and performance requirements, methods of testing and required test results [for purchase];
- Other references to installations include:
  - IMO’s revised ECDIS Performance Standards, MSC.232(82);
  - See also SN.1/Circ.266/Rev.1 (12/2010) on ECDIS software maintenance;
  - See also SN.1/Circ.265 (10/2007) on bridge design

36.4. Review IMO carriage requirements

- SOLAS ch. V Reg. 19.2.10 and 19.2.11 as amended by resolution Annex 1 of MSC 86/26), adopted June 2009 (also MSC.282(86)) makes the carriage of ECDIS mandatory in a phase-in schedule from July 2012 through July 2018.

36.5. Review national ECDIS regulations (where applicable)

- Ships calling ports may need to abide by national regulations governing ECDIS.

36.6. Review STCW Code, as amended

- International ECDIS training requirements are now included in STCW 2010 Part A (Code) through the Manila Amendment 2010, effective 01st January 2012 with a 5-year transition period.
- The basic STCW competence requires maintaining the safety of navigation using ECDIS, with differences in application for operational and management level deck officers:
  - Table A-II/1, Navigation at the operational level, ≥500 GT
  - Table A-II/2, Navigation at the management level, ≥500 GT
  - Table A-II/3, Navigation at the operational level, <500 GT

36.7. Review IMO training Guidance (and providing review of course)

- A detailed outline for training and assessment in the operational use of ECDIS is now included in the STCW 2010 Manila Amendments, Part B: Guidance, but is not to be regarded as required or enforceable;
- See also SN.1/Circ.207/Rev.1 “Differences between RCDS and ECDIS”;
- This Revised Model Course 1.27 (2010 edition), will provide national authorities with a detailed training course for guidance in assessment and certification in the primary STCW competence regarding ECDIS: Maintain the safety of navigation through the use of ECDIS

36.8. Review ISM and IMO requirements of ship owners & operators

- Under the terms of the ISM Code (International Ship Management Code), the ship owner or operator has a responsibility to ensure that personnel are given proper familiarization with their duties.
- If a ship is equipped with an approved ECDIS, the ship owner has to provide ECDIS training to ensure that ECDIS users are both properly trained and familiar with the shipboard equipment before it is used. (Ref: Paragraphs 6.2,6.3,6.5 of ISM Code)
- Under the terms of the STCW Convention, Regulation I/14:

  “Responsibilities of companies

  1 Each Administration shall, in accordance with the provisions of section A-I/14, hold companies responsible for the assignment of seafarers for service on their ships in accordance with the provisions of the present Convention, and shall require every such company to ensure that:

  ….seafarers, on being assigned to any of its ships, are familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures and ship characteristics that are relevant to their routine or emergency duties”

37. Effective navigation with ECDIS (1.0 hr)

The trainee describes how ECDIS is used effectively in navigation (Refs: T1 ch.10.2; T3 ch.7.3 & 8.1 & 11.2 & 16).

37.1. Describe bridge functions incorporating ECDIS

- ECDIS can be used in support of many important bridge functions, but such support requires its own skill and knowledge facility, and constitutes an additional bridge function:
  - Visual monitoring – effective lookout, verify visual contact
  - Planning – charts, updates, routes, weather forecasts, weather routing
  - Piloting – course changes, dead reckoning, vessel position, radar overlay, position history, alarm history
  - Manoeuvres – conditions (wind, tide, current, ice, climate data), vessel characteristics, docking, anchoring, lightering, canal transit
  - At anchor – monitor position, monitor other traffic, tidal current trends

37.2. Review sample bridge operating procedures addressing ECDIS

- Simplified bridge operating procedures addressing ECDIS should include (but should not be limited to) the following:
  - Maintain visual lookout supplemented by ARPA & ECDIS
  - Validate correct functioning of electronic instruments at regular intervals
  - Manage chart database and updates
  - Maintain voyage plans & files (consistent with approved and filed copies)

37.3. Define safe and practical navigation with ECDIS

- Safe and practical navigation with ECDIS should include (but should not be limited to) the following:
  - Use of ECDIS unit itself:
    - Make setup choices for specific conditions
    - Recognize that bridge team members may be viewing the ECDIS for widely differing purposes, therefore setups should be accommodating
    - Perform visual scanning techniques applied to ECDIS pages/screens
  - Use of instruments integrated with the ECDIS (centralization of information):
    - Cross check (trust but verify) displayed information by all other available means
    - Verify settings and functions of sensors connected to ECDIS
  - Acknowledgement of the “Problem of Partial Use” (unfamiliarity with the unit and/or procedures may lead to distracting problem solving attempts

at inopportune times, or to a disuse of the unit altogether, neither of which improves the safety of navigation). Therefore, navigators should:

- Know what can and cannot be accomplished before the need arises
- Know that limited or restricted use results in unverified and unintended settings
- Perform on ECDIS anything done on a paper chart
- Perform on ECDIS things that cannot be otherwise done as effectively or efficiently

– Performance of ECDIS could be affected in following cases:

- ECDIS in operation comprises hardware, software and data. It is important for the safety of navigation that the application software within the ECDIS works fully in accordance with the Performance Standards and is capable of displaying all the relevant digital information contained within the Electronic Navigational Chart (ENC)
- ECDIS that is not updated for the latest version of IHO Standards may not meet the chart carriage requirements as set out in SOLAS regulation V/19.2.1.4
- Any ECDIS which is not upgraded to be compatible with the latest version of the Product specification or the S-52 Presentation Library may be unable to correctly display the latest charted features. Additionally, the appropriate alarms and indications may not be activated even though the features have been included in the ENC. Similarly any ECDIS which is not updated to be fully compliant with the latest version of the S-63 Data Protection Standard may fail to decrypt or to properly authenticate some ENCs, leading to failure to load or install.

37.4. Anomalies in the use of ECDIS

- Trainees should be fully aware of the nature, risk and methods taken to resolve ECDIS anomalies. In particular it should be understood that as a software driven system ECDIS will remain susceptible to future anomalies and that advice and guidance regarding this matter will from time to time be made available to ships.

Ev. 1 Written evaluation (1.0 hr)

The trainee shows knowledge and comprehension in the learning areas of ECDIS that could not be otherwise demonstrated by workstation tasks or in simulation exercises.

Ev. 2 Simulation evaluation – coastal & restricted waters (2.0 hrs)

The trainee successfully completes a simulated transit (See example of Trainee's Evaluation on Simulator, Appendix 5).

Part E: Evaluation and Assessment

■ Introduction

The effectiveness of any evaluation depends on the accuracy of the description of what is to be measured. The learning objectives that are used in the detailed teaching syllabus, Column 3 – Methods for demonstrating competence – and Column 4 – Criteria for evaluating competence – in Tables A-II/1, A-II/2 and A-II/3 of the STCW Code, set out the methods and criteria for evaluation.

Instructors should refer to these when designing the assessment.

It is consistent with the intent of STCW that demonstration of skills and practical understanding is determined by direct observation, while knowledge and theoretical understanding is determined through written examination in a variety of question styles.

■ STCW 2010 Code

The training and assessment of seafarers required under the Convention are administered, supervised and monitored in accordance with the provisions of Regulation I/6 of the STCW Convention.

Assessment is also covered in detail in IMO Model Courses (3.12 & 6.09A).

■ Assessment Planning

Assessment planning should be specific, measurable, achievable, realistic and time bound (SMART). Some methods of assessment that could be used depending upon the course/ qualification are as follows and all should be adapted to suit individual needs:

- observation (in oral examination, simulation exercises, practical demonstration);
- questions (written or oral);
- tests;
- simulation (also refer to section A-I/12 of the STCW code 2010);

■ Validity

The evaluation methods must be based on clearly defined objectives, and must truly represent what is meant to be assessed; e.g. against only the relevant criteria and the syllabus or course guide. There must be a reasonable balance between the subject topics involved and also, in the testing of trainees' KNOWLEDGE, UNDERSTANDING AND PROFICIENCY of the concepts.

■ Reliability

Assessment should also be reliable (if the assessment was done again with a similar group/ learner, would similar results be achieved). Different groups of learners may have the same

subject at different times. If other assessors are also assessing the same course/qualification, there is need to ensure all are making the same decisions. To be reliable an evaluation procedure should produce reasonably consistent results, no matter which set of papers or version of the test is used.

If instructors are assessing their own trainees, they need to know what they are to assess and then decide how to do this. The "what" will come from the standards/learning outcomes of the course/qualification they are delivering and the "how" may already be decided for them if it is in assignments, tests or examinations.

The instructors need to consider the best way to assess the skills, knowledge and attitudes of their learners, whether this will be formative and/or summative and the validity and reliability of the assessment.

All work assessed should be valid, authentic, current, sufficient and reliable; this is often know as VACSR – "valid assessments create standard results":

- valid – the work is relevant to the standards/criteria being assessed;
- authentic – the work has been produced solely by the learner;
- current – the work is still relevant at the time of assessment;
- sufficient – the work covers all the standards/criteria;
- reliable – the work is consistent across all learners, over time and at the required level.

It is important to note that no single method can satisfactorily measure knowledge and skill over the entire spectrum of matters to be tested for the assessment of competence. Care should therefore be taken to select the method most appropriate to the particular aspect of competence to be tested, bearing in mind the need to frame questions which relate as realistically as possible to the requirements of the officer's tasks at sea.

■ Compiling assessments

Whilst each examining authority establishes its own rules, the length of time which can be devoted to assessing the competence of candidates for certificates of competency is limited by practical, economic and social restraints. Therefore a prime objective of those responsible for the organization and administration of the assessment system is to find the most efficient, effective and economical method of assessing the competency of candidates. An examination system should effectively test the breadth of a candidate's KNOWLEDGE, UNDERSTANDING AND PROFICIENCY of the subject areas pertinent to the tasks he is expected to undertake. It is not possible to examine candidates fully in all areas, so in effect the assessment samples a candidate's KNOWLEDGE, UNDERSTANDING AND PROFICIENCY by covering as wide a scope as is possible within the time constraints and testing his depth of KNOWLEDGE, UNDERSTANDING AND PROFICIENCY in selected areas.

The assessment as a whole should assess each candidate's comprehension of principles, concepts and methodology; ability to apply principles, concepts and methodology; ability to organize facts, ideas and arguments and abilities and skills in carrying out the tasks to perform in the duties he or she is to be certificated to undertake.

All evaluation and testing techniques have their advantages and disadvantages. An examining authority should carefully analyse precisely what it should be testing and can test. A careful selection of test and evaluation methods should then be made to ensure that the best of the variety of techniques available today is used. Each assessment shall be that best suited to the learning outcome or ability to be assessed.

■ Quality of test items

No matter which type of test is used, it is essential that all questions or test items used should be as brief as possible, since the time taken to read the questions themselves lengthens the examination. Questions must also be clear and complete. To ensure this, it is necessary that they be reviewed by a person other than the originator. No extraneous information should be incorporated into questions

Appendices for the ECDIS Instructor

This Part of the Model Course includes the following appendices:

- **Appendix 1: Introduction to the Operational use of ECDIS**
- **Appendix 2: ECDIS Performance Standard references**
- **Appendix 3: ECDIS Carriage Requirements**
- **Appendix 4: STCW Regulation I/12 and Section A-I/12 and B-I/12 on use of simulators for ECDIS training**
- **Appendix 5a: Example of Trainee's Proficiency Checklist on use of ECDIS**
- **Appendix 5b: Example of Trainee's Evaluation on Simulator**
- **Appendix 6: Example: Equipment set up for ECDIS training**

Appendix 1

Introduction to the operational use of ECDIS

This document is the first revision to the original ECDIS Model Course 1.27 published by the IMO in 2000. In the intervening decade, several considerable advances have occurred:

- Comprehensive improvements in type-approved ECDIS, including software, chart data, ECDIS workstation hardware, and integration with critical ship functions
- Widespread experience in effective navigation with ECDIS aboard vessels
- Publication of textbooks, articles and information booklets on ECDIS
- Development of simulation that makes available to each trainee an ECDIS workstation in an underway context with vessel controls
- Amendments to STCW requiring competency in the use of ECDIS for all watchkeeping officers wherever type-approved units are installed
- The advent of track control autopilots deriving control information from ECDIS
- The advent of paperless bridges where a new generation of watchkeeping officers gain little or no practice in backup skills such as paper plotting of LOPs

Appendix 2

ECDIS Performance Standard references

The current electronic chart display and information system performance standards adopted by the Organization are:

- Resolution MSC.232(82), revision to the previous Performance Standards:
  - Applying to new ECDIS equipment installations on or after 1 January 2009
- Resolution A.817(19), Performance Standards for Electronic Chart Display and Information System (ECDIS); resolution MSC.64(67), annex 5, amending resolution A.817(19); resolution MSC.86(70), annex 4, amending resolution A.817(19):
  - Applying to ECDIS equipment installations between 1 January 1996 and 1 October 2009.

Appendix 3

ECDIS Carriage Requirements

ANNEX 1

RESOLUTION MSC.282(86)
(adopted on 5 June 2009)

ADOPTION OF AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING FURTHER article VIII(b) of the International Convention for the Safety of Life at Sea (SOLAS), 1974 (hereinafter referred to as the Convention), concerning the amendment procedure applicable to the Annex to the Convention, other than to the provisions of chapter I thereof,

HAVING CONSIDERED, at its eighty-sixth session, amendments to the Convention, proposed and circulated in accordance with article VIII(b)(i) thereof,

1. ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the Convention, the text of which is set out in the Annex to the present resolution;

2. DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on 1 July 2010, unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified their objections to the amendments;

3. INVITES SOLAS Contracting Governments to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 January 2011 upon their acceptance in accordance with paragraph 2 above;

4. REQUESTS the Secretary-General, in conformity with article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the Annex to all Contracting Governments to the Convention;

5. FURTHER REQUESTS the Secretary-General to transmit copies of this resolution and its Annex to Members of the Organization, which are not Contracting Governments to the Convention.

ANNEX

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

[. . .]

CHAPTER V

SAFETY OF NAVIGATION

Regulation 19 – Carriage requirements for shipborne navigational systems and equipment

3 In paragraph 2.1, the existing subparagraph .4 is replaced by the following:

".4 nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage. An electronic chart display and information system (ECDIS) is also accepted as meeting the chart carriage requirements of this subparagraph. Ships to which paragraph 2.10 applies shall comply with the carriage requirements for ECDIS detailed therein.",

[. . .]

5 After the existing paragraph 2.9, the new paragraphs 2.10 and 2.11 are added as follows:

"2.10 Ships engaged on international voyages shall be fitted with an Electronic Chart Display and Information System (ECDIS) as follows:

.1 passenger ships of 500 gross tonnage and upwards constructed on or after 1 July 2012;

.2 tankers of 3,000 gross tonnage and upwards constructed on or after 1 July 2012;

.3 cargo ships, other than tankers, of 10,000 gross tonnage and upwards constructed on or after 1 July 2013;

.4 cargo ships, other than tankers, of 3,000 gross tonnage and upwards but less than 10,000 gross tonnage constructed on or after 1 July 2014;

.5 passenger ships of 500 gross tonnage and upwards constructed before 1 July 2012, not later than the first survey* on or after 1 July 2014;

.6 tankers of 3,000 gross tonnage and upwards constructed before 1 July 2012, not later than the first survey* on or after 1 July 2015;

.7 cargo ships, other than tankers, of 50,000 gross tonnage and upwards constructed before 1 July 2013, not later than the first survey* on or after 1 July 2016;

.8 cargo ships, other than tankers, of 20,000 gross tonnage and upwards but less than 50,000 gross tonnage constructed before 1 July 2013, not later than the first survey* on or after 1 July 2017; and

.9 cargo ships, other than tankers, of 10,000 gross tonnage and upwards but less than 20,000 gross tonnage constructed before 1 July 2013, not later than the first survey* on or after 1 July 2018.

2.11 Administrations may exempt ships from the application of the requirements of paragraph 2.10 when such ships will be taken permanently out of service within two years after the implementation date specified in subparagraphs .5 to .9 of paragraph 2.10."

* Refer to the Unified interpretation of the term "first survey" referred to in SOLAS regulations (MSC.1/Circ.1290).

Appendix 4

STCW Regulation I/12, Section A-I/12 and B-I/12 on use of simulators for ECDIS training

Regulation I/12

Use of simulators

1 The performance standards and other provisions set forth in section A-I/12 and such other requirements as are prescribed in part A of the STCW Code for any certificate concerned shall be complied with in respect of:

.1 all mandatory simulator-based training;

.2 any assessment of competency required by part A of the STCW Code which is carried out by means of a simulator; and

.3 any demonstration, by means of a simulator, of continued proficiency required by part A of the STCW Code.

Section A-I/12

Standards governing the use of simulators

PART 1 – PERFORMANCE STANDARDS

General performance standards for simulators used in training

1 Each Party shall ensure that any simulator used for mandatory simulator-based training shall:

.1 be suitable for the selected objectives and training tasks;

.2 be capable of simulating the operating capabilities of shipboard equipment concerned, to a level of physical realism appropriate to training objectives, and include the capabilities, limitations and possible errors of such equipment;

.3 have sufficient behavioural realism to allow a trainee to acquire the skills appropriate to the training objectives;

.4 provide a controlled operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relevant to the training objectives;

.5 provide an interface through which a trainee can interact with the equipment, the simulated environment and, as appropriate, the instructor; and

.6 permit an instructor to control, monitor and record exercises for the effective debriefing of trainees.

General performance standards for simulators used in assessment of competence

2 Each Party shall ensure that any simulator used for the assessment of competence required under the Convention or for any demonstration of continued proficiency so required shall:

.1 be capable of satisfying the specified assessment objectives;

.2 be capable of simulating the operational capabilities of the shipboard equipment concerned to a level of physical realism appropriate to the assessment objectives, and include the capabilities, limitations and possible errors of such equipment;

.3 have sufficient behavioural realism to allow a candidate to exhibit the skills appropriate to the assessment objectives;

.4 provide an interface through which a candidate can interact with the equipment and simulated environment;

.5 provide a controlled operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relevant to assessment objectives; and

.6 permit an assessor to control, monitor and record exercises for the effective assessment of the performance of candidates.

Additional performance standards

3 In addition to meeting the basic requirements set out in paragraphs 1 and 2, simulation equipment to which this section applies shall meet the performance standards given hereunder in accordance with their specific type.

Radar simulation

4 Radar simulation equipment shall be capable of simulating the operational capabilities of navigational radar equipment which meets all applicable performance standards adopted by the Organization* and incorporate facilities to:

.1 operate in the stabilized relativemotion mode and sea – and groundstabilized truemotion modes;

.2 model weather, tidal streams, current, shadow sectors, spurious echoes and other propagation effects, and generate coastlines, navigational buoys and search and rescue transponders; and

.3 create a real-time operating environment incorporating at least two own-ship stations with ability to change own ship's course and speed, and include parameters for at least 20 target ships and appropriate communication facilities.

* See relevant/appropriate performance standards adopted by the Organization.

Automatic Radar Plotting Aid (ARPA) simulation

5 ARPA simulation equipment shall be capable of simulating the operational capabilities of ARPAs which meet all applicable performance standards adopted by the Organization* and shall incorporate the facilities for:

.1 manual and automatic target acquisition;

.2 past track information;

.3 use of exclusion areas;

.4 vector/graphic time-scale and data display; and

.5 trial manoeuvres.

PART 2 – OTHER PROVISIONS

Simulator training objectives

6 Each Party shall ensure that the aims and objectives of simulator-based training are defined within an overall training programme and that specific training objectives and tasks are selected so as to relate as closely as possible to shipboard tasks and practices.

Training procedures

7 In conducting mandatory simulator-based training, instructors shall ensure that:

.1 trainees are adequately briefed beforehand on the exercise objectives and tasks and are given sufficient planning time before the exercise starts;

.2 trainees have adequate familiarization time on the simulator and with its equipment before any training or assessment exercise commences;

.3 guidance given and exercise stimuli are appropriate to the selected exercise objectives and tasks and to the level of trainee experience;

.4 exercises are effectively monitored, supported as appropriate by audio and visual observation of trainee activity and pre – and post-exercise evaluation reports;

.5 trainees are effectively debriefed to ensure that training objectives have been met and that operational skills demonstrated are of an acceptable standard;

.6 the use of peer assessment during debriefing is encouraged; and

.7 simulator exercises are designed and tested so as to ensure their suitability for the specified training objectives.

Assessment procedures

8 Where simulators are used to assess the ability of candidates to demonstrate levels of competency, assessors shall ensure that:

.1 performance criteria are identified clearly and explicitly and are valid and available to the candidates;

* See relevant/appropriate performance standards adopted by the Organization.

.2 assessment criteria are established clearly and are explicit to ensure reliability and uniformity of assessment and to optimize objective measurement and evaluation, so that subjective judgements are kept to the minimum;

.3 candidates are briefed clearly on the tasks and/or skills to be assessed and on the tasks and performance criteria by which their competency will be determined;

.4 assessment of performance takes into account normal operating procedures and any behavioural interaction with other candidates on the simulator or with simulator staff;

.5 scoring or grading methods to assess performance are used with caution until they have been validated; and

.6 the prime criterion is that a candidate demonstrates the ability to carry out a task safely and effectively to the satisfaction of the assessor.

Qualifications of instructors and assessors*

9 Each Party shall ensure that instructors and assessors are appropriately qualified and experienced for the particular types and levels of training and corresponding assessment of competence as specified in regulation I/6 and section A-I/6.

Section B-I/12

Guidance regarding the use of simulators

TRAINING AND ASSESSMENT IN THE OPERATIONAL USE OF ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEMS (ECDIS)

Introduction

36 When simulators are being used for training or assessment in the operational use of Electronic Chart Display and Information Systems (ECDIS), the following interim guidance should be taken into consideration in any such training or assessment.

37 Training and assessment in the operational use of the ECDIS should:

.1 incorporate the use of ECDIS simulation equipment; and

.2 conform to standards not inferior to those given in paragraphs 38 to 65 below.

38 ECDIS simulation equipment should, in addition to meeting all applicable performance standards set out in section A-I/12 of the STCW Code, as amended, be capable of simulating navigational equipment and bridge operational controls which meet all applicable performance standards adopted by the Organization, incorporate facilities to generate soundings and:

.1 create a real-time operating environment, including navigation control and communications instruments and equipment appropriate to the navigation and watchkeeping tasks to be carried out and the manoeuvring skills to be assessed; and

* The relevant IMO Model Course(s) and resolution MSC.64(67), *Recommendations on new and amended performance standards*, may be of assistance in the preparation of courses.

.2 realistically simulate "own ship" characteristics in openwater conditions, as well as the effects of weather, tidal stream and currents.

39 Demonstrations of, and practice in, ECDIS use should be undertaken, where appropriate, through the use of simulators. Training exercises should preferably be undertaken in real time, in order to increase trainees' awareness of the hazards of the improper use of ECDIS. Accelerated timescale may be used only for demonstrations.

General

Goals of an ECDIS training programme

40 The ECDIS trainee should be able to:

.1 operate the ECDIS equipment, use the navigational functions of ECDIS, select and assess all relevant information and take proper action in the case of a malfunction;

.2 state the potential errors of displayed data and the usual errors of interpretation; and

.3 explain why ECDIS should not be relied upon as the sole reliable aid to navigation.

Theory and demonstration

41 As the safe use of ECDIS requires knowledge and understanding of the basic principles governing ECDIS data and their presentation rules as well as potential errors in displayed data and ECDIS-related limitations and potential dangers**,** a number of lectures covering the theoretical explanation should be provided. As far as possible, such lessons should be presented within a familiar context and make use of practical examples. They should be reinforced during simulator exercises.

42 For safe operation of ECDIS equipment and ECDIS-related information (use of the navigational functions of ECDIS, selection and assessment of all relevant information, becoming familiar with ECDIS man–machine interfacing), practical exercises and training on the ECDIS simulators should constitute the main content of the course.

43 For the definition of training objectives, a structure of activities should be defined. A detailed specification of learning objectives should be developed for each topic of this structure.

Simulator exercises

44 Exercises should be carried out on individual ECDIS simulators, or full-mission navigation simulators including ECDIS, to enable trainees to acquire the necessary practical skills. For realtime navigation exercises, navigation simulators are recommended to cover the complex navigation situation. The exercises should provide training in the use of the various scales, navigational modes, and display modes which are available, so that the trainees will be able to adapt the use of the equipment to the particular situation concerned.

45 The choice of exercises and scenarios is governed by the simulator facilities available. If one or more ECDIS workstations and a full-mission simulator are available, the workstations may primarily be used for basic exercises in the use of ECDIS facilities and for passageplanning exercises, whereas full-mission simulators may primarily be used for exercises related to passagemonitoring functions in real time, as realistic as possible in connection with the total workload of a navigational watch. The degree of complexity of exercises should increase throughout the training programme until the trainee has mastered all aspects of the learning subject.

46 Exercises should produce the greatest impression of realism. To achieve this, the scenarios should be located in a fictitious sea area. Situations, functions and actions for different learning objectives which occur in different sea areas can be integrated into one exercise and experienced in real time.

47 The main objective of simulator exercises is to ensure that trainees understand their responsibilities in the operational use of ECDIS in all safety-relevant aspects and are thoroughly familiar with the system and equipment used.

Principal types of ECDIS systems and their display characteristics

48 The trainee should gain knowledge of the principal types of ECDIS in use; their various display characteristics, data structure and an understanding of:

.1 differences between vector and raster charts;

.2 differences between ECDIS and ECS;

.3 differences between ECDIS and RCDS*;

.4 characteristics of ECDIS and their different solutions; and

.5 characteristics of systems for special purposes (unusual situations/emergencies).

Risks of over-reliance on ECDIS

49 The training in ECDIS operational use should address:

.1 the limitations of ECDIS as a navigational tool;

.2 potential risk of improper functioning of the system;

.3 system limitations, including those of its sensors;

.4 hydrographic data inaccuracy; limitations of vector and raster electronic charts (ECDIS *vs* RCDS and ENC *vs* RNC); and

.5 potential risk of human errors.

Emphasis should be placed on the need to keep a proper look-out and to perform periodical checking, especially of the ship's position, by ECDIS-independent methods.

* SN/Circ.207/Rev.1 – Differences between RCDS and ECDIS.

Detection of misrepresentation of information

50 Knowledge of the limitations of the equipment and detection of misrepresentation of information is essential for the safe use of ECDIS. The following factors should be emphasized during training:

.1 performance standards of the equipment;

.2 radar data representation on an electronic chart, elimination of discrepancy between the radar image and the electronic chart;

.3 possible projection discrepancies between an electronic and paper chart;

.4 possible scale discrepancies (overscaling and underscaling) in displaying an electronic chart and its original scale;

.5 effects of using different reference systems for positioning;

.6 effects of using different horizontal and vertical datums;

.7 effects of the motion of the ship in a seaway;

.8 ECDIS limitations in raster chart display mode;

.9 potential errors in the display of:

.9.1 the own ship's position;

.9.2 radar data and ARPA and AIS information;

.9.3 different geodetic coordinate systems; and

.10 verification of the results of manual or automatic data correction:

.10.1 comparison of chart data and radar picture; and

.10.2 checking the own ship's position by using the other independent positionfixing systems.

51 False interpretation of the data and proper action taken to avoid errors of interpretation should be explained. The implications of the following should be emphasized:

.1 ignoring overscaling of the display;

.2 uncritical acceptance of the own ship's position;

.3 confusion of display mode;

.4 confusion of chart scale;

.5 confusion of reference systems;

.6 different modes of presentation;

.7 different modes of vector stabilization;

.8 differences between true north and gyro north (radar);

.9 using the same data reference system;

.10 using the appropriate chart scale;

.11 using the best-suited sensor to the given situation and circumstances;

.12 entering the correct values of safety data:

.12.1 the own ship's safety contour,

.12.2 safety depth (safe water), and

.12.3 events; and

.13 proper use of all available data.

52 Appreciation that RCDS is only a navigational aid and that, when operating in the RCDS mode, the ECDIS equipment should be used together with an appropriate portfolio of up-to-date paper charts:

.1 appreciation of the differences in operation of RCDS mode as described in SN.1/Circ.207/Rev.1 "Differences between RCDS and ECDIS"; and

.2 ECDIS, in any mode, should be used in training with an appropriate portfolio of upto-date charts.

Factors affecting system performance and accuracy

53 An elementary understanding should be attained of the principles of ECDIS, together with a full practical knowledge of:

.1 starting and setting up ECDIS; connecting data sensors: satellite and radio navigation system receivers, radar, gyrocompass, log, echo-sounder; accuracy and limitations of these sensors, including effects of measurement errors and ship's position accuracy, manoeuvring on the accuracy of course indicator's performance, compass error on the accuracy of course indication, shallow water on the accuracy of log performance, log correction on the accuracy of speed calculation, disturbance (sea state) on the accuracy of an echo-sounder performance; and

.2 the current performance standards for electronic chart display and information systems adopted by the Organization*.

Practice

Setting up and maintaining display

54 Knowledge and skills should be attained in:

.1 the correct starting procedure to obtain the optimum display of ECDIS information;

.2 the selection of display presentation (standard display, display base, all other information displayed individually on demand);

.3 the correct adjustment of all variable radar/ARPA display controls for optimum display of data;

.4 the selection of convenient configuration;

.5 the selection, as appropriate, of required speed input to ECDIS;

* See relevant/appropriate performance standards adopted by the Organization.

.6 the selection of the timescale of vectors; and

.7 performance checks of position, radar/ARPA, compass, speed input sensors and ECDIS.

Operational use of electronic charts

55 Knowledge and skills should be attained in:

.1 the main characteristics of the display of ECDIS data and selecting proper information for navigational tasks;

.2 the automatic functions required for monitoring ship's safety, such as display of position, heading/gyro course, speed, safety values and time;

.3 the manual functions (by the cursor, electronic bearing line, range rings);

.4 selecting and modification of electronic chart content;

.5 scaling (including underscaling and overscaling);

.6 zooming;

.7 setting of the own ship's safety data;

.8 using a daytime or night-time display mode;

.9 reading all chart symbols and abbreviations;

.10 using different kinds of cursors and electronic bars for obtaining navigational data;

.11 viewing an area in different directions and returning to the ship's position;

.12 finding the necessary area, using geographical coordinates;

.13 displaying indispensable data layers appropriate to a navigational situation;

.14 selecting appropriate and unambiguous data (position, course, speed, etc.);

.15 entering the mariner's notes;

.16 using north-up orientation presentation and other kinds of orientation; and

.17 using true – and relativemotion modes.

Route planning

56 Knowledge and skills should be attained in:

.1 loading the ship's characteristics into ECDIS;

.2 selection of a sea area for route planning:

.2.1 reviewing required waters for the sea passage, and

.2.2 changing over of chart scale;

.3 verifying that proper and updated charts are available;

.4 route planning on a display by means of ECDIS, using the graphic editor, taking into consideration rhumb line and great-circle sailing:

.4.1 using the ECDIS database for obtaining navigational, hydrometeorological and other data;

.4.2 taking into consideration turning radius and wheelover points/lines when they are expressed on chart scale;

.4.3 marking dangerous depths and areas and exhibiting guarding depth contours;

.4.4 marking waypoints with the crossing depth contours and critical crosstrack deviations, as well as by adding, replacing and erasing of waypoints;

.4.5 taking into consideration safe speed;

.4.6 checking pre-planned route for navigational safety; and

.4.7 generating alarms and warnings;

.5 route planning with calculation in the table format, including:

.5.1 waypoints selection;

.5.2 recalling the waypoints list;

.5.3 planning notes;

.5.4 adjustment of a planned route;

.5.5 checking a pre-planned route for navigational safety;

.5.6 alternative route planning;

.5.7 saving planned routes, loading and unloading or deleting routes;

.5.8 making a graphic copy of the monitor screen and printing a route;

.5.9 editing and modification of the planned route;

.5.10 setting of safety values according to the size and manoeuvring parameters of the vessel;

.5.11 back-route planning; and

.5.12 connecting several routes.

Route monitoring

57 Knowledge and skills should be attained in:

.1 using independent data to control ship's position or using alternative systems within ECDIS;

.2 using the look-ahead function:

.2.1 changing charts and their scales;

.2.2 reviewing navigational charts;

.2.3 vector time selecting;

.2.4 predicting the ship's position for some time interval;

.2.5 changing the pre-planned route (route modification);

.2.6 entering independent data for the calculation of wind drift and current allowance;

.2.7 reacting properly to the alarm;

.2.8 entering corrections for discrepancies of the geodetic datum;

.2.9 displaying time markers on a ship's route;

.2.10 entering ship's position manually; and

.2.11 measuring coordinates, course, bearings and distances on a chart.

Alarm handling

58 Knowledge and ability to interpret and react properly to all kinds of systems, such as navigational sensors, indicators, data and charts alarms and indicator warnings, including switching the sound and visual alarm signalling system, should be attained in case of:

.1 absence of the next chart in the ECDIS database;

.2 crossing a safety contour;

.3 exceeding cross-track limits;

.4 deviation from planned route;

.5 approaching a waypoint;

.6 approaching a critical point;

.7 discrepancy between calculated and actual time of arrival to a waypoint;

.8 information on under-scaling or over-scaling;

.9 approaching an isolated navigational danger or danger area;

.10 crossing a specified area;

.11 selecting a different geodetic datum;

.12 approaching other ships;

.13 watch termination;

.14 switching timer;

.15 system test failure;

.16 malfunctioning of the positioning system used in ECDIS;

.17 failure of dead-reckoning; and

.18 inability to fix vessel's position using the navigational system.

Manual correction of a ship's position and motion parameters

59 Knowledge and skills should be attained in manually correcting:

.1 the ship's position in dead-reckoning mode, when the satellite and radio navigation system receiver is switched off;

.2 the ship's position, when automatically obtained coordinates are inaccurate; and

.3 course and speed values.

Records in the ship's log

60 Knowledge and skills should be attained in:

.1 automatic voyage recording;

.2 reconstruction of past track, taking into account:

.2.1 recording media;

.2.2 recording intervals;

.2.3 verification of database in use;

.3 viewing records in the electronic ship's log;

.4 instant recording in the electronic ship's log;

.5 changing ship's time;

.6 entering the additional data;

.7 printing the content of the electronic ship's log;

.8 setting up the automatic record time intervals;

.9 composition of voyage data and reporting; and

.10 interface with a voyage data recorder (VDR).

Chart updating

61 Knowledge and skills should be attained in:

.1 performing manual updating of electronic charts. Special attention should be paid to reference-ellipsoid conformity and to conformity of the measurement units used on a chart and in the correction text;

.2 performing semi-automatic updating of electronic charts, using the data obtained on electronic media in the electronic chart format; and

.3 performing automatic updating of electronic charts, using update files obtained via electronic data communication lines.

In the scenarios where non-updated data are employed to create a critical situation, trainees should be required to perform *ad hoc* updating of the chart.

Operational use of ECDIS where radar/ARPA is connected

62 Knowledge and skills should be attained in:

.1 connecting ARPA to ECDIS;

.2 indicating target's speed vectors;

.3 indicating target's tracks;

.4 archiving target's tracks;

.5 viewing the table of the targets;

.6 checking alignment of radar overlay with charted geographic features;

.7 simulating one or more manoeuvres;

.8 corrections to own ship's position, using a reference point captured by ARPA; and

.9 corrections using the ARPA's cursor and electronic bar.

See also section B-I/12, Guidance regarding the use of simulators (pertaining to radar and ARPA), especially paragraphs 17 to 19 and 36 to 38.

Operational use of ECDIS where AIS is connected

63 Knowledge and skills should be attained in:

.1 interface with AIS;

.2 interpretation of AIS data;

.3 indicating target's speed vectors;

.4 indicating target's tracks; and

.5 archiving target's tracks.

Operational warnings, their benefits and limitations

64 Trainees should gain an appreciation of the uses, benefits and limitations of ECDIS operational warnings and their correct setting, where applicable, to avoid spurious interference.

System operational tests

65 Knowledge and skills should be attained in:

.1 methods of testing for malfunctions of ECDIS, including functional self-testing;

.2 precautions to be taken after a malfunction occurs; and

.3 adequate back-up arrangements (take over and navigate using the back-up system).

Debriefing exercise

66 The instructor should analyse the results of all exercises completed by all trainees and print them out. The time spent on the debriefing should occupy between 10% and 15% of the total time used for simulator exercises.

Appendix 5a

Example of Trainee's Proficiency Checklist on use of ECDIS

These tasks are most effectively mastered by:

- Following a developmental sequence, and
- Practising them in navigational contexts (in other words, when underway).
- References: Type approved ECDIS *User Manual*
- Other ECDIS docs: *Technical; Operating Principles; Software Description*

Basic Tasks		
1	Identify all information panels and functions	
2	Enable/disable display of panels and functions	
3	Set screen colour palette – Day/night/etc.	
4	Become familiar with how to open panels and functions	
5	Set orientation of Main display – N/H/C	
6	Set mode of Main display – TM/RM	
7	Select Dual display – alignment/mode/orientation/scale choice	
8	Learn how to return to ownship display	
9	Reposition ownship in Relative Motion	
10	Use of EBL and VRM	
11	Select vector length	
12	Select different chart formats	
13	Load specific charts	
14	Select Chart options if available such as auto-load, auto scale, fixed	
15	Select correct scale to show chart layers – Use of zoom function	
16	Select chart display categories and layers	
17	Obtain chart object information (vector chart)	
18	Set Antigrounding – Safety Contour/Depth	
19	Set Antigrounding cue or equivalent ECDIS function	

Overall Presentation of Display		
20	Select position & time from best available source	
21	Cancel/verify/modify position offset	
22	Select chart & scale appropriate to location	
23	Create uncluttered display, depending upon context and conditions	
24	Choose most appropriate display, orientation and motion	
25	Load a pre-checked and approved Route for monitoring; load existing schedule	
26	Select Safety Parameters appropriate to own ship location, route and environment	
27	If in TM, select appropriate chart setting/look ahead value.	
Intermediate Tasks		
28	Create route plan – rough draft, save	
29	Edit route plan – Focus on Route, fine tune additional data entry	
30	Adjust distance calculations in route planning	
31	Perform safety check	
32	Create & modify Route Schedule ETD, ETA, speeds – Function Panel/Schedule	
33	Select appropriate panel for display of route monitoring data	
34	Select the appropriate active way point	
35	Set/select Route Monitoring alarms – Monitoring/Navigational Alarms if available to do so	
36	Select appropriate display layers for route monitoring	
37	Select relevant Navigation Alarms	
38	Observe alarm condition (Alarm panel)	
39	Set Time Zone for ship's time	
40	Select time icon to display – UTC/ship's time	
41	Observe & assess target information	
42	Configure ARPA settings	
43	Configure AIS settings	
44	Set anchor watch guard ring & alarm	
45	Select tidal information from vector charts	
46	View Logbook if available.	
47	Make manual entry in the Ship Log if available	
48	Unload & load existing user charts	
49	Create a user chart object	
50	Edit a user chart object	
51	Insert a manual correction	
52	Delete a manual correction	
53	Activate Man Overboard function and view available data	

Navigator Tasks		
54	Install/delete chart data	
55	Install chart updates for RNCs	
56	Install chart updates for ENCs	
57	Modify ownship settings	
58	Toggle between UTC and local time	
59	Import data files	
60	Export data files	
61	Print route plan	
62	Create SAR date if option is available	
63	Delete route plan(s)	
64	View track history graphically	
65	Playback files if option is available	

Appendix 5b

Example of Trainee's Evaluation on Simulator

The trainee operates specific functions for route monitoring in coastal and restricted waters, and obtains all relevant information for safe navigation.

- Demonstrate the following task groups on ECDIS while navigating safely in coastal & restricted setting with multiple targets in specified waters:
  - Monitor sea area,
  - Use route created by trainee including route schedule,
  - Select user layers created by trainee,
  - Validate own ship's position by alternate means,
  - Check settings such as vector time, display reset, information layers, alarms, track, sensors, and ownship configurations,
  - Use ECDIS features to assess target threats and execute course and/or speed alterations,
  - Modify route as instructed, checking for safety and adjusting schedule,
  - Assess tide and current, adjust ETA for timed arrival at waypoint as instructed,
  - Comply with COLREGS

Instructor guidelines

- Conduct simulation exercise according to exercise description:
  - Set simulation parameters
  - Define unsafe navigation as that involving a clear violation of minimum under keel clearance or CPA, where such a violation will require a retake of the underway evaluation
  - Monitoring of trainees' ECDIS use for grading of all tasks listed on the score sheet
  - Brief trainees
  - Debrief each trainee

Appendix 6

Example: Equipment set up for ECDIS training

1 Equipment specification for ECDIS Training

The following equipment specifications describe an example setup for ECDIS training; other systems may be equally acceptable provided the system can deliver equal functionality. Provided there is sufficient equipment and an acceptable layout the "ECDIS ship mini-simulator" may be used for all relevant exercises in the course. If a full bridge simulator is used for the final passage plan exercises, the trainee will be required to undertake individual watchkeeping duties.

2 Equipment specification for ECDIS classroom Training

This equipment is for ECDIS workstation classroom training to allow demonstration and practice of ECDIS functionalities. The number of workstations required will depend on the number of trainees on the course and the time needed to complete the required exercises. There is to be a sufficient number of workstations for each trainee to be able to adequately interact with the equipment and achieve the learning outcomes.

3 Trainee Workstation to include:

.1 workstation with dual monitor display to meet minimum ECDIS display requirements, compatible operating system sufficient to run ECDIS software and electronic chart data;

.2 workstation to be integrated into server network with navigational and ship control functionality to allow trainee to interact with other trainees and the instructor's workstation;

.3 the ECDIS display is to be provided on one monitor;

.4 the other monitor to provide information on ship controls, navigational instruments and radar. This could be on either a split screen or menu selection or both. For added realism, the system may also show visuals from a bridge lookout perspective if split-screen functionality is provided; and

.5 the ECDIS display to be able to show both radar and AIS data along with the chart data.

4 Instructor Workstation to include:

.1 single workstation with either dual monitor display to meet minimum ECDIS display requirements or a single larger display able to offer display requirement equivalent functionality through split-screen capability; and

.2 workstation with simulator instructor controls and monitoring software that is able to design exercises locally and execute and playback these exercises at any workstation; provided the hardware has sufficient capability, the instructor's workstation and server/network may be contained in one unit.

5 Server/Network to include:

.1 server system of sufficient capability to store and run the required software and data;

.2 simulator system software installed with suitable ownship models of different characteristics and geographical sea and coastal training areas;

.3 full network control, which is interfaced with the installed simulator software and hydrodynamic modelling data; and

.4 the transfer of data between various hardware components may be either hard-wired or using wi-fi provided there is sufficient bandwidth and continuity of service.

6 Projection Display

A projection or other visual system to be provided so that exercises for group demonstration of ECDIS functionality, ownship control and techniques of ECDIS-based navigation can be displayed for instruction, feedback and other discussions.

7 Equipment specifications for ECDIS navigational mini ship simulator

This equipment to be designed to assess the trainee's watchkeeping capability using ECDIS on a ship's bridge. This will include realistic simulation of the execution and monitoring stages of the passage plan created in earlier exercises.

8 Trainee ECDIS ownship mini simulator for use in route monitoring exercises:

.1 workstation with ECDIS software and chart data installed with compatible operating system sufficient to run installed ECDIS software and electronic chart data;

.2 three displays that can separately display ECDIS data on the first screen, radar on the second screen, and with engine control navigational equipment on the other;

.3 the ECDIS, conning, radar scenes to be capable of being displayed separately and continuously;

.4 the workstation to be connected to an ECDIS integrated ownship network with navigational and ship control functionality and to have the capability to operate in either an independent or interactive way; and

.5 the ECDIS display to be able to show both radar and AIS data along with the chart data.

9 Instructor Workstation for a mini simulator to include:

.1 workstation with suitable display and compatible operating system with installed simulator instructor control and monitoring software; and

.2 workstation to be capable of designing and executing exercises.

Note: in a multiple ownship set-up, it is preferable that the instructor's workstation is remote from the trainee's ownship simulator.

10 Server/Network for a mini simulator to include:

.1 server system of sufficient capability to store and run the required software and data; and

.2 simulator system software with suitable ownship models, geographical training areas and hydrodynamic modelling data, to provide full network control of exercises used on the workstations.

Guidance on the Implementation of Model Courses

Contents

Part 1: Preparation

1. Introduction

1.1 The success of any enterprise depends heavily on sound and effective preparations.

1.2 Although the IMO model course "package" has been made as comprehensive as possible, it is nonetheless vital that sufficient time and resources are devoted to preparation. Preparation not only involves matters concerning administration or organization, but also includes the preparation of any course notes, drawings, sketches, overhead transparencies, etc., which may be necessary.

2. General considerations

2.1 The course "package" should be studied carefully; in particular, the course syllabus and associated material must be attentively and thoroughly studied. This is vital if a clear understanding is to be obtained of what is required, in terms of resources necessary to successfully implement the course.

2.2 A "checklist", such as that set out in annex A1, should be used throughout all stages of preparation to ensure that all necessary actions and activities are being carried out in good time and in an effective manner. The checklist allows the status of the preparation procedures to be monitored, and helps in identifying the remedial actions necessary to meet deadlines. It will be necessary to hold meetings of all those concerned in presenting the course from time to time in order to assess the status of the preparation and "troubleshoot" any difficulties.

2.3 The course syllabus should be discussed with the teaching staff who are to present the course, and their views received on the particular parts they are to present. A study of the syllabus will determine whether the incoming trainees need preparatory work to meet the entry standard. The detailed teaching syllabus is constructed in "training outcome" format. Each specific outcome states precisely what the trainee must do to show that the outcome has been achieved. An example of a model course syllabus is given in annex A2. Part 3 deals with curriculum development and explains how a syllabus is constructed and used.

2.4 The teaching staff who are to present the course should construct notes or lesson plans to achieve these outcomes. A sample lesson plan for one of the areas of the sample syllabus is provided in annex A3.

2.5 It is important that the staff who present the course convey, to the person in charge of the course, their assessment of the course as it progresses.

3. Specific considerations

3.1 Scope of course

In reviewing the scope of the course, the instructor should determine whether it needs any adjustment in order to meet additional local or national requirements (see Part 3).

3.2 Course objective

.1 The course objective, as stated in the course material, should be very carefully considered so that its meaning is fully understood. Does the course objective require expansion to encompass any additional task that national or local requirements will impose upon those who successfully complete the course? Conversely, are there elements included which are not validated by national industry requirements?

.2 It is important that any subsequent assessment made of the course should include a review of the course objectives.

3.3 Entry standards

.1 If the entry standard will not be met by your intended trainee intake, those entering the course should first be required to complete an upgrading course to raise them to the stated entry level. Alternatively, those parts of the course affected could be augmented by inserting course material which will cover the knowledge required.

.2 If the entry standard will be exceeded by your planned trainee intake, you may wish to abridge or omit those parts of the course the teaching of which would be unnecessary, or which could be dealt with as revision.

.3 Study the course material with the above questions in mind and with a view to assessing whether or not it will be necessary for the trainees to carry out preparatory work prior to joining the course. Preparatory material for the trainees can range from refresher notes, selected topics from textbooks and reading of selected technical papers, through to formal courses of instruction. It may be necessary to use a combination of preparatory work and the model course material in modified form. It must be emphasized that where the model course material involves an international requirement, such as a regulation of the International Convention on Standards of Training, Certification and Watchkeeping (STCW) 1978, as amended, the standard must not be relaxed; in many instances, the intention of the Convention is to require review, revision or increased depth of knowledge by candidates undergoing training for higher certificates.

3.4 Course certificate, diploma or document

Where a certificate, diploma or document is to be issued to trainees who successfully complete the course, ensure that this is available and properly worded and that the industry and all authorities concerned are fully aware of its purpose and intent.

3.5 Course intake limitations

.1 The course designers have recommended limitations regarding the numbers of trainees who may participate in the course. As far as possible, these limitations should not be exceeded; otherwise, the quality of the course will be diluted.

.2 It may be necessary to make arrangements for accommodating the trainees and providing facilities for food and transportation. These aspects must be considered at an early stage of the preparations.

3.6 Staff requirements

.1 It is important that an experienced person, preferably someone with experience in course and curriculum development, is given the responsibility of implementing the course.

.2 Such a person is often termed a "course co-ordinator" or "course director". Other staff, such as lecturers, instructors, laboratory technicians, workshop instructors, etc., will be needed to implement the course effectively. Staff involved in presenting the course will need to be properly briefed about the course work they will be dealing with, and a system must be set up for checking the material they may be required to prepare. To do this, it will be essential to make a thorough study of the syllabus and apportion the parts of the course work according to the abilities of the staff called upon to present the work.

.3 The person responsible for implementing the course should consider monitoring the quality of teaching in such areas as variety and form of approach, relationship with trainees, and communicative and interactive skills; where necessary, this person should also provide appropriate counselling and support.

3.7 Teaching facilities and equipment

.1 Rooms and other services

It is important to make reservations as soon as is practicable for the use of lecture rooms, laboratories, workshops and other spaces.

.2 Equipment

Arrangements must be made at an early stage for the use of equipment needed in the spaces mentioned in 3.7.1 to support and carry through the work of the course. For example:

- blackboards and writing materials
- apparatus in laboratories for any associated demonstrations and experiments
- machinery and related equipment in workshops
- equipment and materials in other spaces (e.g. for demonstrating fire fighting, personal survival, etc.)

3.8 Teaching aids

Any training aids specified as being essential to the course should be constructed, or checked for availability and working order.

3.9 Audio-visual aids

Audio-visual aids (AVA) may be recommended in order to reinforce the learning process in some parts of the course. Such recommendations will be identified in Part A of the model course. The following points should be borne in mind:

.1 Overhead projectors

Check through any illustrations provided in the course for producing overhead projector (OHP) transparencies, and arrange them in order of presentation. To produce transparencies, a supply of transparency sheets is required; the illustration scan be

transferred to these via photocopying. Alternatively, transparencies can be produced by writing or drawing on the sheet. Coloured pens are useful for emphasizing salient points. Ensure that spare projector lamps (bulbs) are available.

.2 Slide projectors

If you order slides indicated in the course framework, check through them and arrange them in order of presentation. Slides are usually produced from photographic negatives. If further slides are considered necessary and cannot be produced locally, OHP transparencies should be resorted to.

.3 Cine projector

If films are to be used, check their compatibility with the projector (i.e. 16 mm, 35 mm, sound, etc.). The films must be test-run to ensure there are no breakages.

.4 Video equipment

It is essential to check the type of video tape to be used. The two types commonly used are VHS and Betamax. Although special machines exist which can play either format, the majority of machines play only one or the other type. Note that VHS and Betamax are not compatible; the correct machine type is required to match the tape. Check also that the TV raster format used in the tapes (i.e. number of lines, frames/second, scanning order, etc.) is appropriate to the TV equipment available. (Specialist advice may have to be sought on this aspect.) All video tapes should be test-run prior to their use on the course.

.5 Computer equipment

If computer-based aids are used, check their compatibility with the projector and the available software.

.6 General note

The electricity supply must be checked for correct voltage, and every precaution must be taken to ensure that the equipment operates properly and safely. It is important to use a proper screen which is correctly positioned; it may be necessary to exclude daylight in some cases. A check must be made to ensure that appropriate screens or blinds are available. All material to be presented should be test-run to eliminate any possible troubles, arranged in the correct sequence in which it is to be shown, and properly identified and cross-referenced in the course timetable and lesson plans.

3.10 IMO references

The content of the course, and therefore its standard, reflects the requirements of all the relevant IMO international conventions and the provisions of other instruments as indicated in the model course. The relevant publications can be obtained from the Publication Service of IMO, and should be available, at least to those involved in presenting the course, if the indicated extracts are not included in a compendium supplied with the course.

3.11 Textbooks

The detailed syllabus may refer to a particular textbook or textbooks. It is essential that these books are available to each student taking the course. If supplies of

textbooks are limited, a copy should be loaned to each student, who will return it at the end of the course. Again, some courses are provided with a compendium which includes all or part of the training material required to support the course.

3.12 Bibliography

Any useful supplementary source material is identified by the course designers and listed in the model course. This list should be supplied to the participants so that they are aware where additional information can be obtained, and at least two copies of each book or publication should be available for reference in the training institute library.

3.13 Timetable

If a timetable is provided in a model course, it is for guidance only. It may only take one or two presentations of the course to achieve an optimal timetable. However, even then it must be borne in mind that any timetable is subject to variation, depending on the general needs of the trainees in any one class and the availability of instructors and equipment.

Part 2: Notes on teaching technique

1. Preparation

1.1 Identify the section of the syllabus which is to be dealt with.

1.2 Read and study thoroughly all the syllabus elements.

1.3 Obtain the necessary textbooks or reference papers which cover the training area to be presented.

1.4 Identify the equipment which will be needed, together with support staff necessary for its operation.

1.5 It is essential to use a "lesson plan", which can provide a simplified format for coordinating lecture notes and supporting activities. The lesson plan breaks the material down into identifiable steps, making use of brief statements, possibly with keywords added, and indicating suitable allocations of time for each step. The use of audio-visual material should be indexed at the correct point in the lecture with an appropriate allowance of time. The audio-visual material should be test-run prior to its being used in the lecture. An example of a lesson plan is shown in annex A3.

1.6 The syllabus is structured in training outcome format and it is thereby relatively straight forward to assess each trainee's grasp of the subject matter presented during the lecture. Such assessment may take the form of further discussion, oral questions, written tests or selection-type tests, such as multiple-choice questions, based on the objectives used in the syllabus. Selection-type tests and short-answer tests can provide an objective assessment independent of any bias on the part of the assessor. For certification purposes, assessors should be appropriately qualified for the particular type of training or assessment.

REMEMBER – POOR PREPARATION IS A SURE WAY TO LOSE THE INTEREST OF A GROUP

1.7 Check the rooms to be used before the lecture is delivered. Make sure that all the equipment and apparatus are ready for use and that any support staff are also prepared and ready. In particular, check that all blackboards are clean and that a supply of writing and cleaning materials is readily available.

2. Delivery

2.1 Always face the people you are talking to; never talk with your back to the group.

2.2 Talk clearly and sufficiently loudly to reach everyone.

2.3 Maintain eye contact with the whole group as a way of securing their interest and maintaining it (i.e. do not look continuously at one particular person, nor at a point in space).

2.4 People are all different, and they behave and react in different ways. An important function of a lecturer is to maintain interest and interaction between members of a group.

2.5 Some points or statements are more important than others and should therefore be emphasized. To ensure that such points or statements are remembered, they must be restated a number of times, preferably in different words.

2.6 If a blackboard is to be used, any writing on it must be clear and large enough for everyone to see. Use colour to emphasize important points, particularly in sketches.

2.7 It is only possible to maintain a high level of interest for a relatively short period of time; therefore, break the lecture up into different periods of activity to keep interest at its highest level. Speaking, writing, sketching, use of audio-visual material, questions, and discussions can all be used to accomplish this. When a group is writing or sketching, walk amongst the group, looking at their work, and provide comment or advice to individual members of the group when necessary.

2.8 When holding a discussion, do not allow individual members of the group to monopolize the activity, but ensure that all members have a chance to express opinions or ideas.

2.9 If addressing questions to a group, do not ask them collectively; otherwise, the same person may reply each time. Instead, address the questions to individuals in turn, so that everyone is invited to participate.

2.10 It is important to be guided by the syllabus content and not to be tempted to introduce material which may be too advanced, or may contribute little to the course objective. There is often competition between instructors to achieve a level which is too advanced. Also, instructors often strongly resist attempts to reduce the level to that required by a syllabus.

2.11 Finally, effective preparation makes a major contribution to the success of a lecture. Things often go wrong; preparedness and good planning will contribute to putting things right. Poor teaching cannot be improved by good accommodation or advanced equipment, but good teaching can overcome any disadvantages that poor accommodation and lack of equipment can present.

Part 3: Curriculum development

1. Curriculum

The dictionary defines *curriculum* as a "regular course of study", while *syllabus* is defined as "a concise statement of the subjects forming a course of study". Thus, in general terms, a curriculum is simply a course, while a syllabus can be thought of as a list (traditionally, a "list of things to be taught").

2. Course content

The subjects which are needed to form a training course, and the precise skills and depth of knowledge required in the various subjects, can only be determined through an in-depth assessment of the job functions which the course participants are to be trained to perform (job analysis). This analysis determines the training needs, hence the purpose of the course (course objective). After ascertaining this, it is possible to define the scope of the course.

(**Note**: Determination of whether or not the course objective has been achieved may quite possibly entail assessment, over a period of time, of the "on-the-job performance" of those completing the course. However, the detailed learning objectives are quite specific and immediately assessable.)

3. Job analysis

A job analysis can only be properly carried out by a group whose members are representative of the organizations and bodies involved in the area of work to be covered by the course. The validation of results, via review with persons currently employed in the job concerned, is essential if undertraining and overtraining are to be avoided.

4. Course plan

Following definition of the course objective and scope, a course plan or outline can be drawn up. The potential students for the course (the trainee target group) must then be identified, the entry standard to the course decided and the prerequisites defined.

5. Syllabus

The final step in the process is the preparation of the detailed syllabus with associated timescales; the identification of those parts of textbooks and technical papers which cover the training areas to a sufficient degree to meet, but not exceed, each learning objective; and the drawing up of a bibliography of additional material for supplementary reading.

6. Syllabus content

The material contained in a syllabus is not static; technology is continuously undergoing change and there must therefore be a means for reviewing course material in order to eliminate what is redundant and introduce new material reflecting current practice. As defined above, a syllabus can be thought of as a list and, traditionally, there have always been an "examination syllabus" and a "teaching

syllabus"; these indicate, respectively, the subject matter contained in an examination paper, and the subject matter a teacher is to use in preparing lessons or lectures.

7. Training outcomes

7.1 The prime communication difficulty presented by any syllabus is how to convey the "depth" of knowledge required. A syllabus is usually constructed as a series of "training outcomes" to help resolve this difficulty.

7.2 Thus, curriculum development makes use of training outcomes to ensure that a common minimum level and breadth of attainment is achieved by all the trainees following the same course, irrespective of the training institution (i.e. teaching/ lecturing staff).

7.3 Training outcomes are trainee-oriented, in that they describe an end result which is to be achieved by the trainee as a result of a learning process.

7.4 In many cases, the learning process is linked to a skill or work activity and, to demonstrate properly the attainment of the objective, the trainee response may have to be based on practical application or use, or on work experience.

7.5 The training outcome, although aimed principally at the trainee to ensure achievement of a specific learning step, also provides a framework for the teacher or lecturer upon which lessons or lectures can be constructed.

7.6 A training outcome is specific and describes precisely what a trainee must do to demonstrate his knowledge, understanding or skill as an end product of a learning process.

7.7 The learning process is the "knowledge acquisition" or "skill development" that takes place during a course. The outcome of the process is an acquired "knowledge", "understanding", "skill"; but these terms alone are not sufficiently precise for describing a training outcome.

7.8 Verbs, such as "calculates", "defines", "explains", "lists", "solves" and "states", must be used when constructing a specific training outcome, so as to define precisely what the trainee will be enabled to do.

7.9 In the IMO model course project, the aim is to provide a series of model courses to assist instructors in developing countries to enhance or update the maritime training they provide, and to allow a common minimum standard to be achieved throughout the world. The use of training outcomes is a tangible way of achieving this desired aim.

7.10 As an example, a syllabus in training-outcome format for the subject of ship construction appears in annex A2. This is a standard way of structuring this kind of syllabus. Although, in this case, an outcome for each area has been identified – and could be used in an assessment procedure – this stage is often dropped to obtain a more compact syllabus structure.

8. Assessment

Training outcomes describe an outcome which is to be achieved by the trainee. Of equal importance is the fact that such an achievement can be measured OBJECTIVELY through an evaluation which will not be influenced by the personal opinions and judgements of the examiner. Objective testing or evaluation provides a sound base on which to make reliable judgements concerning the levels of understanding and knowledge achieved, thus allowing an effective evaluation to be made of the progress of trainees in a course.

Annex A1 – Preparation checklist

Ref	Component	Identified	Reserved	Electricity supply	Purchases	Tested	Accepted	Started	Finished	Status OK
1	Course plan									
2	Timetable									
3	Syllabus									
4	Scope									
5	Objective									
6	Entry standard									
7	Preparatory course									
8	Course certificate									
9	Participant numbers									
10	Staffing									

Co-ordinator _____

Lecturers _____

Instructors _____

Technicians _____

Other _____

Annex A1 – Preparation checklist *(continued)*

Ref	Component	Identified	Reserved	Electricity supply	Purchases	Tested	Accepted	Started	Finished	Status OK
11	Facilities									
	a) Rooms									
	Lab									
	Workshop									
	Other									
	Class									
	b) Equipment									
	Lab									
	Workshop									
	Other									
12	AVA Equipment and Materials									
	OHP									
	Slide									
	Cine									
	Video									
13	IMO Reference									
14	Textbooks									
15	Bibliography									

Annex A2 – Example of a Model Course syllabus in a subject area

Subject area : Ship construction

Prerequisite : Have a broad understanding of shipyard practice

General aims : Have knowledge of materials used in shipbuilding, specification of shipbuilding steel and process of approval

Textbooks : No specific textbook has been used to construct the syllabus, but the instructor would be assisted in preparation of lecture notes by referring to suitable books on ship construction, such as *Ship Construction* by Eyres (T12) and *Merchant Ship Construction* by Taylor (T58)

Course outline

Knowledge, understanding and proficiency		Total hours for each topic	Total hours for each subject area of required performance
Competence :			
3.1 CONTROL TRIM, STABILITY and STRESS			
3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY			
.1	Shipbuilding materials	3	
.2	Welding	3	
.3	Bulkheads	4	
.4	Watertight and weathertight doors	3	
.5	Corrosion and its prevention	4	
.6	Surveys and dry-docking	2	
.7	Stability	83	102

Part C3: Detailed teaching syllabus

Introduction

The detailed teaching syllabus is presented as a series of learning objectives. The objective, therefore, describes what the trainee must do to demonstrate that the specified knowledge or skill has been transferred.

Thus each training outcome is supported by a number of related performance elements in which the trainee is required to be proficient. The teaching syllabus shows the Required performance expected of the trainee in the tables that follow.

In order to assist the instructor, references are shown to indicate IMO references and publications, textbooks and teaching aids that instructors may wish to use in preparing and presenting their lessons.

The material listed in the course framework has been used to structure the detailed training syllabus; in particular:

- Teaching aids (indicated by A)
- IMO references (indicated by R), and
- Textbooks (indicated by T)

will provide valuable information to instructors.

Explanation of information contained in the syllabus tables

The information on each table is systematically organized in the following way. The line at the head of the table describes the FUNCTION with which the training is concerned. A function means a group of tasks, duties and responsibilities as specified in the STCW Code. It describes related activities which make up a professional discipline or traditional departmental responsibility on board.

The header of the first column denotes the **COMPETENCE** concerned. Each function comprises a number of COMPETENCES. Each competence is uniquely and consistently numbered on this model course.

In this function the competence is **Control trim, stability and stress**. It is numbered 3.1, that is the first competence in Function 3. The term “competence” should be understood as the application of knowledge, understanding, proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner.

Shown next is the required TRAINING OUTCOME. The training outcomes are the areas of knowledge, understanding and proficiency in which the trainee must be able to demonstrate knowledge and understanding. Each COMPETENCE comprises a number of training outcomes. For example, the above competence comprises three training outcomes. The first is concerned with FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY. Each training outcome is uniquely and consistently numbered in this model course. That concerned with fundamental principles of ship construction, trim and stability is uniquely numbered 3.1.1. For clarity, training outcomes are printed in black type on grey, for example TRAINING OUTCOME.

Finally, each training outcome embodies a variable number of Required performances – as evidence of competence. The instruction, training and learning should lead to the trainee meeting the specified Required performance. For the training outcome concerned with the fundamental principles of ship construction, trim and stability there are three areas of performance. These are:

3.1.1.1 Shipbuilding materials
3.1.1.2 Welding
3.1.1.3 Bulkheads

Following each numbered area of Required performance there is a list of activities that the trainee should complete and which collectively specify the standard of competence that the trainee must meet. These are for the guidance of teachers and instructors in designing lessons, lectures, tests and exercises for use in the teaching process. For example, under the topic 3.1.1.1, to meet the Required performance, the trainee should be able to:

- state that steels are alloys of iron, with properties dependent upon the type and amount of alloying materials used
- state that the specification of shipbuilding steels are laid down by classification societies
- state that shipbuilding steel is tested and graded by classification society surveyors who stamp it with approved marks

and so on.

IMO references (Rx) are listed in the column to the right-hand side. Teaching aids (Ax), videos (Vx) and text books (Tx) relevant to the training outcome and Required performances are placed immediately following the TRAINING OUTCOME title.

It is not intended that lessons are organized to follow the sequence of Required performances listed in the Tables. The Syllabus Tables are organized to match with the competence in the STCW Code Table A-II/2. Lessons and teaching should follow college practices. It is not necessary, for example, for shipbuilding materials to be studied before stability. What is necessary is that *all* of the material is covered and that teaching is effective to allow trainees to meet the standard of the Required performance.

FUNCTION 3: CONTROLLING THE OPERATION OF THE SHIP AND CARE FOR PERSONS ON BOARD AT THE MANAGEMENT LEVEL

COMPETENCE 3.1	**Control trim, stability and stress**	**IMO reference**

3.1.1 FUNDAMENTAL PRINCIPLES OF SHIP CONSTRUCTION, TRIM AND STABILITY

Textbooks: T11, T12, T35, T58, T69

Teaching aids: A1, A4, V5, V6, V7

Required performance:

1.1 Shipbuilding materials (3 hours) R1

- states that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used
- states that the specifications of shipbuilding steels are laid down by classification societies
- states that shipbuilding steel is tested and graded by classification surveyors, who stamp it with approved marks
- explains that mild steel, graded A – E, is used for most parts of the ship
- states why higher tensile steel may be used in areas of high stress, such as the sheer strake
- explains that the use of higher tensile steel in place of mild steel results in saving of weight for the same strength
- explains what is meant by:
  - tensile strength
  - ductility
  - hardness
  - toughness
- defines strain as extension divided by original length
- sketches a stress-strain curve for mild steel
- explains
  - yield point
  - ultimate tensile stress
  - modulus of elasticity
- explains that toughness is related to the tendency to brittle fracture
- explains that stress fracture may be initiated by a small crack or notch in a plate
- states that cold conditions increase the chances of brittle fracture
- states why mild steel is unsuitable for the very low temperatures involved in the containment of liquefied gases
- lists examples where castings or forgings are used in ship construction
- explains the advantages of the use of aluminium alloys in the construction of superstructures
- states that aluminium alloys are tested and graded by classification society surveyors
- explains how strength is preserved in aluminium super structures in the event of fire
- describes the special precautions against corrosion that are needed where aluminium alloy is connected to steelwork

Annex A3 – Example of a lesson plan for annex A2

Subject area : 3.1 Control trim, stability and stress **Lesson Number: 1** **Duration : 3 hours**

Training Area : 3.1.1 Fundamental principles of ship construction, trim and stability

Main element Specific training outcome in teaching sequence, with memory keys	Teaching method	Textbook	IMO reference	A/V aid	Instructor guidelines	Lecture notes	Time (minutes)
1.1 Shipbuilding materials (3 hours)							
States that steels are alloys of iron, with properties dependent upon the type and amounts of alloying materials used	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	10
States that the specifications of shipbuilding steels are laid down by classification societies	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	20
Explains that mild steel, graded A to E, is used for most parts of the ship	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	15
States why higher tensile steel may be used in areas of high stress, such as the sheer strake	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	10
Explains that use of higher tensile steel in place of mild steel results in a saving of weight for the same strength	Lecture	T12, T58	STCW II/2, A-II/2	V5 to V7	A1	Compiled by the lecturer	15