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TRAINING AND WATCHKEEPING
5th session
Agenda item 3

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VALIDATED MODEL TRAINING COURSES

Draft revised model course 1.08 on Radar Navigation at Management Level (RADAR, ARPA, Bridge Teamwork and Search and Rescue)

Note by the Secretariat

SUMMARY

Executive summary: This document provides the draft revised model course 1.08 on Radar Navigation at Management Level (RADAR, ARPA, Bridge Teamwork and Search and Rescue)

Strategic direction, if applicable: 1

Output: 1.3

Action to be taken: Paragraph 2

Related document: HTW 5/3/11

General

1 The draft revised model course 1.08 on Radar Navigation at Management Level (RADAR, ARPA, Bridge Teamwork and Search and Rescue) referred to in document HTW 5/3/11/Add.1 is set out in the annex.

Action requested of the Sub-Committee

2 The Sub-Committee is invited to consider the draft revised model course 1.08 on Radar Navigation at Management Level (RADAR, ARPA, Bridge Teamwork and Search and Rescue), as set out in the annex, together with the report of the Review Group, as set out in document HTW 5/3/11, and take action, as appropriate.

ANNEX

**DRAFT REVISED MODEL COURSE 1.08 ON RADAR NAVIGATION
AT MANAGEMENT LEVEL (RADAR, ARPA, BRIDGE TEAMWORK AND
SEARCH AND RESCUE)**

Model Course 1.08

RADAR NAVIGATION AT MANAGEMENT LEVEL (RADAR, ARPA, BRIDGE TEAMWORK AND SEARCH AND RESCUE)

2018 Edition



London, 2018

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Foreword

[To be inserted by the Secretariat]

KITACK LIM
Secretary-General

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Introduction

■ Purpose of the model courses

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

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

Because educational systems and the cultural backgrounds of trainees in maritime subjects vary considerably from country to country, the model course 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 technical intent of IMO conventions and other related recommendations.

■ Use of the model course

To use the model course, instructors 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 trainees should be taken into account during this review. 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, Instructors may delete from the course, or reduce the emphasis on items dealing with knowledge or skills already attained by trainees. Instructors should also identify any academic knowledge, skills or technical training which trainees may not have acquired.

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

Adjustment of the course objective, scope and content may also be necessary if trainees completing the course are to undertake duties in the maritime industry which

differ from the course objectives specified in the model course. Within the course outline the course designers have indicated their assessment of the time which should be allotted to each area of learning. However, it must be appreciated that these allocations are arbitrary and assume that trainees have fully met all entry requirements of the course. Instructors should, therefore, review these assessments and may need to re-allocate, as necessary, the time required to achieve each specific learning objective or training outcome.

■ Lesson plans

Having adjusted the course content to suit trainees' intake and any revision of the course objectives as appropriate, Instructors should draw up lesson plans based on the detailed syllabus. The detailed syllabus contains specific references to the textbooks or teaching materials proposed to be used 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 Instructors in the presentation of the material.

■ Presentation

The presentation of concepts and methodologies must be repeated in various ways until Instructors are satisfied that trainees have attained each specific learning objective or training objective. The syllabus is laid out in learning objective format and each objective specifies a required performance or, what trainees must be able to do as the learning or training 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;
- relevant support staff;
- teaching and other spaces;
- appropriate equipment and teaching aids;
- textbooks, appropriate technical papers, etc.; and
- other relevant reference materials.

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 in Appendix I.

■ Training and the STCW Convention

The standards of competence that have to be met by seafarers are defined in Part A of the STCW Code in the International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW Convention), 1978, as amended. This IMO model course addresses the competences and the training that is required to achieve the standards for the knowledge, understanding and proficiency (KUPs) set out in table A-II/2 of the STCW Code.

Part A provides the framework for the course, its aims and objectives and notes on suggested teaching facilities and equipment. A list of suggested teaching aids, bibliographies, IMO references and textbooks is also included as guidance.

Part B provides an outline of lectures, demonstrations and exercises for the course. A timetable is not included, but from the teaching and learning perspective, it is more important that the trainee achieves the minimum standard of competence defined in the STCW Code than that a strict timetable is followed. Depending on their experience and ability, some trainees may take longer to become proficient in some topics and sub-topics than others.

Part C gives the Detailed Teaching Syllabus. This is based on the theoretical and practical knowledge specified in the STCW Code. It is written as a series of learning objectives, in other words what the trainee is expected to be able to do as a result of the learning experience. Each of the objectives is expanded to define a required performance of knowledge, understanding and proficiency. IMO references, textbook references and suggested teaching aids are included to assist Instructors in designing lessons.

Part D gives guidance notes and additional explanations to Instructors on the topics and learning outcomes listed in Part C. For the various topics, this part presents subject matter details, activities, and recommended presentation and assessment techniques.

Part E presents a generic guide for effective evaluation/assessment of trainees. Parts C and D of this model course address the generic subject matter of Part E in greater detail.

A separate IMO model course addresses Assessment of Competence. This course explains the use of various methods for demonstrating competence and criteria for evaluating competence as tabulated in the STCW Code.

■ Validation

The guidance contained in this document has been validated by the Sub-Committee on Human Element, Training and Watchkeeping for use by Administrations and

training providers in developing relevant training programmes for the effective implementation of uniform minimum standards for training and certification of seafarers. Validation in this context means that the Sub-Committee has found no grounds to object to the contents of this model course, but has not granted its approval to the document, as the Sub-Committee does not consider any model course to be an official interpretation of IMO Instruments.

Part A: Course Framework

■ Aims

The aim of this model course is to meet the mandatory minimum standards of competence for seafarers in Navigation for the Function: Maintain safe navigation through the use of information from navigation equipment and systems to assist command decision-making at the Management Level as specified in table A-II/2 of the STCW Code.

This course provides training in use of radar, ARPA/TT and AIS reporting functions, bridge teamwork, and search and rescue for trainees at the management level on ships fitted with radar equipment. This course takes account of IMO model courses 1.07 and 7.03, and includes the training related to acquiring, analyzing and applying radar resources to manage proper command decision-making with regard to safe navigation and successful search and rescue, to meet the mandatory requirements relating to the radar system: "plan a voyage and conduct navigation", "determine position and the accuracy of resultant position fix by any means", "coordinate search and rescue operations", "establish watchkeeping arrangements and procedures" as set out in section A-II/2 of the STCW Code.

■ Objective

The objective is to provide trainees with guidance and information to gain knowledge, understanding and proficiency (KUP) required to achieve the objectives of the learning outcomes to demonstrate the standard of competence in Navigation at the Management Level assigned to shipboard duties as required in section A-II/2 and set out in table A-II/2 of the STCW Code.

Trainees who complete this course should be able to successfully demonstrate their competence at the Management Level by being:

- aware when the radar should be used, and able to supervise officers in charge of a navigational watch to select a suitable mode and range setting for particular circumstances, and to set the controls for optimal performance;
- fully aware of the limitations of the equipment in detecting targets, and able to evaluate the accuracy and reliability of information obtained and displayed;
- able to pay due attention to the functions of radar in position fixing, navigation, clearing of danger and altering course;
- able to coordinate the preparation of voyage plans, and use all effective means to ensure the implementation of voyage plans;

- able to develop a good understanding of the provisions in the Convention on the International Regulations for Preventing Collisions at Sea, 1972, relating to the use of radar;
- able to identify developing situations and ascertain risks correctly by radar and take appropriate actions, to verify the effectiveness of collision avoidance and determine the proper timing for resuming the course and speed after collision avoidance, bearing in mind that assumptions should not be made on the basis of scanty radar information; and
- able to instruct the bridge team to use radar information to determine the position of a distressed target, to approach the search and rescue spot by continuous setting-up of radar and evaluating radar information, and to manage proper informed decision-making to ensure successful coordination of the search and rescue operations.

■ **Entry standards**

This course is principally intended for trainees at the management level for radar navigation on board. Prior to entering the course, trainees should be officers in charge of a navigational watch who satisfy the minimum requirements set out in STCW Code, table A-II/1, and have completed approved seagoing service, and perform functions appropriate to the certificate held, for a period of not less than that required by the Party concerned for a certificate of competence at management level.

Trainees for certification of masters or chief mates should have completed, or be following a planned and structured programme of training; shipboard training should include tasks or projects relating to management-level duties of masters or chief mates.

Considering the particular duties of personnel at the management level, it is advised that trainees should be familiar with the basic theory of Integrated Navigation System (INS), and basic requirements set out in table A-II/1 of the STCW Code. It should also be made clear to trainees that the following contents of this course are a part of the KUPs for the relevant competence set out in table A-II/2 of the STCW Code. These include "plan a voyage and conduct navigation", "determine position and the accuracy of resultant position fix by any means", "coordinate search and rescue operations", "establish watchkeeping arrangements and procedures" and "maintain safe navigation through the use of information from navigation equipment and systems to assist command decision-making".

■ Course certificate

On successful completion of the course and assessments, a document may be issued certifying that the holder has successfully completed a training course which meets, or exceeds the level of knowledge, understanding and proficiency for the standard of competence specified in table A-II/2 of the STCW Code.

■ Course intake limitations

The course intake is limited by the number of trainees who can receive adequate individual attention from the instructor(s). The maximum trainee - instructor ratio may be up to 24 to 1 for classroom lectures, and 8 to 1 for practical sessions and simulations. Depending on the availability of radar and radar simulator equipment, the course intake should be limited to three or four trainees per radar and/or radar simulator display to allow each trainee sufficient practice in the operation of the equipment while acting various roles.

Teaching staff should note that the ratios are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, and equipment available.

■ Staff requirements

Instructors must have appropriate training in instructional techniques and training methods, and should be appropriately qualified in accordance with the provisions of STCW Code, section A-I/6. All training and assessments carried out, and instructions given, should be by qualified personnel who understand the specific objectives of the course.

To enhance the effectiveness and allow for interaction among trainees in simulator training exercises, more than two own-ship stations could be used, and in this case, an assistant instructor with similar experience would be desirable.

■ Teaching facilities and equipment

Simulators used for the training should provide a controllable environment and sufficient own-ship stations to accommodate the trainees for each course. Simulators used for training should meet the requirements set out in paragraphs 1, 4, and 5 of STCW Code, section A-I/12, and simulators for assessment should meet the requirements set out in paragraphs 2, 4, and 5 of STCW Code, section A-I/12 .

Real radar or ARPA equipment used when delivering the course should satisfy the applicable SOLAS Convention regulations and IMO performance standards for radar or ARPA equipment, as set out in annex 4 to the *Adoption of new and amended*

performance standards (resolution MSC. 64(67)), the *Performance standards for automatic radar plotting aids (ARPAs)* (resolution A.823(19)) and the *Adoption of the revised performance standards for radar equipment* (resolution MSC.192(79)).

Suitable teaching spaces equipped with the relevant facilities to facilitate the delivery of training through lectures, group exercises and discussions, as appropriate, should be provided. Appropriate multi-media equipment should be made available, where necessary.

■ Teaching aids (A)

- A1 Instructor manual (Part D of this course)
- A2 Audiovisual aids
- A3 Plotting charts and instruments
- A4 Multi-media training aids such as Videos, Computer Based Training (CBT), etc. may be used as deemed fit by Instructors when presenting this course.

■ Bibliographies (B)

- B1 *The Mariner's Handbook*. 2016. United Kingdom Hydrographic Office.
- B2 *Bridge Procedures Guide*. 2016. International Chamber of Shipping.
- B3 *Radio Regulations*. 2016. ITU.
- B4 *Aids to Navigation Guide (Navguide)*. 2014. 7th Ed, IALA.
- B5 *Maritime Buoyage System*. 2012. 7th Ed, IALA.

■ IMO References (R)

- R1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended.
- R2 International Convention for Safety of Life at Sea.
- R3 The International Regulations for Preventing Collisions at Sea, 1972 (IMO-904).
- R4 Resolution MSC.192(79): Revised Recommendation on Performance Standards for Radar Equipment, 2004.
- R5 Resolution MSC.64(67) Annex 4: Recommendation on Performance Standards for Radar Equipment, 1996.
- R6 Resolution A.823(19): Performance Standards for Automatic Radar Plotting Aids, 1995.
- R7 Resolution MSC.74(69) Annex 3: Recommendation on Performance Standards for a Universal Shipborne Automatic Identification System (AIS), 1998.
- R8 Resolution MSC.246(83): Performance Standards for Survival Craft AIS Search and Rescue Transmitters (AIS-SART) for Use in Search and Rescue Operations, 2007.

- R9 Resolution MSC.112(73): Revised Recommendation on Performance Standards for Shipborne Global Positioning System (GPS), 2000.
- R10 Resolution MSC.116(73): Recommendation on Performance Standards for Marine Transmitting Heading Devices (THDS), 2004.
- R11 IMO: Resolution MSC.96(72): Recommendation on Performance Standards for Devices to Measure and Indicate Speed and Distance, 2000.
- R12 SN.1/Circ.197: Operation of Marine Radar for SART Detection, 1997.
- R13 Resolution MSC.164(78): Revised Performance Standards for Radar Reflectors, 2004.
- R14 Resolution A.893(21): Guidelines for Voyage Planning, 1999.
- R15 Ships' Routeing, 2015 Ed.
- R16 International Aeronautical & Maritime Search and Rescue Manual, 2016 Ed.
- R17 IMO: International Convention on Maritime Search and Rescue, 1979.
- R18 IMO: GMDSS Manual, 2015 Ed.

■ **Textbooks (T)**

- T1 Bole, A, Wall, A, and Norris, A. 2014. Radar and ARPA Manual. 3rd Ed. Oxford: Elsevier Ltd.
- T2 Liu, T, Zhang, B. 2016. Shipborne Navigational Radar. Dalian, China: Dalian Maritime University Press.
- T3 Burger, W. 1999, reprinted 2008. Radar Observer's Handbook for Merchant Navy Officers. 9th ed. Glasgow: Brown, Son and Ferguson LTD.
- T4 Cockcroft, A. N. and Lameijer, J. N. F. 2012. A Guide to the Collision Avoidance Rules. 7th ed. Oxford: Elsevier Ltd.
- T5 Swift, A.J. and Bailey, T. J. 2004. Bridge Team Management: A Practical Guide. 2nd ed. London: The Nautical Institute.
- T6 Anwar, N. 2015. Navigation Advanced for Mates and Masters. 2nd Ed. Livingston: Witherby Seamanship International Ltd.

- T7 Passage Planning Principles. 2006. London and Lanarkshire: Witherbys Publishing Ltd and Seamanship International Limited.
- T8 Passage Planning Practice. 2006. London and Lanarkshire: Witherbys Publishing Ltd and Seamanship International Limited.
- T9 Frost, A. 2016. Practical Navigation for Officers of the Watch. 2nd Ed. Glasgow: Brown, Son & Ferguson LTD.

Function: navigation at the management level

STCW 2010 table A-II/2		IMO Model course 1.08		
Competence	Knowledge, Understanding and Proficiency	Topic	Sub-topic	Knowledge, Understanding and Proficiency
Plan a voyage and conduct navigation	Voyage planning and navigation for all conditions by acceptable methods of plotting ocean tracks	1	1.1	1.1.2 Requirements of SOLAS Convention for radar installation
		2	2.1	2.1 Making a voyage plan
		2	2.2	2.2 Executing a voyage plan
	Routing in accordance with the General Provisions on Ships' Routing	2	2.1	2.1 Making a voyage plan
		2	2.2	2.2 Executing a voyage plan
Determine position and the accuracy of resultant position fix by any means	Position determination in all conditions	1	1.2	1.2 Operation principles of radar system, factors affecting radar information accuracy, radar characteristics and limitations
		2	2.2	2.2 Executing a voyage plan
Coordinate search and rescue operations	A thorough knowledge of and ability to apply the procedures contained in the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual	4	4.1	4.1 Identification and confirmation of distress locating signals
		4	4.2	4.2 Use of radar in SAR operations
Establish watchkeeping arrangements and procedures	Thorough knowledge of content, application and intent of the International Regulations for Preventing Collisions at Sea, 1972, as amended	1	1.1	1.1.3 COLREG provisions on the use of radar
	Thorough knowledge of the content, application and intent of the Principles to be observed in keeping a navigational watch	1	1.1	1.1.1 Competence requirements of the STCW Code on radar navigation
Maintain safe navigation	An appreciation of system errors and	1	1.1	1.1.4 Different IMO resolutions on radar performance

through the use of information from navigation equipment and systems to assist command decision-making <i>Note:</i> Training and assessment in the use of ARPA is not required for those who serve exclusively on ships not fitted with ARPA. This limitation shall be reflected in the endorsement issued to the seafarer concerned	thorough understanding of the operational aspects of navigational systems			standards concerning target detecting ability and fallback arrangement
		1	1.2	1.2 Operation principles of radar system, factors affecting radar information accuracy, radar characteristics and limitations
		1	1.3	1.3 Awareness of radar working conditions
	Blind pilotage planning	2	2.1	2.1 Making a voyage plan
	Evaluation of navigational information derived from all sources, including radar and ARPA, in order to make and implement command decisions for collision avoidance and for directing the safe navigation of the ship	2	2.2	2.2 Executing a voyage plan
		3	3.1	3.1 Use of radar acquiring information for collision avoidance
		3	3.2	3.2 Use of radar in collision avoidance actions
	The interrelationship and optimum use of all navigational data available for conducting navigation	2	2.2	2.2 Executing a voyage plan

Part B: General Outline

■ **Lectures**

As far as possible, lectures should be presented within a familiar context and should make use of practical examples. The presentation and transfer of theoretical knowledge may be achieved in various ways by combining diagrams, pictures, sketches, computer data and radar application cases, as required.

Effective teaching methodology may involve delivery of the relevant knowledge to trainees by certain techniques, and enhancing the knowledge by further explanation. For example, the instructor may firstly introduce general contents to trainees, then illustrate each objective in detail, and finally provide a summary and conclusion. Utilization of multimedia equipment and disseminating handouts to trainees would be an effective and advisable way to supplement lectures.

■ **Practical training**

Well-designed practical training exercises that reflect the requirements set out in table A-II/2 of the STCW Code, substantially improve training outcomes. Practical training such as, the use of plotting charts and instruments, multi-media aids, and data recovery relevant to actual on-board management level tasks and duties will facilitate effective learning.

■ **Course Timetable**

No specific timetable has been included in this course. Teaching staff should note that the suggested hours for lectures, demonstrations and practical work, and length of time allocated to each objective within the sequence is for indicative purposes only. These factors may be adapted by Instructors to suit individual groups of trainees depending on their experience, ability, equipment and the number of Instructors available for teaching.

Development of a detailed timetable depends on the level of skills of the trainees entering the course and any revision work of basic principles that may be required.

Instructors must develop their own timetable depending on:

- the level of skills of trainees;
- the numbers to be trained; and
- the number of instructors,

and normal practices at the training establishment.

Preparation and planning constitute an important factor which makes a major contribution to the effective presentation of any course of instruction.

*Care should be taken when indicating the total hours for the model course and each subject presented in a model course. The approval of a detailed timetable is best left to Administrations due to their understanding of the entering candidates' knowledge and skills, the class size and the resources available to each training provider.

■ **Course Outline**

Part B is a general description of topics and the sequence of presentations. The course is divided into 4 topics and 9 sub-topics corresponding to the competence and KUPs defined in table A-II/2 of the STCW Code. The training is delivered by means of lectures and practical training exercises. Teaching staff should note that the suggested timings are for indicative purposes only, and session timing should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

The course timetable should reflect the varying needs for the different target groups. It may be possible for experienced instructors to accommodate different target groups within the same course by adjusting the timetable and presentations accordingly.

■ Course Outline

Knowledge, understanding and proficiency	Lecture (hours)	Practical training (hours)
1. Proficiency in the radar system and related resources	1.0	2.0
1.1 Requirements of STCW, SOLAS, COLREG and Performance Standards for Radar Equipment and related applications	0.3	
1.2 Operation principles of radar system, factors affecting radar information accuracy, radar characteristics and limitations	0.4	
1.3 Awareness of radar working conditions	0.3	2.0
Practical Training1 Awareness of radar working conditions		
2. Use of radar in navigation	3.0	9.0
2.1 Making a voyage plan	2.0	
2.2 Executing a voyage plan	1.0	
Practical Training 2 Use of radar in navigation		9.0
3. Use of radar in collision avoidance	3.0	9
3.1 Use of radar acquiring information for collision avoidance	1.0	
3.2 Use of radar in collision avoidance actions	2.0	
Practical Training3 Use of radar in collision avoidance		9
4. Use of radar in search and rescue (SAR)	3.0	6
4.1 Identification and confirmation of distress locating signals	1.0	
4.2 Use of radar in SAR operations	2.0	
Practical Training 4 Use of radar in search and rescue		6
Total	10.0	26

Part C: Detailed Outline

■ Introduction

Part C correlates the knowledge, understanding and proficiencies defined in the STCW Code, with the specific outcomes that trainees must acquire. Each specific outcome is presented as a topic or sub-topic. This is done so that the developer of the course, the instructor delivering the course and other model course users can focus on outcome-based learning.

The detailed teaching syllabus has been written in learning outcomes format in which the outcome describes what the trainee must do to demonstrate that the specified knowledge or skill has been acquired and the proper attitude has been developed. All the outcomes are understood to be prefixed by the words, "At the end of the session, the trainees should be able to"

In Part C, the detailed teaching syllabus breaks down each topic/sub-topic into Learning Objectives under the column of "Knowledge, understanding and proficiency". A table lists each topic or sub-topic and the corresponding guidance in Part B of the STCW Code. Teaching aids and references are significant to the detailed teaching syllabus and delivery of the course, in particular,

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

would prove to be valuable information sources to users.

The following are examples of the use of references:

- "A1" means teaching aid 1, i.e. the Instructor Manual in Part D of this model course;
- "B1" means bibliography 1;
- "R1" means IMO reference materials 1;
- "T2" means textbooks 2.

■ Lesson plans

While designing lesson plans based on the Detailed Teaching Syllabus, Instructors should arrange knowledge points appropriately, taking into account the STCW Code, the SOLAS Convention, IAMSAR, IMO Radar performance standards, and the relationship with other relevant IMO model courses, where applicable.

■ Detailed Outline

All objectives are understood to be prefixed by the words "The expected learning outcome is that trainees are able to..."

Knowledge, understanding and proficiency	IMO References	Textbooks & Bibliographies	Teaching aids
1 Proficiency in the radar system and related resources (3.0 hours)			
1.1 Requirements of STCW, SOLAS, COLREG and Performance Standards for Radar Equipment and related applications (0.3 hours)			
.1 describe the standard of competence on radar navigation in the KUPs of the STCW Code for personnel at the management level	R1		A1; A2
.2 express the resolutions on the performance standards for radar system in the SOLAS Convention, as well as the number of radar sets and bands required for ships of different tonnage	R2	T2	A1; A2
.3 illustrate the influences of COLREG on collision avoidance decision-making with regard to the use of radar to maintain a proper lookout, to determine the reasonable safe speed, to appraise the risk of collision and to take effective action timely for collision avoidance; interpret the implications and influences of scanty radar information on safe navigation	R3	T4	A1; A2
.4 generalise the requirements of different IMO resolutions on radar performance standards for radar equipment in the detection range, discrimination, detection accuracy, clutter suppression, target tracking, etc.; analyze the impact of backup and fallback arrangements in case of partial malfunction of radar system	R4; R5; R6	T1; T2; T3	A1; A2
1.2 Operation principles of radar system, factors affecting radar information accuracy, radar characteristics and limitations (0.4 hours)			
.1 analyze the principles of radar detection, information processing and display, evaluate the influence of sensor errors, noises, clutters and false echoes on radar image presentation	R4; R5; R6	T1; T2; T3	A1; A2; A4
.2 analyze the influences of errors from essential sensors on radar information, evaluate the factors that affect radar information, such as blind area, the changes	R4; R5; R6; R7; R9; R10; R11	T1; T2; T3	A1; A2; A4

of electromagnetic wave propagation, the changes of weather and sea condition, radar clutters, radar false echoes and target characteristic, etc.			
.3 predict the possible faults of bridge team in radar operation, stress the importance of team management to acquire essential and complete navigational information by operating radar properly in accordance with the operating procedures	R4; R5; R6; R7; R8; R9; R10; R11; R12; R13	T1; T2; T3; B4; B5	A1; A2; A4
.4 analyze the influences of characteristics of radar presentations and limitations on radar watchkeeping, observation, position fix, navigation, collision avoidance decision-making; assess the countermeasures to be taken	R4; R5; R6; R7; R8; R9; R10; R11; R12; R13	T1; T2; T3; B4; B5	A1; A2; A4
1.3 Awareness of radar working conditions (0.3 hours)			
.1 appraise abnormal operation of the radar system in reference to the "Scope of equipment" requirements of the IMO radar performance standards	R4; R5; R6	T1; T2; T3	A1; A2
.2 generalise the complexity of radar system; analyze the influence of radar equipment on the normal operation and radar information output	R4; R5; R6; R7; R9; R10; R11	T1; T2; T3	A1; A2
.3 analyze the adverse effects of human element on working conditions and function of the radar system due to inappropriate setup and operation; appraise radar working conditions using effective team management skills and good radar application experience	R4; R5; R6; R7; R8; R9; R10; R11; R12	T1; T2; T3	A1; A2
Practical training 1 Awareness of radar working conditions (2.0 hours)	R4; R5; R6; R7; R9; R10; R11	T1; T2; T3	A1
2 Use of radar in navigation (12.0 hours)			
2.1 Making a voyage plan (2.0 hours)			
.1 manage the bridge team, evaluate and select radar targets when making a voyage plan taking into account avoiding risks, improving accuracy, and highlighting the limitations and aiming at safe navigation	R2; R13; R14	T1; T2; T5; T6; T8; B4; B5	A1; A2; A4
.2 select suitable radar targets and fixing methods and assess the accuracy of the resulting fix considering circumstances, limitations of radar and bridge resources	R2; R13; R14	T1; T2; T5; T6; B2	A1; A2; A3; A4
.3 select and assess radar navigation objects and methods considering circumstances, limitations of radar and bridge resources	R2; R4; R13; R14	T1; T2; T5; T6; T7; T8; T9; B2	A1; A2; A3; A4

.4 select and assess reference radar navigation objects and methods to keep clear of dangers considering circumstances, limitations of radar and bridge resources	R2; R4; R13; R14	T1; T2; T5; T6; T7; T8; T9; B2	A1; A2; A3; A4
2.2 Executing a voyage plan (1.0 hours)			
.1 execute a voyage plan in coastal and narrow channel waters to ensure safety of navigation by managing bridge resources effectively, by supervising the watchkeeping officers' radar operation, by evaluating radar information prudently, and by utilizing radar resources properly and effectively	R2; R14; R15	T1; T2; T5; T6; T7; T8; T9; B2	A1; A2; A4
.2 execute a voyage plan in TSS and VTS waters to ensure safety of navigation by managing bridge resources effectively, by supervising the watchkeeping officers' radar operation, by evaluating radar information prudently, and by utilizing radar resources properly and effectively	R2; R14; R15	T1; T2; T5; T6; T7; T8; T9; B2	A1; A2; A4
.3 execute a voyage plan in/near ice-infested waters to ensure safety of navigation by managing bridge resources effectively, by supervising the watchkeeping officers' radar operation, by evaluating radar information prudently, and by utilizing radar resources properly and effectively	R2; R14	T1; T2; T5; T6; T7; T8; T9; B1	A1; A2; A4
.4 execute an anchoring plan to ensure safety of navigation by managing bridge resources effectively, by supervising the watchkeeping officers' radar operation, by evaluating radar information prudently, and by utilizing radar resources properly and effectively	R2; R14	T1; T2; T5; T6; T7; T8; T9; B2	A1; A2; A4
.5 execute a berthing and unberthing plan to ensure safety of navigation by managing bridge resources effectively, by supervising the watchkeeping officers' radar operation, by evaluating radar information prudently, and by utilizing radar resources properly and effectively	R2; R14	T1; T2; T5; T6; T7; T8; T9	A1; A2; A4
Practical training 2 Use of radar in navigation	R2; R14; R15	T1; T2; T5; T6; T7; T8; T9	A1; A2; A3
3 Use of radar in collision avoidance (12.0 hours)			
3.1 Use of radar acquiring information for collision avoidance (1.0 hours)			
.1 analyze the factors affecting the accuracy of manual plotting and evaluate the reliability of plotting information	R5	T1; T3; T4	A1; A2; A3

.2 deduce the errors of radar target tracking information, AIS reporting information and their associated information; analyze the limitations of processing delay of automatic target tracking system; and evaluate the reliability of information	R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; B4	A1; A2; A4
3.2 Use of radar in collision avoidance actions (2.0 hours)			
.1 acquire reliable collision avoidance information through radar target tracking, AIS target reporting, the association of radar tracked with AIS reported targets, manual radar plotting and equivalent systematic observation; effectively manage bridge resources; differentiate and evaluate the radar information; and properly appraise situations according to the prevailing circumstances and conditions	R3; R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; T4; B1; B2	A1; A2; A3; A4
.2 acquire reliable collision avoidance information through radar target tracking, AIS target reporting, the association of radar tracked with AIS reported targets, manual radar plotting and equivalent systematic observation; effectively manage bridge resources; differentiate and evaluate the radar information; and properly determine if risk of collision exists according to the prevailing circumstances and conditions	R3; R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; T4; B1; B2	A1; A2; A3; A4
.3 interpret conduct of vessels in sight of one another and in restricted visibility and use radar to obtain reliable collision avoidance information; differentiate and evaluate the radar information; effectively manage the bridge resources; and make proper decisions and take effective actions for collision avoidance according to the prevailing circumstances and conditions	R3; R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; T4; B1; B2	A1; A2; A3; A4
.4 acquire reliable collision avoidance information through radar target tracking, AIS target reporting, the association of radar tracked with AIS reported targets, manual radar plotting and equivalent systematic observation; effectively manage bridge resources; differentiate and evaluate the radar information; and appraise the effectiveness of collision avoidance actions according to the prevailing circumstances and conditions	R3; R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; T4; B1; B2	A1; A2; A3; A4
.5 acquire reliable collision avoidance information through manual radar plotting and trial manoeuvre; effectively manage the bridge resources; differentiate and evaluate the radar information; and determine the time of restoring the original course or/and speed according to the prevailing circumstances and conditions	R3; R4; R5; R6; R7; R9; R10; R11	T1; T2; T3; T4; B1; B2	A1; A2; A3; A4