

Training Circular No. 5 of 2004

No.11-TR(30)2003

Dated: March 22, 2004

Sub: Guidelines - Radar Observer Simulator Course (ROSC)

Maritime safety and efficiency is of utmost concern to the Directorate General of Shipping(DGS), the constituted authority of the Government of India for all maritime affairs.

It was noticed that some training institutes barely met the minimum standards set by the Directorate, while other provided training facilities that were world class. In order to bring about uniformity of training, amenities and equipment provided by all, old guidelines were revised and new ones formulated. This was done by the DGS in consultation with the training institutes and employers (shipowners and manning agencies). Draft guidelines were displayed on the website of the DGS and comments invited from interested parties, regardless of the position or office held.

Meetings of interested parties were held and modification made to the draft guidelines. In keeping with Government policy, the guidelines have been made in as transparent manner as practicable. The final guidelines for [Radar Observer Simulator Course \(ROSC\)](#) is attached herewith.

It is expected that training institutes would follow these guidelines in letter and spirit.

The above guidelines shall come into force w.e.f. [01.05.2004](#).

This issues with the approval of the Director General of Shipping and ex-officio Addl. Secretary to the Government of India.

Sd/-

(Naresh Salecha)

Sr.Dy. Director General of Shipping

**GUIDELINES FOR THE CONDUCT OF
RADAR OBSERVER SIMULATOR COURSE (ROSC)**

ISSUED BY

THE DIRECTORATE GENERAL OF SHIPPING

To avoid unnecessary repetition, reference has been made herein to DGS Order no: 1 of 2003(Guidelines for the conduct of Pre-Sea Training courses for Merchant Navy) wherever appropriate.

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RADAR OBSERVER SIMULATOR COURSE (ROSC)

1. BASIC DETAILS OF THE COURSE

1.1. *Aims*

This course provides training in the basic theory and use of radar for officers in charge of a navigational watch. It is based on the standards of competence as per Section A-II/1 of STCW 95.

Appendix M-II/1C of META Manual Vol. II & IMO Model Course 1.07 should be used in the preparation of material for this course.

1.2. *Objectives:*

A student successfully completing this course and meeting the required performance standards will recognise when radar should be in use; will select a suitable mode and range setting for the circumstances; will be able to set the controls for optimal performance; and will be aware of the limitations of the equipment in detecting targets and in terms of accuracy.

1.3. Application:

Compliance with these guidelines shall be mandatory for all institutes from **1st May 2004**.

2. QUALIFICATION & ELIGIBILITY OF STUDENTS

2.1. Entry standards:

This course is intended for students prior to certification as officers in charge of a navigational watch. Before being admitted to this course, students should have completed a minimum period of twelve months at sea.

2.2. Required attendance:

100% attendance is required for successful completion of the course. However, in exceptional circumstances, a student is allowed absence of up to one day subject to his attending the lectures missed out during the next course at the same institute. The institute shall keep proper records of such cases and intimate Chairman of respective Academic Council.

2.3. Course intake limitations:

2.3.1 The number of students shall not exceed 24 per class.

2.3.2 Course intake will be limited to not more than three students per available radar display to allow each student sufficient practice in the operation of the equipment.

3. INFRASTRUCTURE REQUIREMENT

3.1. The Radar Simulator equipment for this course shall be of a type approved or accepted by the DGS.

3.2. Paper charts for the exercise areas must be available.

3.3. Each Radar set shall be inside a soundproof cubicle (called an own ship) such that the discussions and orders given in one cubicle cannot be heard by other own ships.

3.4. Each own ship cubicle shall be not less than 4m² in area and have a chart table of appropriate size, chart table lamp and charts of the simulation areas.

3.5. There shall be a classroom of not less than 1.5m² per sanctioned strength of students for use for lectures and plotting practice.

3.6. Individual table (not less than 60 cm x 45 cm) and chair shall be provided per student. Writing tablets (chairs with attached writing surfaces) will not suffice for this course as radar plotting requires use of a textbook, plotting sheet, calculator and drawing/writing instruments.

3.7. Plotting Sheets, Parallel Rulers, Dividers, Compasses, etc.

3.8. Video Films/CDs/DVDs including 'Bridge Watchkeeping Procedures'.

3.9. Physical requirement for classrooms, black/white boards, overhead projector, screen, notice board, faculty room, study environment and teaching equipment etc are to be provided as per DGS order 1 of 2003.

3.10. The institute shall have a library-cum-reading room of not less than 36 m2 in area.

3.11. Additional infrastructure, equipment, Training Aids, Video Cassettes/CDs/DVDs and Reference Books etc., required for this course are as per

Annexure 1

4. COURSE DETAILS

4.1. Course duration: 10 days

4.2. Course outline: As per Annexure 2

4.3. Detailed Teaching Syllabus: As per Annexure 3

5. HOLIDAYS

5.1. Sundays shall be holidays.

5.2. Independence Day and Republic Day shall be compulsory holidays.

6. FACULTY REQUIREMENT

6.1. Qualifications and experience of course in charge:

6.1.1. Certificate of competency, issued or recognised by the Government of India, as Master of a Foreign Going Ship

and

6.1.2. At least 5 years service on Merchant ships

and

6.1.3. At least one year in the rank of Master

or

One year as Chief Officer and one year as regular (full time) faculty member in ROSC, ARPA Course, RANSCO, SMS Course, Pre-sea degree courses for deck cadets or Competency Courses.

6.2. Qualifications and experience of faculty members:

6.2.1. Certificate of Competency, issued or recognised by the Government of India, as Master of a Foreign Going Ship

and

6.2.2. At least 5 years service on Merchant ships of which at least one year should have been at management level.

- 6.2.3. Radio Officer with Class II Certificate of Proficiency and with seagoing experience on merchant ships may be permitted to take classroom lectures pertaining to technical aspects of Radar.

6.3. Training of Trainers & Assessors Course:

As per DGS Order no: 1 of 2003.

6.4. Visiting faculty members:

Qualifications and experience of visiting faculty members should be the same as that of regular faculty.

6.5. Age limit for regular faculty members:

As per DGS Order no: 1 of 2003.

7. FACULTY STRENGTH

7.1. Not less than one Master Mariner (inclusive of the course-in-charge who shall be on regular basis) for every three own ships.

7.2. Additional faculty members (Master Mariner and/or Radio Officer as appropriate) may be on visiting basis. The Radio Officer, if employed, must teach only theory portions.

7.3. A minimum of 50% of the entire portion must be covered by regular faculty.

8. COURSE DURATION

A total of 60 hours of lectures, practical training and assessment.

9. ASSESSMENT

At the end of the course, there shall be assessment as follows:

9.1. Plotting examination on paper with 70% as pass marks

9.2. Written examination on theory, operation and interpretation with 50% as pass marks.

9.3. Practical examination of operation of Radar and Oral on ROR.

10. QUALITY STANDARDS

As per DGS Order no: 1 of 2003.

11. INSPECTIONS

As per DGS Order no: 1 of 2003.

12. FEES TO GOVT.

As per DGS Order no: 1 of 2003.

TEACHING AIDS

Equipment

The following equipment shall be made available for conducting the course:

- Overhead Projector and Transparencies
- Plotting Sheets
- Navigation charts, Parallel Rulers, Dividers, Compass

Video films/CDs/DVDs

- Bridge Watchkeeping Procedures

Publications

IMO Model course 1.07 for Radar & ARPA

STCW 95 as amended

IMO Performance standards for radar equipment

The International Regulations for preventing Collision at Sea, 1972.

IMO Performance standards for gyro compasses

IMO Performance standards for devices to indicate speed and distance.

International convention for Safety of Life at Sea, 1974 (SOLAS 1974)

Shipborne Radar & ARPA by Capt. H. Subramaniam,

Radar Observer's Handbook for Merchant Navy Officers by W.Burger

Radar and ARPA Manual by A.G. Bole and W.O. Dineley

Radar & Electronic Navigation by Sonnenberg

A Guide to the Collision Avoidance Rules, A.N. Cockcroft and J.N.F. Lameijer.

Admiralty Manual of Navigation.

COURSE OUTLINE

Annexure 2

| S r. N o. | Subject Area | Lect ure | Demo n-stra tion using Radar | Exer cise Usin g Rada r |
|--------------------|-------------------------------------|---------------------|--|--|
| 1. | Fundamental theory | Hour s | Hours | Hour s |
| | 1.1 Fundamental principles of radar | 4 | | |
| | 1.2 Magnetic compass safe distances | 0.25 0.25 3.0 | | |

| | | | | |
|-----------|---|--|--|--|
| | 1.3 Radiation hazards and precautions 1.4 Characteristics of radar sets 1.5 External factors affecting radar detection 1.6 Factors which might cause faculty interpretation | 1.5 1.0 | | |
| | | 10.0 | 0.0 | 0.0 |
| 2. | Performance standards for Radar equipment | | | |
| | 2.1 Performance standards as per IMO A 4779XII0 2.2 Range and Bearing accuracy 2.3 Range and bearing discrimination | 0.5 0.5 0.5 | 0.5 0.5 | |
| | | 1.5 | 1.0 | 0.0 |
| 3. | Setting up and operating displays | | | |
| | 3.1 Function and adjustment of controls 3.2 Measurement of range and bearing | 2.0 1.0 | 1.0 1.0 | 1.0 1.0 |
| | | 3.0 | 2.0 | 2.0 |
| 4. | Manual Plotting (Relative Motion) | | | |
| | 4.1 The relative motion triangle 4.2 CPA and TCPA 4.3 Course, speed and aspect of targets 4.4 Reporting a target 4.5 Set and drift of current 4.6 Action taken by target | 0.5 1.0 1.0 0.5 0.5 0.5 | 0.5 1.0 0.5 0.5 1.0 1.0 | 0.5 0.5 0.25 0.25 0.5 0.5 |

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|----|--|-----|-----|------|
| | 4.7 Action taken by own ship | 1.0 | 2.0 | 0.5 |
| | 4.8 Predict action to take by own ship | | | |
| | | 5.5 | 6.5 | 3.0 |
| 5. | Manual Plotting (True Motion) | | | |
| | 5.1 Basic difference between Relative Plot & True Plot | 1.0 | | 0.25 |
| | | 1.0 | | 0.25 |
| | 5.2 Basic difference between Sea-stabilised True Plot & Ground-stabilised True Plot | 0.5 | | 0.25 |
| | 5.3 Courses & speeds of targets, aspect, action taken by targets directly from display | 0.5 | | 0.25 |
| | 5.4 CPA & TCPA by construction of relative triangle | | | |
| | | 3.0 | 0.0 | 1.0 |
| 6. | The use of radar for navigation | | | |
| | 6.1 The use of radar for position fixing | 0.5 | 1.0 | 1.0 |
| | | 0.5 | 0.5 | |
| | 6.2 Aids to radar navigation including Racon, Ramark, SART & AIS | 0.5 | 1.0 | 1.0 |
| | 6.3 Parallel indexing techniques in radar navigation | | | |
| | | 1.5 | 2.5 | 2.0 |
| 7. | Radar and COLREGS | | | |
| | 7.1 Importance of good lookout and frequent plotting | 0.5 | | |
| | 7.2 Factors affecting safe speed | 0.5 | | |
| | 7.3 Good plotting and avoidance of close quarters situations | 1.0 | | |

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| | 7.4 Substantial actions to avoid close quarters situations | 1.0 | | |
| | 7.5 Use of Radar in various situations | 1.0 | | |
| | | 4.0 | 0.0 | 0.0 |
| 8. | Review of Plotting Techniques | | | |
| | 8.1 Revision of relative motion triangle | 0.25 | | 0.5 |
| | | 0.5 | | 0.5 |
| | 8.2 Revision of obtaining course, speed and aspect of targets from true and relative plots | 0.25 | | 0.5 |
| | 8.3 Revision of obtaining CPA and TCPA from true and relative plots | 0.5 | | 0.5 |
| | 8.4 Revision of determining changes in CPA & TCPA due to alteration of course and/or speed of "own" or target ship | 0.5 | | 0.5 |
| | 8.5 Revision of determining the alteration of course and/or speed to achieve a desired CPA | 0.5 | | 0.5 |
| | 8.6 Revision of detection of alteration of course and/or speed of a target. | | | |
| | | 2.5 | 0.0 | 3.0 |
| | Sub total of each heading | 31.0 | 12.0 | 11 |
| | Total contact hours | | 54 | |
| 9 | Review and Final Assessment | | 6 | |
| | Grand total | | 60 | |
| | | | | |

(the hours herein include lectures & demonstration on Radar set, but does not include exercises using Radar or assessment).

| | | | |
|----------|--|------|------|
| 1. | Basic Theory and Operation of Marine Radar | | 10.0 |
| 1.1. | Fundamental principles of radar | 4.0 | |
| 1.1.1. | explains the principles of range and bearing measurement | | |
| 1.1.2. | explains the function and siting of components | | |
| 1.2. | Safe distances | 0.25 | |
| 1.2.1. | explains the importance of not storing radar spares nearer to magnetic compasses than the specified safe distances | | |
| 1.3. | Radiation hazards and precautions. | 0.25 | |
| 1.3.1. | states the safety precautions necessary in the vicinity of open equipment and the radiation hazard near antennae and open wave-guides. | | |
| 1.4. | The characteristics of radar sets that affect performance | 3.0 | |
| 1.4.1. | states the relationship between maximum range and pulse repetition frequency | | |
| 1.4.2. | states the relationship between detection range and transmitted energy (power and pulse length) | | |
| 1.4.3. | states the relationship between minimum range and pulse length | | |
| 1.4.4. \ | describes the effects on bearing and range accuracy of beam width, heading marker error, centring error, yawing, parallax, variable range marker, gyro error | | |
| 1.4.5. | describes the effects on bearing and range discrimination of beam width, | | |

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| | spot size, plan position indicator tube size, pulse length, gain | | |
| 1.5. | External factors affecting radar detection | 1.5 | |
| 1.5.1. | states the equation for the distance to the radar horizon and explains the relationship between antenna location and detection ranges | | |
| 1.5.2. | explains the effect of variations in refraction on radar detection range (super refraction, sub refraction, ducting, elevated duct) | | |
| 1.5.3. | explains the effect on radar detection ranges by rain, hail, snow, fog, haze. | | |
| 1.5.4. | identifies shadow areas, shadow sectors and blind sectors and their relationships to the antenna location | | |
| 1.5.5. | explains how the characteristics of targets influence their detection range (aspect, shape, composition, size) | | |
| 1.5.6. | explains how sea clutter and rain clutter may mask targets | | |
| 1.6. | Factors which might cause faulty interpretation | 1.0 | |
| 1.6.1. | explains the cause and effect of interference | | |
| 1.6.2. | explains the cause and effect of side lobe echoes | | |
| 1.6.3. | explains the cause and effect of indirect echoes | | |
| 1.6.4. | explains the cause and effect of multiple echoes | | |
| 1.6.5. | explains the cause and effect of second trace echoes | | |
| 1.6.6. | states the effect on radar performance of power lines and | | |

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| | bridges crossing rivers and estuaries | | |
| 1.6.7. | explains the effect of the ship in seaway | | |
| 2. | Performance standards for radar equipment | | 2.5 |
| 2.1. | lists the performance standards contained in IMO Res A. 477(XII) | 0.5 | |
| 2.2. | states required accuracy (range and bearing measurement) | 1.0 | |
| 2.3. | states required discrimination (range and bearing) | 1.0 | |
| 3. | Setting up and operating displays | | 5 |
| 3.1. | Function and adjustment of controls | 3 | |
| 3.1.1. | operates main controls (power, antenna) | | |
| 3.1.2. | operates transmitter controls (standby, transmit, pulse length, PRF) | | |
| 3.1.3. | adjusts receiver controls to give an optimal picture (tuning, gain, linear/logarithmic gain, sensitivity time control, fast time control) | | |
| 3.1.4. | adjusts display controls (brilliance, scale illumination, range selector, range rings, VRM, EBM, mechanical cursor, heading marker, clutter, anti-clutter) | | |
| 3.1.5. | demonstrates correct order of making adjustments and states the criteria for optimum setting of the controls | | |
| 3.1.6. | states that small or poor echoes may escape detection | | |
| 3.1.7. | describes the effects of saturation by receiver noise | | |
| 3.1.8. | explains the importance of frequent changes in range scale | | |

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|----------------|--|----------|--|
| 3.1.9. | explains the different types of display presentations - relative motion ' unstabilised; stabilised north-up, course-up; true motion | | |
| 3.1.10. | Explains sea-stabilised and ground stabilised true motion displays | | |
| 3.1.11. | explains the advantages and limitations of the different types of display modes | | |
| 3.1.12. | explains the need for compass input for relative stabilised display and compass and log input for true motion display | | |
| 3.1.13. | identifies the effects of compass error on stabilised and true motion displays | | |
| 3.1.14. | identifies the effects of transmitting log error on true motion display, manual speed input error | | |
| 3.1.15. | operates special controls (presentation, speed, re-set, course made good correction, compass repeater) | | |
| 3.1.16. | identifies maladjusted controls and explains their effects and dangers | | |
| 3.1.17. | detects and corrects maladjustments | | |
| 3.1.18. | states effects of incorrect speed setting and CMG correction on true motion displays | | |
| 3.1.19. | describes the purpose and use of the performance monitor | | |
| 3.1.20. | records radar data: (performance monitor readings, modifications, blind and shadow sector diagram) | | |
| 3.1.21. | explains how propagation conditions scan affect target detection | | |
| 3.2. | Measurement of range and bearing | 2 | |

| | | | |
|--------|---|-----|----|
| 3.2.1. | states methods and accuracy of measuring ranges (fixed range markers, VRM) | | |
| 3.2.2. | measures ranges with emphasis on accuracy | | |
| 3.2.3. | explains the methods and accuracies of measuring bearings (rotatable cursor, EBL) | | |
| 3.2.4. | measures bearings with emphasis on accuracy | | |
| 3.2.5. | checks and corrects error in range and bearing | | |
| 4. | Manual Radar Plotting (Relative Motion) | | 12 |
| 4.1. | Construct relative motion triangle | 0.5 | |
| 4.1.1. | explains a relative motion triangle various vectors and angles | | |
| 4.1.2. | constructs a relative motion triangle on a plotting chart | | |
| 4.1.3. | constructs a relative motion triangle on a reflection plotter, if provided on the display. | | |
| 4.2. | Closest point of approach (CPA) and time to closest approach (TCPA) | 1.5 | |
| 4.2.1. | Determines CPA and TCPA with relative presentation | | |
| 4.2.2. | states the factors affecting the accuracy of CPA and TCPA obtained by plotting | | |
| 4.3. | Course, speed and aspect of other ships | 2.0 | |
| 4.3.1. | determines course, speed and aspect of other ships from a relative presentation (stabilised and unstabilised) | | |
| 4.3.2. | takes range and bearings at frequent, regular intervals | | |

| | | | |
|--------|--|-----|---|
| 4.3.3. | states the factors affecting the accuracy of derived course, speed and aspect | | |
| 4.4. | Reporting a target | 1.0 | |
| 4.4.1. | makes a report stating the bearing, range, CPA, TCPA, course, speed, aspect | | |
| 4.5. | Set and drift of current | 1.0 | |
| 4.5.1. | determines set and rate of current from observations of fixed target | | |
| 4.5.2. | explains the track through water and over the ground by own ship | | |
| 4.6. | Action taken by target | 1.5 | |
| 4.6.1. | recognises the effects of changes in the course and/or speed by other ships | | |
| 4.7. | Action taken by own ship | 1.5 | |
| 4.7.1. | recognises the effects of changes in the course and/or speed by own ship | | |
| 4.8. | Predict action to be taken by own to achieve desired CPA | 3.0 | |
| 4.8.1. | Determines the action (alteration of course, speed or both) to be taken at a given time by own ship to achieve a desired CPA | | |
| 5. | Manual Radar Plotting (True Motion) | | 3 |
| 5.1. | explains the basic difference between a relative plot and a true plot | 1.0 | |
| 5.2. | explains the basic difference between a sea-stabilised true plot and a ground stabilised true plot | 1.0 | |
| 5.3. | obtains course and speed of target, aspect, action taken by target (course and/ or speed) directly from the display | 0.5 | |

| | | | |
|--------|---|-----|---|
| 5.4. | Obtains CPA and TCPA by construction of the triangle of relative velocities | 0.5 | |
| 6. | Use Radar for navigation | | 4 |
| 6.1. | The use of radar for position fixing | 1.5 | |
| 6.1.1. | states characteristics of good radar conspicuous objects | | |
| 6.1.2. | states the characteristics of objects which give poor radar response | | |
| 6.1.3. | fixes the position based on radar bearing and range | | |
| 6.1.4. | Explains possible errors and how to minimise them | | |
| 6.1.5. | Compares between visual and radar observations | | |
| 6.1.6. | cross checks the accuracy of radar against other navigational aids | | |
| 6.1.7. | compares features displayed by radar with charted features | | |
| 6.2. | Aids to radar navigation | 1.0 | |
| 6.2.1. | recognition and use of passive aids (radar reflectors) | | |
| 6.2.2. | recognition and use of active aids (ramark, racon, transponders) | | |
| 6.2.3. | recognition and use of SART & AIS | | |
| 6.2.4. | explains the use of Automatic Identification System (AIS) | | |
| 6.3. | The use of parallel indexing technique in radar navigation | 1.5 | |
| 6.3.1. | sets up and uses a PI line by electronic means | | |
| 6.3.2. | constructs and uses a PI line on a reflection plotter, if fitted | | |
| 6.3.3. | takes correct action when an echo departs from a PI line | | |

| | | | |
|---------|--|-----|-----|
| 6.3.4. | uses more than one PI line | | |
| 6.3.5. | constructs and uses lines for two range scales | | |
| 6.3.6. | states the importance of "wheel over" position | | |
| 6.3.7. | demonstrates use of "wheel over" | | |
| 6.3.8. | states the importance of safety margins | | |
| 6.3.9. | demonstrates use of safety margins | | |
| 6.3.10. | interprets real motion of vessel from a tracked echo | | |
| 6.3.11. | takes appropriate action to counteract for current: on a straight course & when manoeuvring | | |
| 6.3.12. | demonstrates use of a line of turn | | |
| 6.3.13. | constructs and uses PI for radial turns | | |
| 7. | Radar and COLREGS | | 4 |
| 7.1. | uses radar as a means of lookout, and explains the importance of continuous plotting | 0.5 | |
| 7.2. | lists factors that determine safe speed, with emphasis on factors related to radar | 0.5 | |
| 7.3. | lists factors which provide a good plot to avoid collision/close quarter situation | 1.0 | |
| 7.4. | makes substantial alteration of course or speed to avoid collision/close quarter situation | 1.0 | |
| 7.5. | states times when radar is to be used in clear weather by day, at night when there are indications that visibility may deteriorate, and at all times in congested waters | 1.0 | |
| 8. | Review of Plotting Techniques | | 2.5 |

| | | | |
|------|--|----------|--|
| 8.1. | uses plotting sheet and reflection plotter to construct the relative motion triangle and identifies the sides and angles | 0.2 5 | |
| 8.2. | determines course, speed and aspect of other ships from true and relative plots | 0.5 | |
| 8.3. | determines CPA and TCPA from true and relative plots | 0.2 5 | |
| 8.4. | determines changes in CPA and TCPA resulting from alteration of course or speed of "own" or target ship | 0.5 | |
| 8.5. | uses a relative plot to determine the alteration of course or speed needed to achieve a required CPA | 0.5 | |
| 8.6. | detects alteration of course or speed of a target and determines the alteration from a plot | 0.5 | |

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| 6.1. Qualifications and experience of course in charge: |
| 6.2. Qualifications and experience of faculty members: |
| 6.3. Training of Trainers & Assessors Course: |
| 6.4. Visiting faculty members: |

| |
|--|
| 6.5. Age limit for regular faculty members: |
| 7. FACULTY STRENGTH |
| 8. COURSE DURATION |
| 9. ASSESSMENT |
| 10. QUALITY STANDARDS |
| 11. INSPECTIONS |
| 12. FEES TO GOVT. |
| Annexure 1 - Additional equipment, etc |
| Annexure 2 ' Course outline |
| Annexure 3 ' Detailed teaching syllabus |

RADAR OBSERVER SIMULATOR COURSE (ROSC)

1. BASIC DETAILS OF THE COURSE

1.1. Aims

This course provides training in the basic theory and use of radar for officers in charge of a navigational watch. It is based on the standards of competence as per Section A-II/1 of STCW 95.

Appendix M-II/1C of META Manual Vol. II & IMO Model Course 1.07 should be used in the preparation of material for this course.

1.2. Objectives:

A student successfully completing this course and meeting the required performance standards will recognise when radar should be in use; will select a suitable mode and range setting for the circumstances; will be able to set the controls for optimal performance; and will be aware of the limitations of the equipment in detecting targets and in terms of accuracy.

1.3. Application:

Compliance with these guidelines shall be mandatory for all institutes from **1st May 2004**.

2. QUALIFICATION & ELIGIBILITY OF STUDENTS

2.1. Entry standards:

This course is intended for students prior to certification as officers in charge of a navigational watch. Before being admitted to this course, students should have completed a minimum period of twelve months at sea.

2.2. Required attendance:

100% attendance is required for successful completion of the course. However, in exceptional circumstances, a student is allowed absence of up to one day subject to his attending the lectures missed out during the next course at the same institute. The institute shall keep proper records of such cases and intimate Chairman of respective Academic Council.

2.3. Course intake limitations:

2.3.1 The number of students shall not exceed 24 per class.

2.3.2 Course intake will be limited to not more than three students per available radar display to allow each student sufficient practice in the operation of the equipment.

3. INFRASTRUCTURE REQUIREMENT

3.1. The Radar Simulator equipment for this course shall be of a type approved or accepted by the DGS.

3.2. Paper charts for the exercise areas must be available.

3.3. Each Radar set shall be inside a soundproof cubicle (called an own ship) such that the discussions and orders given in one cubicle cannot be heard by other own ships.

3.4. Each own ship cubicle shall be not less than 4m² in area and have a chart table of appropriate size, chart table lamp and charts of the simulation areas.

3.5. There shall be a classroom of not less than 1.5m² per sanctioned strength of students for use for lectures and plotting practice.

3.6. Individual table (not less than 60 cm x 45 cm) and chair shall be provided per student. Writing tablets (chairs with attached writing surfaces) will not suffice for this course as radar plotting requires use of a textbook, plotting sheet, calculator and drawing/writing instruments.

3.7. Plotting Sheets, Parallel Rulers, Dividers, Compasses, etc.

3.8. Video Films/CDs/DVDs including 'Bridge Watchkeeping Procedures'.

3.9. Physical requirement for classrooms, black/white boards, overhead projector, screen, notice board, faculty room, study environment and teaching equipment etc are to be provided as per DGS order 1 of 2003.

3.10. The institute shall have a library-cum-reading room of not less than 36 m2 in area.

3.11. Additional infrastructure, equipment, Training Aids, Video Cassettes/CDs/DVDs and Reference Books etc., required for this course are as per

Annexure 1

4. COURSE DETAILS

4.1. Course duration: 10 days

4.2. Course outline: As per Annexure 2

4.3. Detailed Teaching Syllabus: As per Annexure 3

5. HOLIDAYS

5.1. Sundays shall be holidays.

5.2. Independence Day and Republic Day shall be compulsory holidays.

6. FACULTY REQUIREMENT

6.1. Qualifications and experience of course in charge:

6.1.1. Certificate of competency, issued or recognised by the Government of India, as Master of a Foreign Going Ship

and

6.1.2. At least 5 years service on Merchant ships

and

6.1.3. At least one year in the rank of Master

or

One year as Chief Officer and one year as regular (full time) faculty member in ROSC, ARPA Course, RANSCO, SMS Course, Pre-sea degree courses for deck cadets or Competency Courses.

6.2. Qualifications and experience of faculty members:

6.2.1. Certificate of Competency, issued or recognised by the Government of India, as Master of a Foreign Going Ship

and

6.2.2. At least 5 years service on Merchant ships of which at least one year should have been at management level.

- 6.2.3. Radio Officer with Class II Certificate of Proficiency and with seagoing experience on merchant ships may be permitted to take classroom lectures pertaining to technical aspects of Radar.

6.3. Training of Trainers & Assessors Course:

As per DGS Order no: 1 of 2003.

6.4. Visiting faculty members:

Qualifications and experience of visiting faculty members should be the same as that of regular faculty.

6.5. Age limit for regular faculty members:

As per DGS Order no: 1 of 2003.

7. FACULTY STRENGTH

7.1. Not less than one Master Mariner (inclusive of the course-in-charge who shall be on regular basis) for every three own ships.

7.2. Additional faculty members (Master Mariner and/or Radio Officer as appropriate) may be on visiting basis. The Radio Officer, if employed, must teach only theory portions.

7.3. A minimum of 50% of the entire portion must be covered by regular faculty.

8. COURSE DURATION

A total of 60 hours of lectures, practical training and assessment.

9. ASSESSMENT

At the end of the course, there shall be assessment as follows:

9.1. Plotting examination on paper with 70% as pass marks

9.2. Written examination on theory, operation and interpretation with 50% as pass marks.

9.3. Practical examination of operation of Radar and Oral on ROR.

10. QUALITY STANDARDS

As per DGS Order no: 1 of 2003.

11. INSPECTIONS

As per DGS Order no: 1 of 2003.

12. FEES TO GOVT.

As per DGS Order no: 1 of 2003.

TEACHING AIDS

Equipment

The following equipment shall be made available for conducting the course:

- Overhead Projector and Transparencies
- Plotting Sheets
- Navigation charts, Parallel Rulers, Dividers, Compass

Video films/CDs/DVDs

- Bridge Watchkeeping Procedures

Publications

IMO Model course 1.07 for Radar & ARPA

STCW 95 as amended

IMO Performance standards for radar equipment

The International Regulations for preventing Collision at Sea, 1972.

IMO Performance standards for gyro compasses

IMO Performance standards for devices to indicate speed and distance.

International convention for Safety of Life at Sea, 1974 (SOLAS 1974)

Shipborne Radar & ARPA by Capt. H. Subramaniam,

Radar Observer's Handbook for Merchant Navy Officers by W.Burger

Radar and ARPA Manual by A.G. Bole and W.O. Dineley

Radar & Electronic Navigation by Sonnenberg

A Guide to the Collision Avoidance Rules, A.N. Cockcroft and J.N.F. Lameijer.

Admiralty Manual of Navigation.

COURSE OUTLINE

Annexure 2

| S r. N o. | Subject Area | Lect ure | Demo n-stra tion using Radar | Exer cise Usin g Rada r |
|--------------------|-------------------------------------|---------------------|--|--|
| 1. | Fundamental theory | Hour s | Hours | Hour s |
| | 1.1 Fundamental principles of radar | 4 | | |
| | 1.2 Magnetic compass safe distances | 0.25 0.25 3.0 | | |

| | | | | |
|-----------|---|--|--|--|
| | 1.3 Radiation hazards and precautions 1.4 Characteristics of radar sets 1.5 External factors affecting radar detection 1.6 Factors which might cause faculty interpretation | 1.5 1.0 | | |
| | | 10.0 | 0.0 | 0.0 |
| 2. | Performance standards for Radar equipment | | | |
| | 2.1 Performance standards as per IMO A 4779XII0 2.2 Range and Bearing accuracy 2.3 Range and bearing discrimination | 0.5 0.5 0.5 | 0.5 0.5 | |
| | | 1.5 | 1.0 | 0.0 |
| 3. | Setting up and operating displays | | | |
| | 3.1 Function and adjustment of controls 3.2 Measurement of range and bearing | 2.0 1.0 | 1.0 1.0 | 1.0 1.0 |
| | | 3.0 | 2.0 | 2.0 |
| 4. | Manual Plotting (Relative Motion) | | | |
| | 4.1 The relative motion triangle 4.2 CPA and TCPA 4.3 Course, speed and aspect of targets 4.4 Reporting a target 4.5 Set and drift of current 4.6 Action taken by target | 0.5 1.0 1.0 0.5 0.5 0.5 | 0.5 1.0 0.5 0.5 1.0 1.0 | 0.5 0.5 0.25 0.25 0.5 0.5 |

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|----|--|-----|-----|------|
| | 4.7 Action taken by own ship | 1.0 | 2.0 | 0.5 |
| | 4.8 Predict action to take by own ship | | | |
| | | 5.5 | 6.5 | 3.0 |
| 5. | Manual Plotting (True Motion) | | | |
| | 5.1 Basic difference between Relative Plot & True Plot | 1.0 | | 0.25 |
| | | 1.0 | | 0.25 |
| | 5.2 Basic difference between Sea-stabilised True Plot & Ground-stabilised True Plot | 0.5 | | 0.25 |
| | 5.3 Courses & speeds of targets, aspect, action taken by targets directly from display | 0.5 | | 0.25 |
| | 5.4 CPA & TCPA by construction of relative triangle | | | |
| | | 3.0 | 0.0 | 1.0 |
| 6. | The use of radar for navigation | | | |
| | 6.1 The use of radar for position fixing | 0.5 | 1.0 | 1.0 |
| | | 0.5 | 0.5 | |
| | 6.2 Aids to radar navigation including Racon, Ramark, SART & AIS | 0.5 | 1.0 | 1.0 |
| | 6.3 Parallel indexing techniques in radar navigation | | | |
| | | 1.5 | 2.5 | 2.0 |
| 7. | Radar and COLREGS | | | |
| | 7.1 Importance of good lookout and frequent plotting | 0.5 | | |
| | 7.2 Factors affecting safe speed | 0.5 | | |
| | 7.3 Good plotting and avoidance of close quarters situations | 1.0 | | |

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| | 7.4 Substantial actions to avoid close quarters situations | 1.0 | | |
| | 7.5 Use of Radar in various situations | 1.0 | | |
| | | 4.0 | 0.0 | 0.0 |
| 8. | Review of Plotting Techniques | | | |
| | 8.1 Revision of relative motion triangle | 0.25 | | 0.5 |
| | | 0.5 | | 0.5 |
| | 8.2 Revision of obtaining course, speed and aspect of targets from true and relative plots | 0.25 | | 0.5 |
| | 8.3 Revision of obtaining CPA and TCPA from true and relative plots | 0.5 | | 0.5 |
| | 8.4 Revision of determining changes in CPA & TCPA due to alteration of course and/or speed of "own" or target ship | 0.5 | | 0.5 |
| | 8.5 Revision of determining the alteration of course and/or speed to achieve a desired CPA | 0.5 | | 0.5 |
| | 8.6 Revision of detection of alteration of course and/or speed of a target. | | | |
| | | 2.5 | 0.0 | 3.0 |
| | Sub total of each heading | 31.0 | 12.0 | 11 |
| | Total contact hours | | 54 | |
| 9 | Review and Final Assessment | | 6 | |
| | Grand total | | 60 | |
| | | | | |

(the hours herein include lectures & demonstration on Radar set, but does not include exercises using Radar or assessment).

| | | | |
|----------|--|------|------|
| 1. | Basic Theory and Operation of Marine Radar | | 10.0 |
| 1.1. | Fundamental principles of radar | 4.0 | |
| 1.1.1. | explains the principles of range and bearing measurement | | |
| 1.1.2. | explains the function and siting of components | | |
| 1.2. | Safe distances | 0.25 | |
| 1.2.1. | explains the importance of not storing radar spares nearer to magnetic compasses than the specified safe distances | | |
| 1.3. | Radiation hazards and precautions. | 0.25 | |
| 1.3.1. | states the safety precautions necessary in the vicinity of open equipment and the radiation hazard near antennae and open wave-guides. | | |
| 1.4. | The characteristics of radar sets that affect performance | 3.0 | |
| 1.4.1. | states the relationship between maximum range and pulse repetition frequency | | |
| 1.4.2. | states the relationship between detection range and transmitted energy (power and pulse length) | | |
| 1.4.3. | states the relationship between minimum range and pulse length | | |
| 1.4.4. \ | describes the effects on bearing and range accuracy of beam width, heading marker error, centring error, yawing, parallax, variable range marker, gyro error | | |
| 1.4.5. | describes the effects on bearing and range discrimination of beam width, | | |

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| | spot size, plan position indicator tube size, pulse length, gain | | |
| 1.5. | External factors affecting radar detection | 1.5 | |
| 1.5.1. | states the equation for the distance to the radar horizon and explains the relationship between antenna location and detection ranges | | |
| 1.5.2. | explains the effect of variations in refraction on radar detection range (super refraction, sub refraction, ducting, elevated duct) | | |
| 1.5.3. | explains the effect on radar detection ranges by rain, hail, snow, fog, haze. | | |
| 1.5.4. | identifies shadow areas, shadow sectors and blind sectors and their relationships to the antenna location | | |
| 1.5.5. | explains how the characteristics of targets influence their detection range (aspect, shape, composition, size) | | |
| 1.5.6. | explains how sea clutter and rain clutter may mask targets | | |
| 1.6. | Factors which might cause faulty interpretation | 1.0 | |
| 1.6.1. | explains the cause and effect of interference | | |
| 1.6.2. | explains the cause and effect of side lobe echoes | | |
| 1.6.3. | explains the cause and effect of indirect echoes | | |
| 1.6.4. | explains the cause and effect of multiple echoes | | |
| 1.6.5. | explains the cause and effect of second trace echoes | | |
| 1.6.6. | states the effect on radar performance of power lines and | | |

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| | bridges crossing rivers and estuaries | | |
| 1.6.7. | explains the effect of the ship in seaway | | |
| 2. | Performance standards for radar equipment | | 2.5 |
| 2.1. | lists the performance standards contained in IMO Res A. 477(XII) | 0.5 | |
| 2.2. | states required accuracy (range and bearing measurement) | 1.0 | |
| 2.3. | states required discrimination (range and bearing) | 1.0 | |
| 3. | Setting up and operating displays | | 5 |
| 3.1. | Function and adjustment of controls | 3 | |
| 3.1.1. | operates main controls (power, antenna) | | |
| 3.1.2. | operates transmitter controls (standby, transmit, pulse length, PRF) | | |
| 3.1.3. | adjusts receiver controls to give an optimal picture (tuning, gain, linear/logarithmic gain, sensitivity time control, fast time control) | | |
| 3.1.4. | adjusts display controls (brilliance, scale illumination, range selector, range rings, VRM, EBM, mechanical cursor, heading marker, clutter, anti-clutter) | | |
| 3.1.5. | demonstrates correct order of making adjustments and states the criteria for optimum setting of the controls | | |
| 3.1.6. | states that small or poor echoes may escape detection | | |
| 3.1.7. | describes the effects of saturation by receiver noise | | |
| 3.1.8. | explains the importance of frequent changes in range scale | | |

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| 3.1.9. | explains the different types of display presentations - relative motion ' unstabilised; stabilised north-up, course-up; true motion | | |
| 3.1.10. | Explains sea-stabilised and ground stabilised true motion displays | | |
| 3.1.11. | explains the advantages and limitations of the different types of display modes | | |
| 3.1.12. | explains the need for compass input for relative stabilised display and compass and log input for true motion display | | |
| 3.1.13. | identifies the effects of compass error on stabilised and true motion displays | | |
| 3.1.14. | identifies the effects of transmitting log error on true motion display, manual speed input error | | |
| 3.1.15. | operates special controls (presentation, speed, re-set, course made good correction, compass repeater) | | |
| 3.1.16. | identifies maladjusted controls and explains their effects and dangers | | |
| 3.1.17. | detects and corrects maladjustments | | |
| 3.1.18. | states effects of incorrect speed setting and CMG correction on true motion displays | | |
| 3.1.19. | describes the purpose and use of the performance monitor | | |
| 3.1.20. | records radar data: (performance monitor readings, modifications, blind and shadow sector diagram) | | |
| 3.1.21. | explains how propagation conditions scan affect target detection | | |
| 3.2. | Measurement of range and bearing | 2 | |

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| 3.2.1. | states methods and accuracy of measuring ranges (fixed range markers, VRM) | | |
| 3.2.2. | measures ranges with emphasis on accuracy | | |
| 3.2.3. | explains the methods and accuracies of measuring bearings (rotatable cursor, EBL) | | |
| 3.2.4. | measures bearings with emphasis on accuracy | | |
| 3.2.5. | checks and corrects error in range and bearing | | |
| 4. | Manual Radar Plotting (Relative Motion) | | 12 |
| 4.1. | Construct relative motion triangle | 0.5 | |
| 4.1.1. | explains a relative motion triangle various vectors and angles | | |
| 4.1.2. | constructs a relative motion triangle on a plotting chart | | |
| 4.1.3. | constructs a relative motion triangle on a reflection plotter, if provided on the display. | | |
| 4.2. | Closest point of approach (CPA) and time to closest approach (TCPA) | 1.5 | |
| 4.2.1. | Determines CPA and TCPA with relative presentation | | |
| 4.2.2. | states the factors affecting the accuracy of CPA and TCPA obtained by plotting | | |
| 4.3. | Course, speed and aspect of other ships | 2.0 | |
| 4.3.1. | determines course, speed and aspect of other ships from a relative presentation (stabilised and unstabilised) | | |
| 4.3.2. | takes range and bearings at frequent, regular intervals | | |

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| 4.3.3. | states the factors affecting the accuracy of derived course, speed and aspect | | |
| 4.4. | Reporting a target | 1.0 | |
| 4.4.1. | makes a report stating the bearing, range, CPA, TCPA, course, speed, aspect | | |
| 4.5. | Set and drift of current | 1.0 | |
| 4.5.1. | determines set and rate of current from observations of fixed target | | |
| 4.5.2. | explains the track through water and over the ground by own ship | | |
| 4.6. | Action taken by target | 1.5 | |
| 4.6.1. | recognises the effects of changes in the course and/or speed by other ships | | |
| 4.7. | Action taken by own ship | 1.5 | |
| 4.7.1. | recognises the effects of changes in the course and/or speed by own ship | | |
| 4.8. | Predict action to be taken by own to achieve desired CPA | 3.0 | |
| 4.8.1. | Determines the action (alteration of course, speed or both) to be taken at a given time by own ship to achieve a desired CPA | | |
| 5. | Manual Radar Plotting (True Motion) | | 3 |
| 5.1. | explains the basic difference between a relative plot and a true plot | 1.0 | |
| 5.2. | explains the basic difference between a sea-stabilised true plot and a ground stabilised true plot | 1.0 | |
| 5.3. | obtains course and speed of target, aspect, action taken by target (course and/ or speed) directly from the display | 0.5 | |

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| 5.4. | Obtains CPA and TCPA by construction of the triangle of relative velocities | 0.5 | |
| 6. | Use Radar for navigation | | 4 |
| 6.1. | The use of radar for position fixing | 1.5 | |
| 6.1.1. | states characteristics of good radar conspicuous objects | | |
| 6.1.2. | states the characteristics of objects which give poor radar response | | |
| 6.1.3. | fixes the position based on radar bearing and range | | |
| 6.1.4. | Explains possible errors and how to minimise them | | |
| 6.1.5. | Compares between visual and radar observations | | |
| 6.1.6. | cross checks the accuracy of radar against other navigational aids | | |
| 6.1.7. | compares features displayed by radar with charted features | | |
| 6.2. | Aids to radar navigation | 1.0 | |
| 6.2.1. | recognition and use of passive aids (radar reflectors) | | |
| 6.2.2. | recognition and use of active aids (ramark, racon, transponders) | | |
| 6.2.3. | recognition and use of SART & AIS | | |
| 6.2.4. | explains the use of Automatic Identification System (AIS) | | |
| 6.3. | The use of parallel indexing technique in radar navigation | 1.5 | |
| 6.3.1. | sets up and uses a PI line by electronic means | | |
| 6.3.2. | constructs and uses a PI line on a reflection plotter, if fitted | | |
| 6.3.3. | takes correct action when an echo departs from a PI line | | |

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| 6.3.4. | uses more than one PI line | | |
| 6.3.5. | constructs and uses lines for two range scales | | |
| 6.3.6. | states the importance of "wheel over" position | | |
| 6.3.7. | demonstrates use of "wheel over" | | |
| 6.3.8. | states the importance of safety margins | | |
| 6.3.9. | demonstrates use of safety margins | | |
| 6.3.10. | interprets real motion of vessel from a tracked echo | | |
| 6.3.11. | takes appropriate action to counteract for current: on a straight course & when manoeuvring | | |
| 6.3.12. | demonstrates use of a line of turn | | |
| 6.3.13. | constructs and uses PI for radial turns | | |
| 7. | Radar and COLREGS | | 4 |
| 7.1. | uses radar as a means of lookout, and explains the importance of continuous plotting | 0.5 | |
| 7.2. | lists factors that determine safe speed, with emphasis on factors related to radar | 0.5 | |
| 7.3. | lists factors which provide a good plot to avoid collision/close quarter situation | 1.0 | |
| 7.4. | makes substantial alteration of course or speed to avoid collision/close quarter situation | 1.0 | |
| 7.5. | states times when radar is to be used in clear weather by day, at night when there are indications that visibility may deteriorate, and at all times in congested waters | 1.0 | |
| 8. | Review of Plotting Techniques | | 2.5 |

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|------|--|----------|--|
| 8.1. | uses plotting sheet and reflection plotter to construct the relative motion triangle and identifies the sides and angles | 0.2 5 | |
| 8.2. | determines course, speed and aspect of other ships from true and relative plots | 0.5 | |
| 8.3. | determines CPA and TCPA from true and relative plots | 0.2 5 | |
| 8.4. | determines changes in CPA and TCPA resulting from alteration of course or speed of "own" or target ship | 0.5 | |
| 8.5. | uses a relative plot to determine the alteration of course or speed needed to achieve a required CPA | 0.5 | |
| 8.6. | detects alteration of course or speed of a target and determines the alteration from a plot | 0.5 | |