INTERNATIONAL MARITIME ORGANIZATION

E

MARITIME SAFETY COMMITTEE
102nd session
Agenda item 5

MSC 102/5/14
11 February 2020
Original: ENGLISH
Pre-session public release: ☒

REGULATORY SCOPING EXERCISE FOR THE USE OF MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

Development of interim regulatory measures for operation of MASS in the Russian Federation

Submitted by the Russian Federation

SUMMARY

Executive summary:	This document provides information about the work carried out by the Russian Federation regarding the development of national legislation for the conducting of trials and subsequent operation of MASS. The generalized approach is proposed for the national and international legislation to treat the ship as a subject of law, depersonalizing the ship from its crew, which would substantially facilitate the development and amending the existing legislation for the purpose of MASS. The document also proposes the approach to interpret the existing provisions of COLREG 1972 in order to deal with the automatic passage of MASS. It is proposed to consider the approaches with a view to use them in further IMO work related to MASS.
Strategic direction, if applicable:	2
Output:	2.7
Action to be taken:	Paragraph 15
Related document:	COLREG 1972

Introduction

1 For the purpose of the wide spreading of technologies related to automatic and remote-controlled navigation of ships, the Russian Federation conducted a number of actions to test the technical means and create a legal framework for the operation of Maritime Autonomous Surface Ships (MASS) flying the flag of the Russian Federation, as part of the roadmap "MARINET" of the National Technical Initiative.

2 In 2019 a group of Russian developers and leading shipping companies started a project on prototype testing of tools for automatic and remote-controlled ship navigation on a few ships in real conditions: arctic tanker, bulk carrier in the Caspian Sea and dredging caravan in the Black Sea. The project has been supported by the Ministry of Trade and Industry, with the involvement of the Ministry of Transport of the Russian Federation and the Russian Maritime Register of Shipping.

3 The Ministry of Industry and Trade of the Russian Federation prepared a draft of federal law "on introduction of changes to the Merchant Shipping Code of the Russian Federation and certain legislative acts of the Russian Federation concerning legal arrangements which arise of the use of autonomous ships" and also a draft Government Decree "on provision of a prototype testing of maritime autonomous surface ships flying the flag of the Russian Federation". The drafts take into account the results of the project above.

4 Thus, steps would be taken in the Russian Federation to approbate the operation of MASS and use of a regulatory platform for the operation of MASS under the flag of the Russian Federation, which opens the possibilities for shipowners operating Russian ships to use the means of automatic and remote control as an experiment.

Content of works

5 Based on the results of the analysis of international and national regulatory framework, interim results of the regulatory scoping exercise (RSE) and the pilot project on approbation of automatic remote control, the following legal concept for regulating MASS has been developed in the Russian Federation. Four levels of autonomy, implied by the RSE, are considered not as ship types but as operation regimes of MASS:

- automatic performance of functions related to the operation of ship in allowable conditions (for example under determined scenarios);

- remote performance of functions related to the operation of ship in allowable conditions (for example, under normal functioning of means of operation, without emergency situations);

- remote performance of certain functions related to the operation of ship in coordination with the crew on board which performs other functions (for example, during navigation in difficult areas, during pilotage); and

- manual operation of ship with support of the means of automatic and remote operation as supplementary (for example, in case of emergency situations or accidents).

Therefore, the starting point is the existing set of functions relevant to the obligations of the crew. Depending on the level of automation, automatic functions can be excluded from the set of functions performed by the crew. Such a functional approach is consistent with the principles laid down in the STCW Convention (as amended in 2010 in Manila).

6 From the point of regulation the fundamental aspect is the presence of the crew on board (could be a reduced crew with revised functions performed) or its absence. The autonomous ship with crew on board irrespective of the set of functions performed by its members (semi-autonomous ship) gives the possibility to apply an existing regulatory framework in the field of maritime safety "as is". That very option is considered as primary for prototype testing of MASS under the Russian flag before completion of the RSE and relevant amendments to international instruments. At the same time, legal framework has been developed with regard to fully automatic ships without crew on board, which could be further refined pursuant to changes to international regulatory framework developed by IMO.

7 Key amendments to Russian law relate to the functions of master of the ship, who is now assigned to navigate the ship, as well as to a large number of administrative functions both in managing crew and in interacting with persons/bodies external to the ship (port authorities, cargo owners, border and customs authorities, etc.). In particular, the amendments stipulate that the crew of the semi-autonomous ships includes marine specialists, one of whom acts as a master of the ship, but may not fully comply with the qualification requirements for the master. Fully autonomous ship operates without the master and the functions of the master are assigned to the shipowner.

8 The responsibility for safety of the autonomous ship rests with the shipowner, who should have relevant competent officers. Such officers may be located outside the autonomous ship (ashore, or on another ship), but they should have all the necessary technical and organizational tools to operate the ship. The shipowner is also required to appoint a person responsible for operating of individual autonomous ships ("onshore master"). Technically, this person may be responsible for the operation of several ships at the same time. However, it is assumed that such a person should be other than a person appointed by the company to be in charge of ship safety as per the International Safety Management Code (ISM Code).

9 The shipowner or their representative deals with the coastal or port authorities on behalf of MASS while MASS is navigating or is anchored at port. It should be noted that under existing Russian law the shipowner is the person responsible for the operation of the ship, and many legal acts already treat the ship as an independent subject of legal relations. Therefore, a task in front of lawmakers is to modify all existing rules in a way that gives the ship a right to act as a subject of law, removing the legal personality from the master and the crew.

10 The requirements in the field of qualification and certification of officers for autonomous ships are supposed to be reflected in the national regulation on the certification of the crew for seagoing ships.

11 A list of the main legislative initiatives to ensure the appropriate use of MASS in the Russian Federation is given in the annex.

12 In order to conduct MASS trials in the Russian Federation, an Act of the Government of the Russian Federation has been drafted, which establishes an interim legal framework for MASS in full compliance with the *Interim guidelines for MASS trials* adopted by MSC (MSC.1/Circ.1604). This framework prescribes, inter alia, full compliance with COLREG 1972. To ensure this, the relevant recommendations have also been prepared, which will help to apply COLREG 1972 taking into account MASS automatic collision avoidance system. In these recommendations COLREG 1972 regulations are determined in a way which allows to define the scenarios (algorithms) of MASS movements in every possible situation, as well as the limits for the use of automatic control.

13 The said recommendations on the application of COLREG 1972 in the current version, that can be subject to the further modification following trials of MASS under the Russian flag, are given in the appendix.

Proposals

14 The Russian Federation proposes to consider legal norms presented above as a basis for further development and elaboration of international regulations for trials and operation of MASS and, in particular, to:

.1 note the information provided on the ongoing work in the Russian Federation to develop a legal framework for trials and operation of MASS;

.2 note the conceptual regulatory approach outlined above, which is based on the functions currently carried out by the crew, subject to automation for MASS along with the subsequent redistribution of non-automatic functions and the relevant reduction in the number of crew members;

.3 note the regulatory approach outlined above, under which ship is considered as an independent subject of legal relations; and

.4 support the need for a deterministic approach in interpreting the current version of COLREG 1972 regulations for the purpose of MASS automatic collision avoidance.

Action requested of the Committee

15 The Committee is invited to consider the proposals in paragraph 14 and decide as appropriate.

***

ANNEX

THE MAIN PROPOSED CHANGES IN THE LEGISLATION OF THE RUSSIAN FEDERATION TO ENSURE MASS OPERATION

1 Types of autonomous ships in the regulatory framework

Depending on the degree of automation, an autonomous ship is:

- a semi-autonomous ship, if the degree of automation of the ship allows to avoid continuous monitoring of the ship machinery, mechanisms and equipment (keeping navigation watch), as well as to avoid continuous control of ship's navigation by the crew, who nevertheless conducts general monitoring of the ship and, if necessary, carries out control of the ship, its machines and mechanisms, and, if necessary, takes measures to restore normal operation of ships' machinery and equipment; or

- a fully autonomous ship, if the degree of automation of the ship allows the ship to navigate without crew on board while observing the ship and controlling its movement by personnel located outside the ship, or without continuous monitoring and control by personnel located outside the ship.

2 Classification and certification of ships

Organizations recognized by the Russian Federation are instructed to introduce rules for classification of autonomous ships, rules for assigning categories to autonomous ships and classification certificates confirming compliance of ships with these rules.

3 Ship certificates

Since many ship certificates and documentation relate to the crew of the ship and her maintenance, there is a need to formulate regulations so that the availability or keeping of some of the ship documents for autonomous ships is not required:

- An autonomous ship, which is not operated by a crew, does not have a radio logbook, crew list, logbook, engine logbook and sanitary logbook.

- An autonomous ship is granted with a right to not have ship documents on board, and control authorities should be able to verify the documents, in this case, through the shipowner:

- Ship documents of an autonomous ship without a crew may not be on board of the ship and are presented to the regulatory authorities by the shipowner or his representative in electronic forms.

4 The master of the ship and the crew

Existing rules stipulate that the main function of the ship master is to control the ship in terms of navigation. The captain of the ship also has a large range of administrative functions for both management of the crew and interaction with external parties (port authorities, cargo owners, border and customs authorities, and etc.). In case of an autonomous ship, the navigation control function of the ship is automatic and provided either by entirely technical systems of the ship or by these systems under control of the shipowner's coastal personnel.

- The crew of the ship, except an autonomous ship, includes the captain of the ship, other persons of administrative staff and the ship's crew.

- The crew of a semi-autonomous ship includes ship specialists, one of which acts as the captain of the ship, but may not meet the full set of qualification requirements for the captain of the ship.

- A fully autonomous ship does not have a crew.

- Ship control functions, including navigation, may be performed by automatic ship equipment or by the shipowner's specialists located outside the autonomous ship.

5 Minimum safe manning

The current national legislation establishes a requirement for a minimum crew on board to ensure a safe operation of the ship, which can also be attributed to semi-autonomous ships (this raises the issue of interpreting the gradation of ensuring the safe operation of the ship considering the level of automation of ship processes). However, for fully autonomous ships, the requirement is not applicable at all.

Each ship, except a fully autonomous ship, should have a crew on board whose members are appropriately qualified and whose composition is sufficient in number.

A minimum safe manning document of a semi-autonomous ship should consider a degree of automation (autonomy) of the ship. So, if any functions of the ship traditionally performed by the crew are automatic (visual and audio watch, ship movement control, collision prevention, operation of the main and auxiliary engines, and etc.), then such functions may be excluded from the minimum safe manning eliminating the corresponding positions from the minimum ship crew or by distributing the functions of crew members between even fewer crew members.

The minimum safe manning document of an autonomous ship should address the degree of automation of an autonomous ship.

Since a fully autonomous ship does not have a crew on board, there should not be any document establishing the number of its crew.

In respect of a fully autonomous ship, a minimum safe manning document is not issued.

6 Qualification requirements for the staff

The crew of a semi-autonomous ship may consist of a limited number of specialists whose functions differ from those performed by crew members of a non-autonomous ship. The control of an autonomous ship, in the presence of a crew, and in its absence, should be supported or carried out with the help of specialists outside the autonomous ship. For both the crew members of the autonomous ship and the specialists in the management of the autonomous ships the qualification requirements must be developed and established. The most suitable legal instrument for establishing qualification requirements for the mentioned crew members and specialists is the Regulation on the certification of crew members of seagoing ships.

Qualification requirements and requirements for the seagoing experience of crew members of autonomous ships are stipulated by the Regulation on the certification of crew members of seagoing ships. Crew members of autonomous ships may combine various functions according to their occupations provided that regime of work and rest is met.

Remote control of an autonomous ship or assistance in managing an autonomous ship to the crew of an autonomous ship must be carried out by a specialist who has at least three years' experience as a captain or chief mate of a seagoing ship of at least 3,000 GT and who has additional training in the management of autonomous ships from a maritime educational institution, or a specialist with highest technical education having advanced training from a maritime educational institution with an autonomous ship management programme.

7 MASS operation

Responsibility for operation of autonomous ship lays on the crew of the ship (if any) in accordance with the distribution of functions between crew members of the autonomous ship. In general, the responsibility for the safe management of an autonomous ship lies with the shipowner, who must have specialists competent in the control of autonomous ships. Such specialists are located outside their autonomous ship (ashore, or on board other ships), but must have all the necessary technical and organizational tools to operate the ship. The shipowner is also assigned with the responsibility to appoint the person responsible for operation the autonomous ship with respect to each autonomous ship ("shore captain"). This person in charge may manage several ships at the same time, but it is assumed that this is a different person than the company's designated person responsible for safety in accordance with the requirements of the International Code for the Management of Safe Ship Operation (ISM Code). Since the operation of autonomous ships is a very specific task requiring the concentration of specific competencies, it is proposed to give the shipowner the right to arrange an autonomous ship management agreement with a specialized company competent in the management of autonomous ships. At the same time, the responsibility for the safe operation of an autonomous ship rests with the shipowner.

Depending on the degree of automation, the operation of an autonomous ship, including navigation, safety, protection of the marine environment, is carried out automatically under the supervision of the crew of the ship (if any) and under the supervision of specialists of the shipowner located outside the ship. The shipowner may entrust a company competent in the field of autonomous shipping to operate the ship by the specialists of this company located outside the ship, while the responsibility for the safe management of the ship remains with the shipowner in any case.

The shipowner of the autonomous ship must designate the person(s) responsible for the safe operation of each autonomous ship. Such person may be appointed on behalf of the shipowner by a company competent in the field of autonomous shipping and may be an employee of that company.

The shipowner of the autonomous ship provides continuous monitoring and, if necessary, control of the autonomous ship by specialists located outside the ship.

A fully autonomous ship, the level of automation of which allows an autonomous ship to navigate independently from the place of departure to its destination without continuous monitoring and control, is exempted from the requirement of continuous monitoring and control by the specialists located outside the ship.

8 Pilotage

Russian legislation stipulates that a shipmaster is not allowed to sail without a pilot on board in the area of mandatory pilotage, and an administrative penalty to the master for a violation of the requirement. Since the shipowner is responsible for the operation of the ship, and in many regulations the ship acts as an independent subject of legal regulations (not shipmaster), it is proposed in the case of pilotage to indicate the ship as the subject, not the master. Such a replacement makes the regulation more universal and applicable both to autonomous ships and non-autonomous ships.

Pilotage of an autonomous ship should be carried out both in the absence of a crew on board an autonomous ship, and in case of a reduced number and functionality of the crew of an autonomous ship. Ensuring the organization of pilotage of an autonomous ship should be assigned to the shipowner. The controls of an autonomous ship must be designed so that the pilot carrying out an autonomous ship in the pilotage area may utilize such controls. In order to provide administrative procedures regarding the management of the ship, it is proposed to establish a scheme in which during pilotage a representative of the shipowner would be on board an autonomous ship, even if the autonomous ship doesn't have crew on board.

The shipowner of the autonomous ship must ensure safe conditions for embarkation and disembarkation of the pilot on an autonomous ship without a crew, as well as access for the pilot to the ship's controls. A pilot takes aboard an autonomous ship without a crew, accompanied or after boarding a representative (representatives) of a shipowner with sufficient qualifications to operate an autonomous ship. Such a representative (representatives) of the shipowner is not a member of the crew.

In areas of mandatory pilotage, a fully autonomous ship may be exempted from mandatory pilotage at the request of the shipowner of the autonomous ship.

The pilot doesn't have the right, without the consent of the representative of the shipowner of the autonomous ship, to leave the ship before he anchors the ship, moors the ship in a safe position, puts the ship into the sea or will be replaced by another pilot.

The presence of a pilot on a ship does not negate the responsibility of the shipowner of the autonomous ship and its representative on the ship for the safe operation of the autonomous ship.

If there are sufficient grounds for doubting the correctness of the pilot's recommendations, the representative of the shipowner of the autonomous ship has the right to refuse the services of this pilot to ensure safe navigation of the ship. In the event that pilotage of the ship is mandatory, the representative of the shipowner of the autonomous ship must request the replacement of the pilot.

9 Representation of interests

It is also required to fix the legal issue of representing the interests of the shipowner and the cargo owner in the absence of a captain and other crew members on board an autonomous ship, or in a situation where the autonomous ship's crew consists only of technical specialists. Typically, the interests of a shipowner in a seaport are represented by a maritime agent. In fact, at present, it is the maritime agent that interacts with coastal services, government agencies, and makes payments in the seaport of call on behalf of the shipowner. This practice is enshrined in relation to all possible functions of representing interests, both of the shipowner and the cargo owner. At the same time, one of both can represent their interests by themselves.

The interests of the shipowner and the cargo owner of the autonomous ship are represented by the shipowner and cargo owner independently or by persons authorized by them.

The captain of the ship is entitled to conclude a rescue agreement on behalf of the shipowner and an agreement to save the property on behalf of the owner of the property. In the case of an autonomous ship, other representatives of the shipowner should be endowed with similar rights.

The captain of the ship or the representative of the shipowner of the autonomous ship has the right to conclude rescue agreements for the implementation of rescue operations on behalf of the shipowner. The captain of the ship or the shipowner (representative of the shipowner) has the right to conclude such agreements on behalf of the owner of the property on board the ship.

APPENDIX

RECOMMENDATIONS ON USING COLREG 1972 FOR AUTOMATIC COLLISION AVOIDANCE BY MASS

I. Main principles of automatic ship control

1 A maritime autonomous surface ship (MASS) is a ship equipped with automatic and remote-control systems, capable of moving in the automatic mode (automatic control mode).

2 For the purpose of application of these recommendations, navigation risks mean restrictions for ship manoeuvring to avoid collisions, such as depths, traffic separation zones, traffic lanes, the information about which is received from the remote ship control system.

3 For the purpose of application of these recommendations, the "in sight of each other" situation means that the MASS optical search system detected a target within an area of at least 12 miles.

4 Automatic ship control is possible in any water area beyond port areas, sufficient for ship manoeuvring within the limits of allowable deviation from the preset track.

5 In the automatic control mode, the ship is going along a preset track if there are no targets to avoid (other ships).

6 Ship collision avoidance in the automatic control mode is allowed if the number of dangerous target ships shall not exceed 5 within a radius of 12 miles from the ship.

7 The following zones are established around the ship for collision avoidance in the automatic control mode:

.1 A zone at a distance of 12-7 miles – the "coverage and situation appraisal zone". This zone corresponds to the scale of the radar manoeuvring tablet. A ship's lights and/or aspect angle are clearly distinguishable within this zone in good visibility conditions. Targets and their movement parameters are determined in this zone: the true course (CSE) and speed (SPD) of the other ship, the risk criteria – time to closest point of approach (TCPA) and closest point of approach (CPA).

.2 A zone at a distance of 7-5 miles – the "timely decision zone" for making decisions to avoid collision with a dangerous ship at a specified distance, i.e. calculation of a new course and/or speed.

.3 A zone at a distance of 5-2 miles – the "decision and monitoring zone". This zone is used for carrying out the manoeuvre to avoid collision with the dangerous ship and lookout for the other ship's movement. It is possible to correct own ship's manoeuvre in this zone even if the other ship has carried out a dangerous counter manoeuvre.

.4 A zone at a distance of 2 miles and less – the "close proximity zone". In this zone, if the other ship poses threat of dangerous approach, the automatic ship control system (automatic navigation system, ANS) shall command for own ship's manoeuvre to avoid collision at a distance not less than minimum allowable.

8 In all these zones, moving targets (ships) are detected continuously and the following parameters are calculated based on the source data: target bearing and distance, true course and speed, closest point of approach and time to closest point of approach, target type and dimensions (optional).

9 Collision avoidance is performed within the 12-mile zone, which allows to obtain sufficiently accurate and reliable data with regard to all means available, and reliably track all possible manoeuvres.

10 A criterion for the commencement of application of the automatic collision avoidance scenarios (algorithms) is the positively identified danger of a target within the specified collision avoidance zones. The ANS shall apply the respective collision avoidance rule and scenario to the target. If, according to the appraisal, the target does not pose a threat, the ANS does not take actions for collision avoidance.

11 The end of automatic collision avoidance (end of collision avoidance algorithm execution) is the time when the target to avoid passes a ship's traverse (the course angle becomes more than 90 degrees port or starboard) and is left behind (except for ships overtaking our ship). After that, a manoeuvre to return to the initial track is carried out (i.e. the ship returns to the previous course and speed; the course to return to the initial track is selected from the current point to the next waypoint if there are no navigation obstacles for that. If there are navigation obstacles, they shall be passed at a safe distance and an angle as close to the initial course before the manoeuvre as possible). If avoidance is performed according to a selected scenario, it may be considered normal.

12 For ships in sight of each other, automatic collision avoidance is performed for three types of dangerous approach, each of which corresponds to its own encounter sector (sector boundaries are determined relative to the centre plane of our ship):

.1 Head-in situation – rule 14 of COLREG;

.2 Overtaking – rule 13 of COLREG;

.3 Crossing situation – rule 15 of COLREG. This situation has two options – crossing from the starboard or port side.

Depending on the approach situation, the responsibilities of and actions by both ships are specified in rules 16 and 17 of COLREG.

13 "Restricted visibility" means any condition in which visibility is reduced by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes. The onset of restricted visibility conditions is defined as conditions when the optical search system does not visually detect a target identified by the ARPA within the visibility range determined by the camera height above the sea surface. In daytime (including civil twilight and nautical twilight), an additional sign of restricted visibility conditions is the absence of a clear horizon line detected by the optical search system.

14 If multiple dangerous ships are present within the zone at a distance of less than 12 miles, collision avoidance is performed according to the principle of the most dangerous ship selection. The current scenario for the most dangerous ship is considered with regard to return to the previous course and speed.

.1 If the calculated manoeuvre results in dangerous approach to other ships, current manoeuvre intensification is considered so as to avoid collision with the most dangerous ship.

.2 If the current manoeuvre intensification does not result in collision avoidance, the current scenario is considered unacceptable.

.3 If a solution is found, the effect of this manoeuvre on the situation with the remaining ships is considered, also from the point of view of the intensification of this manoeuvre. If the current manoeuvre intensification does not result in collision avoidance, the current scenario is considered unacceptable.

.4 If a solution is found, returning to the previous course and speed is considered. If returning to the previous course and speed results in dangerous approach to other ships, increasing the time of our ship keeping the course and speed resulting from the manoeuvre is considered so as to avoid the threats encountered.

.5 If increasing the time of the ship keeping the new course and new speed does not allow to avoid collision with the remaining ships, the current scenario is considered unacceptable.

.6 If the time to return to the previous course and speed is more than 30 minutes, the current scenario is considered unacceptable.

15 In the multithreaded tracking mode, continuous monitoring of actions by all ships shall be present:

.1 if the ship that our ship intends to avoid collision with is manoeuvring, the ANS shall not begin its manoeuvre if there is no certainty that its actions do not prevent our ship to manoeuvre;

.2 if a manoeuvre has already been started and the ANS finds that the other ship is manoeuvring so that it prevents our ship from carrying out its manoeuvre, the ANS shall pause its manoeuvre and, if the situation becomes worse, decrease speed to the minimum necessary to retain the ship on course;

.3 if a manoeuvre has already been started and the ANS finds a previously undetected target that may prevent our ship from carrying out its manoeuvre, the ANS shall pause its manoeuvre and, if the situation becomes worse, decrease speed to the minimum necessary to retain the ship on course.

16 Collision avoidance manoeuvres shall take into account ship parameters (length, speed, manoeuvring elements, the condition of the power plant and steering gears, wind speed and direction). If, due to these factors, the calculated manoeuvre cannot be implemented, it shall be considered as unacceptable.

17 The minimum ship speed below which ship control is lost is established individually for each ship, but is at least 3 knots on the average. The maximum speed is established individually for each ship so that the distance of stopping to standstill by the fast-astern manoeuvre with full load does not exceed 15 ship hull lengths.

18 The ANS shall signal the need to transfer to manual (remote) control in the following cases:

.1 the presence of more than 5 dangerous targets with which dangerous approach is possible at a distance of up to 12 miles;

.2 absence of a solution allowing to avoid dangerous approach; or

.3 an incorrect execution of the manoeuvre (the actual track does not correspond to the preset track).

If the ship does not transfer to manual control within three minutes after the signal, the ANS shall decrease speed to the minimum necessary to retain the ship on course and provide the signal "ship not under command".

19 The adopted safe collision avoidance zone depends on the ship dimensions (except for scenarios where a larger distance is specified).

II. Automatic collision avoidance scenarios (algorithms)

Scenario 1 Head-in ship approach

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

A target is detected at a distance of 12 miles straight ahead. The relative bearing of the target does not exceed 10 degrees, the target is steering on the opposite course. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	10 to 12 miles
5	Course angle	-10 to +10 degrees
6	Ship and target course difference (±180°) ΔK	-10 to +10degrees
7	Ship and target speed difference, ΔV	"No"

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure:

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in section I.

- Check that the manoeuvre is safe concerning navigation.

Option 1

Alter the ship course to starboard so that to pass target 1 on the port side at a distance not less than minimum allowable.

Option 2 (if option 1 is unacceptable)

Alter the ship course to starboard and decrease speed by one step so that to pass target 1 on the port side at a distance not less than minimum allowable.

Option 3 (if options 1 and 2 are unacceptable)

Alter the ship course to starboard and decrease speed by two steps so that to pass target 1 on the port side at a distance not less than minimum allowable.

Option 4 (if options 1, 2 and 3 are unacceptable)

Increase the allowable distance by 1.5 times. Alter the ship course to port so that to pass target 1 on the starboard side at a distance not less than minimum allowable.

Option 5 (if options 1, 2, 3 and 4 are unacceptable)

Increase the allowable distance by 1.5 times. Alter the ship course to port and decrease speed by one step so that to pass target 1 on the starboard side at a distance not less than minimum allowable.

Option 6 (if options 1, 2, 3, 4 and 5 are unacceptable)

Increase the allowable distance by 1,5 times. Alter the ship course to port and decrease speed by two steps so that to pass the target on the starboard side at a distance not less than minimum allowable.

Scenario 2 Overtaking: avoiding collision with overtaking ship

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

A target is detected at a distance of 12 miles. The relative bearing of the target exceeds 125 degrees, the target bearing is not changing, the distance is decreasing. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

To prevent from incorrect interpretations, the situation shall be considered an overtaking if:

- the relative bearing of the overtaking ship is 125 degrees or more; or
- the relative bearing of the ship being overtaken is 65 degrees or less.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	less than 2 miles
5	Course angle	-125 to +125 degrees
6	Ship and target course difference ΔK	**± 15°**
7	Ship and target speed difference, ΔV	"Yes"

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre procedure if the overtaking ship does not take any actions:

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

Option 1

When the distance decreases to below two miles, turn to the side opposite to that on which the target is overtaking our ship, so that to pass target 1 at a distance not less than minimum allowable.

Option 2 (if option 1 is unacceptable)

When the distance decreases to below two miles, turn to the side opposite to that on which the target is overtaking our ship and decrease speed by one step so that to pass target 1 at a distance not less than minimum allowable.

Scenario 3 Overtaking: avoiding collision with ship being overtaken

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

A target is detected at a distance of 12 miles. The relative bearing of the target does not exceed 65 degrees, the target bearing is not changing, the distance is decreasing. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	less than 5 miles
5	Course angle	-65 to +65 degrees
6	Ship and target course difference ΔK	**± 15°**
7	Ship and target speed difference, ΔV	"Yes"

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1.	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2.	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.
- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.
- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.
- Calculate the time to return to the previous course and speed.
- Calculate the course to return to the desired track to paragraph 11 in Section I.
- Check that the manoeuvre is safe concerning navigation.

Option 1

Turn to the side on which our ship is overtaking the target, so that to pass target 1 at a distance not less than minimum allowable.

Option 2 (if option 1 is unacceptable)

Turn to the side on which our ship is overtaking the target and decrease speed by one step so that to pass target 1 at a distance not less than minimum allowable.

Scenario 4 Crossing situation: both ships have equal priority in the context of rule 18. Actions by give-way ship

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

The target is detected at a distance of less than 12 miles. The relative bearing of the target is within 10° starboard and 125° starboard, the target is steering on a crossing course. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	10 to 12 miles
5	Course angle	10° starboard to 125°starboard
6	Ship and target course difference (±180°) ΔK	15° to 170°

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No";

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$(ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 25 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to item 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation

Option 1

Option 1 is used of the distance exceeds 5 miles. If the distance is 5 miles or less, the ANS goes to option 2 immediately.

.1 Select an angle of altering the ship course to starboard so that CPA is at least 1,3 times more than the allowable distance, by cycling through angles of 45º, 60º, 75º, 90º. The ANS commands a turn to starboard by the first angle selected. If the turning angle cannot be found, the ANS goes to the following option.

.2 The ANS finds time at which returning to the previous course and speed is possible, so that to pass target 1 at a distance not less than minimum allowable. This time is continuously being checked and corrected with regard to the current situation. When the point of return is reached, the ANS commands to return to the previous course and speed.

.3 The ship goes parallel to the track course until target 1 has been passed at a distance not less than minimum allowable. After passing, the ANS returns the ship to the desired track goes on to paragraph 11 in Section I.

Option 2 (if option 1 is unacceptable)

An angle of turning to starboard is selected so that to pass target 1 at a distance not less than minimum allowable (this option may be required if the speed of our ship is considerably less than the speed of the target).

Option 3 (if options 1 and 2 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 1.

Option 4 (if options 1, 2 and 3 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 2.

Option 5 (if options 1, 2, 3 and 4 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 1.

Option 6 (if options 1, 5, 3, 4 and 5 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 2.

Options 7-12 (if options 1-6 are unacceptable)

The allowable distance is increased by 1,5 times. Options 1-6 are repeated in sequence for turning to port.

Scenario 5 Crossing situation: both ships have equal priority in the context of rule 18. Actions by ship required to keep her course and speed

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

The target is detected at a distance of less than 5 miles. The relative bearing of the target is within 10° port and 125° port, the target is steering on a crossing course. It becomes evident that the give-way ship is not taking the actions required by COLREG. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	2 to 5 miles
5	Course angle	10° port to 125° port
6	Ship and target course difference (±180°) ΔK	15° to 170°

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No";

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.
- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph18 in Section I.
- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.
- Calculate the time to return to the previous course and speed.
- Calculate the course to return to the desired track according to paragraph 11 in Section I.
- Check that the manoeuvre is safe concerning navigation.

Option 1

An angle of turning to starboard is selected so that to pass target 1 at a distance not less than minimum allowable.

Option 2 (if option 1 is unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 1.

Option 3 (if options 1 and 2 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 1.

Options 4-6 (if options 1-3 are unacceptable)

The allowable distance is increased by 1,5 times. Options 1-3 are repeated in sequence for turning to port.

Scenario 6 Crossing situation: ships have equal priority in the context of rule 18. Actions by give-way ship

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

The target is detected at a distance of less than 12 miles. The relative bearing of the target is within 10° starboard and 125° starboard or 10° port and 125° port, the target is steering on a crossing course. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course. The target has priority in the context of rule 18.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	10 to 12 miles
5	Course angle	10° starboard to 125° starboard or 10° port to 125° port
6	Ship and target course difference (±180°) ΔK	15° to 170°

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 25 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

Option 1

Option 1 is used of the distance exceeds 5 miles. If the distance is 5 miles or less, the ANS goes to option 2 immediately.

- Select an angle of altering the ship course to starboard so that CPA is at least 1.3 times more than the allowable distance, by cycling through angles of 45º, 60º, 75º, 90º. The ANS commands a turn to starboard by the first angle selected. If the turning angle cannot be found, the ANS goes to the following option.

- The ANS finds time at which returning to the previous course and speed is possible, so that to pass target 1 at a distance not less than minimum allowable. This time is continuously being checked and corrected with regard to the current situation. When the point of return is reached, the ANS commands to return to the previous course and speed.

- The ship goes parallel to the track course until target 1 has been passed at a distance not less than minimum allowable. After passing, the ANS returns the ship to the desired track according to paragraph 11 in Section I.

Option 2 (if option 1 is unacceptable)

An angle of turning to starboard is selected so that to pass target 1 at a distance not less than minimum allowable (this option may be required if the speed of our ship is considerably less than the speed of the target).

Option 3 (if options 1 and 2 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 1.

Option 4 (if options 1, 2 and 3 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 2.

Option 5 (if options 1, 2, 3 and 4 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 1.

Option 6 (if options 1-5 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 2.

Options 7-12 (if options 1-6 are unacceptable)

Increase the allowable distance by 1.5 times. Options 1-6 are repeated in sequence for turning to port.

Scenario 7 Crossing situation: ships have equal priority in the context of rule 18. Actions by ship required to keep her course and speed

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

The target is detected at a distance of less than 5 miles. The relative bearing of the target is within 10° starboard and 125° starboard or 10° port and 125° port, the target is steering on a crossing course. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course. The target has priority in the context of rule 18. It becomes evident that the give-way ship is not taking the actions required by COLREG. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	2 to 5 miles
5	Course angle	10° starboard to 125° starboard or 10° port to 125° port
6	Ship and target course difference (±180°) ΔK	15° to 170°

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option. If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

Option 1

An angle of turning to starboard is selected so that to pass target 1 at a distance not less than minimum allowable.

Option 2 (if option 1 is unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 1.

Option 3 (if options 1 and 2 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 1.

Options 4-6 (if options 1-3 are unacceptable)

Increase the allowable distance by 1.5 times. Options 1-3 are repeated in sequence for turning to port.

Scenario 8 Crossing ship traffic separation scheme

1 Brief scenario description

A ship is going along a predefined route in an area not restricting her (the ship's) freedom of manoeuvring by course near the traffic separation scheme. The ship must cross the traffic separation scheme.

A target is detected at a distance of 4-5 miles, the target is moving in the traffic. The relative bearing of the target is within 65° port and 65° starboard, the target bearing is changing little, the distance is decreasing. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course.

Wherever possible, preliminary track crossing the ship traffic separation scheme shall be plotted using the course perpendicular to the general traffic flow direction.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	less than 2 miles
5	Course angle	-125 to +125 degrees
6	Ship and target course difference ΔK	**± 60°-90 °**
7	Ship and target speed difference, ΔV	"Yes"

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.
- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option.

- If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

If dangerous approach is possible in the ship traffic separation scheme, the rules adopted for open water space apply. For this reason, crossing situation scenarios 4, 5, 6, 7 are used for traffic crossing situations.

Scenario 9 Entering ship traffic separation scheme

1 Brief scenario description

A ship is going along a predefined route in an area not restricting her (the ship's) freedom of manoeuvring by course near the traffic separation scheme. The ship must enter the traffic separation scheme.

A target is detected at a distance of 4-5 miles, the target is moving in the traffic. The relative bearing of the target is within 65° port and 65° starboard or 125° port and 125° starboard through the stern, the target bearing is changing little, the distance is decreasing. The target is dangerous, a collision avoidance manoeuvre shall be carried out in order to avoid the target, the preferable manoeuvre is by altering the course. Reference: see Scenario 8.

Wherever possible, preliminary track crossing the ship traffic separation scheme shall be plotted using a course at as low an angle to the general traffic flow as possible.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	less than 2 miles
5	Course angle	-65 to +65 or -125 to +125 degrees through the stern
6	Ship and target course difference ΔK	**± 15°**
7	Ship and target speed difference, ΔV	"Yes"

3 Initial scenario situation

Weather conditions:
Visibility: 15 miles;
Precipitation: "No";
Fog: "No";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$(ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 15 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option.

- If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 14 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

If dangerous approach is possible in the ship traffic separation scheme, the rules adopted for open water space apply. For this reason, overtaking scenarios 2 and 3 are used for traffic crossing situations.

Scenario 10 Collision avoidance in restricted visibility conditions

1 Brief scenario description

A ship is going along a predefined route in an area free from navigation risks and not restricting her (the ship's) freedom of manoeuvring by course.

The target is detected at a distance of less than 12 miles.

2 Scenario selection criteria

Item	Parameter	Value (range)
1	Restricted visibility condition criteria	3 miles
2	Own ship's ability to manoeuvre by speed	"Yes"
3	Own ship's ability to increase speed	"No"
4	Distance to target, D	10 to 12 miles
5	Course angle	1) 90º port to 90º starboard forward the beam 2) 90º starboard to 90º port abaft the beam
6	Ship and target course difference (±180º) ΔK	15º to 170º

According to paragraphs (d)(i) and 19(d)(ii) of rule 19, the dangerous target's position forward or abaft the beam shall be taken into account when selecting a manoeuvre. Depending on that, the priority turn side is selected:

.1 90º port to 90º starboard forward the beam – turn to starboard takes priority.

.2 90º starboard to 90º port abaft the beam – turn to the side opposite to the target's relative bearing side takes priority.

3 Initial scenario situation

Weather conditions:
Visibility: less than 3 miles;
Precipitation: "No";
Fog: "Yes";
Other weather phenomena affecting ship safety: "No";
Collision avoidance manoeuvring restrictions: "No".

4 Dangerous target approach criteria

Item	Criterion	Values
1	Closest point of approach	CPA <= $r_{all.}$ (ΔCPA = ±0.1 $r_{all.}$)
2	Time to closest point of approach	TCPA = 25 min (ΔTCPA = ±3 min)

5 Collision avoidance manoeuvre selection procedure

- Calculate the manoeuvre beginning time, target position(s) at the time of manoeuvre beginning.

- Select a manoeuvre by sequential search of options until a satisfactory option is found (if any). If the current manoeuvre is unacceptable due to navigation and/or manoeuvring restrictions, the ANS goes on to the next option.

- If a satisfactory option cannot be found after all the options have been considered, the ANS goes on to paragraph 18 in Section I.

- If other ships are present within the 12-mile zone, check for potential dangerous approach situations that may result from carrying out the manoeuvre according to paragraph 11 in Section I. If the manoeuvre is unacceptable, the ANS goes on to the next option.

- Calculate the time to return to the previous course and speed.

- Calculate the course to return to the desired track according to paragraph 11 in Section I.

- Check that the manoeuvre is safe concerning navigation.

Option 1

Option 1 is used of the distance exceeds 5 miles. If the distance is 5 miles or less, the ANS goes to the next option immediately.

.1 Select an angle of altering the ship course to the priority side so that CPA is at least 1.3 times more than the allowable distance, by cycling through angles of 45º, 60º, 75º, 90º. The ANS commands a turn to starboard by the first angle selected. If the turning angle cannot be found, the ANS goes to the following option.

.2 The ANS finds time at which returning to the previous course and speed is possible, so that to pass target 1 at a distance not less than minimum allowable. This time is continuously being checked and corrected with regard to the current situation. When the point of return is reached, the ANS commands to return to the previous course and speed.

.3 The ship goes parallel to the track course until target 1 has been passed at a distance not less than minimum allowable. After passing, the ANS returns the ship to the desired track according to paragraph 11 in Section I.

Option 2 (if option 1 is unacceptable)

An angle of turning to the priority side is selected so that to pass target 1 at a distance not less than minimum allowable (this option may be required if the speed of our ship is considerably less than the speed of the target).

Option 3 (if options 1 and 2 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 1.

Option 4 (if options 1, 2 and 3 are unacceptable)

The ANS considers if speed can be decreased by 1 step and selects an angle of turning to starboard as described in option 2.

Option 5 (if options 1, 2, 3 and 4 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 1.

Option 6 (if options 1-5 are unacceptable)

The ANS considers if speed can be decreased by 2 steps and selects an angle of turning to starboard as described in option 2.

Options 7-12 (if options 1-6 are unacceptable)

Increase the allowable distance by 1.5 times. Options 1-6 are repeated in sequence for turning to the side opposite to the priority side.