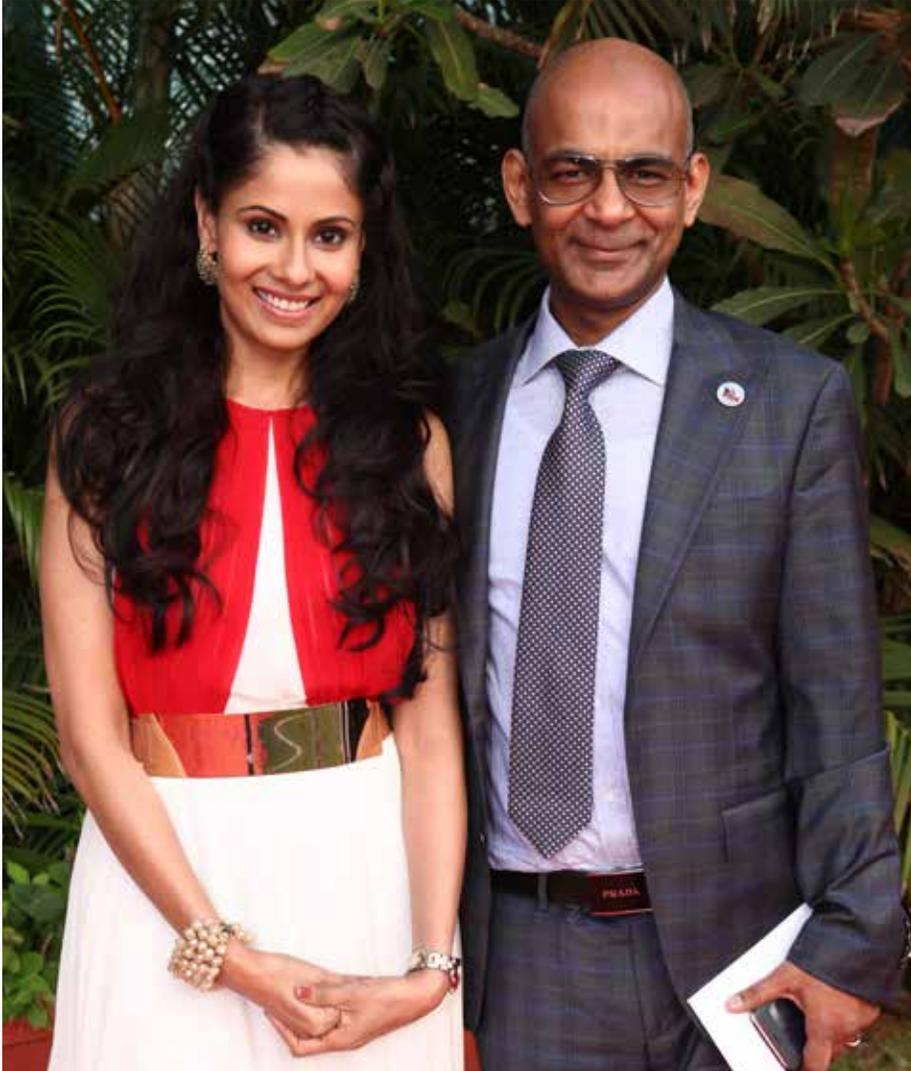


# Recommendations for International Regulation for Preventing Collisions at Sea



*(Dr Binay Singh at the Sailor Today Sea Shore Awards 2017 seen here with emcee Chaavi Mittal.)*

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**A**t the present time the percentage of accidents due to human factor is rapidly increasing, and a significant part of such accidents falls

on vessels collisions. Reduction of accidents due to the above mentioned reason demands diversified scientific research for elaborating practical recommendations to navigators.

The synthesis of a simulation model of two vessels on crossing courses with further modelling the process with the elaborated computer program has showed a number of indeterminacies faced by a navigator in the process of actual crossing, which reduce the safety of the crossing manoeuvre.

The indeterminacy in correct interaction of vessels arises as early as at the stage of assessing the danger of the situation of approaching, i.e. when revealing a situational disturbance. A linear characteristic – maximum permissible distance of the closest approach, the value whereof being somewhat variable depending on the conditions of navigation - shall be considered a generally accepted measure of dangerous approach. Though IRPCS – 72 do not regulate the value of maximum permissible distance of the closest approach but only contain the indicators of a dangerous approach situation (characteristics of bearing deviation), good practice at open sea assumes this distance approximately to be equal to two miles.

The absence of strictly determined algorithm of identifying the situation of dangerous approach results in the fact that in actual conditions of navigation the value of maximum permissible distance of the closest approach is determined subjectively depending on psycho-physical state

of the navigator, and what is more, the situation arising can be assessed on the approaching vessels quite differently. On one of the vessels the approach can be assessed as dangerous, while on the other one it can be assumed that the vessels shall pass clear.

The consequences of such mutually contradictory assess may be absolutely unpredictable and may result in an accident causing damage to both vessels.

For example, the first vessel assess the approach in the situation of approaching as dangerous and based on this interpretation identifies herself as the privileged vessel. The second vessel considers the approaching as being safe and is not going to manoeuvre at all. As the time goes, the first vessel assuming that according to Rule 17 she must take measures for the prevention of collision begins manoeuvring at close range to the second vessel, thus provoking the reaction of the second vessel and worsening the situation right down to collision.

This is why clear and definite criteria of assessment in the situation of dangerous approach giving identical results for both vessels are necessary. The research for determining the value of maximum permissible distance of the closest approach was carried out. The results of the research have revealed the principle essential factors including stochastic component due to measurement errors, vessels' sizes, attracting effect and some distance allowing for possible force majeure circumstances.

Though the method of assessment of the maximum permissible distance of the closest approach is quite correct for a single assessment, it does not make allowance for the refinement of the possible value of this distance in case of the vessel's position further surveillance, thus lowering the stochastic component.

If the danger of approaching is recognized by both vessels, it is necessary to determine the materialized region of mutual responsibilities of the vessels (according to Rule 17). IRPCS -72 do not contain objective criteria of such assessment, instead they include subjective criteria, for example, concerning the second region of mutual responsibilities «... this second vessel, when it becomes evident that the vessel that must give way, does not take a corresponding action, ..., can take an action to avoid collision only by her own manoeuvring.

Such ambiguous demands in the situation of two vessels interaction taking into account individual subjective assessments of the navigators of each vessel, often lead to different assessments of the materialized region of mutual responsibilities and the moment when the vessels enter the next region in the process of the situation development.

In the first place, the above mentioned circumstance cancels the main principle of IRPCS -72 coordination, the possibility of clear prognostication of each of the interacting vessels' actions, which results in non-coordinated movements of the vessels leading to big consequences.

Know-how existing in the region of determining mutual responsibilities of the vessels based on the ability of the vessels to control the general situation of crossing also contains indeterminacy. All other things being equal, the extent of controlling the situation of crossing depends on the correlation of the speeds of the interacting vessels.

The higher speed vessel has an advantage, and in the given situation of approach she recognizes a less dangerous region of mutual responsibility due to a larger possibility to control the situation of crossing. The vessel possessing less speed identifies the same situation of approach at the same time as the region of mutual responsibility with a higher status of danger.

If a stand-on vessel has lesser speed than her active partner in crossing, she falls into the second and the third regions of mutual responsibilities much earlier and misleads the partner with her actions.

This is why a procedure for identical definition of the region of mutual responsibilities of vessels must be elaborated to ensure correct conduct of vessels in the process of crossing. A minimax approach to this task, where a region of mutual responsibilities for both vessels is determined from the position of the vessel having less speed, serves as an opening offer. For example, if according to the method suggested the vessel having less speed determines the second region of mutual responsibility, while the higher speed vessel determines the first region, then the second region of mutual responsibility shall

be accepted for the vessels interaction.

One more problem in determining the region of mutual responsibilities of vessels from the position of the less speed vessel shall be the realization of different regions of mutual responsibilities depending on the relative side of deviation. The matter is that maximum distance of the closest approach from the position of the less speed vessel has two meanings, corresponding to maximum starboard or port side deviation of the vessel, at that, the two above mentioned meanings together with the maximum permissible distance of the closest approach define the regions of mutual responsibilities. It is evident that the regions of mutual responsibilities of the vessels for relative starboard and port side diversions can have identical or different status of danger.

In this case, there does not exist a unique notion of the region of mutual responsibilities status, which makes the prognostication of the situation development when approaching and co-ordination of the vessels interaction when crossing so difficult. Evidently, precision can be reached by another agreement stating that the status of the region of mutual responsibilities corresponds to the status of the region with a less meaning. For example, if the regions have the first and the second status, the first one shall be taken as the mutual region.

It should be noted that Rule 17 determining the second region of mutual responsibilities and allowing the passive vessel manoeuvring for

passing, deprives each of the crossing vessels of the prognosis as to the partner's behavior. Thus, the vessel that must keep out of the way, after falling into the second region of mutual responsibilities becomes deprived of the information on supposed behavior of the passive vessel, which according to IRPCS-72 she has the right either to continue movement with unchanged parameters, or to manoeuvre for crossing with her own efforts. On the other side, the stand-on vessel when performing the manoeuvre of crossing can expect both: manoeuvring on the side of the active vessel or her further unchanged movement.

Such loss of the prognosis in the rapidly complicating situation of a dangerous approach and the actual absence of co-ordination in the interaction of the crossing vessels dramatically decreases the safety of the crossing process.

If the situation of dangerous approach of vessels is characterized by the first region of mutual responsibilities, which may soon transform into the second region in case of inactivity of the active vessel, it shall be expedient for the passive vessel to calculate the manoeuvre of safe crossing in advance having in mind the probability of falling into the second region. This may ensure a quick, definite and correct manoeuvre favorable for safe crossing.

In this case, the less speed vessels should use the calculations of true courses of deviation, resulting in maximal and minimal relative courses. Such courses ensure

maximum values of the closest approach distance that guarantees maximum safety of crossing in the second region of mutual responsibilities of the vessels.

The situation of crossing that involves two vessels having identical high priority is one of the most indeterminate (Rule 18), for example two fishing boats or vessels limited by their draught, etc..

IRPCS – 72 do not co-ordinate interaction of crossing vessels in similar situations, thus enhancing already difficult position of such vessels and increasing the risk of danger when crossing.

However, in case of crossing the vessels with the lowest priority – power driven vessels – there arises a number of indeterminate situations. One of them is the situation of power driven vessels head-on - moving straight towards each other (Rule 14). According to this rule, two power driven vessels moving towards each other (on opposite courses) must turn starboard cleanly passing port-to-port.

This manoeuvre demands certain synchronization of both vessels, which is not regulated by the Rules. This is why it is expedient to point out an indicator of synchronization of the beginning of joint crossing manoeuvre in the situation of crossing under Rule 14.

The situation when two power driven vessels move on opposite parallel courses but relative bearings exceed the values defining the situation of Rule 14, at that the distance of closest approach between the vessels is less than

maximum permissible distance. For example, when the distance between the vessels is about three miles and with a maximum permissible distance of 0,5 mile, relative bearings may reach at least 10 degrees. Such situation of approach is dangerous, and in this case, at small speeds of the vessels such situation can be characterized with the first region of mutual responsibilities. However, the above mentioned situation is not covered either by Rule 14 or by Rule 15 (cross courses).

Consequently, such situation is not regulated by clear and unique coordination of IRPCS-72, creating indeterminacy when manoeuvring, and there arises a danger of collision of the crossing vessels.

This is why the interaction of dangerously approaching vessels should be coordinated in the situation being considered with the purpose of increasing the safety of the passage manoeuvre.

When elaborating the simulated model of interaction of dangerously approaching vessels and when simulating the process of crossing the vessels having less speed, an ambiguity was revealed between actual and relative forms of travel line of the crossing. The vessels having less speed can change the values of relative course only within a certain range limited by minimal and maximal relative courses.

Please, note that the less is the ratio between the speeds of the vessel and the target, the narrower the range of possible relative courses.

Depending on the difference of courses of the operating vessel and the target, as well as the initial course of the operating vessel and the ratio of speeds, standard true travel line of starboard deviation and the following return to the set travel line can correspond to the relative travel lines of various forms.

This situation of ambiguous reflection of true travel line of the crossing manoeuvre as a relative one is very essential because it influences the calculation of all parameters of the crossing manoeuvre; at that depending on the form of relative travel line of the crossing manoeuvre, various analytical expressions shall be used.

Extending somewhat beyond the framework of the crossing model with a single target being considered, in the conditions of open sea it can be stated that IRPCS -72 coordinate only the interaction of two vessels because the Rules realize only binary co-ordination. The emergence of the second target dangerously approaching the operating vessel is not taken into account by the Rules at all, as well as possible navigation dangers, which dramatically reduces the effectiveness of IRPCS-72 as a coordinating instrument in the conditions of dangerously approaching vessels.

Thus, summing up the results of the above analysis based on the simulation of the vessels crossing process it can be stated as follows:

1. To avoid ambiguity when assessing the degree of danger for the approaching vessels, clear and unique criteria of the

situation assessment in the conditions of dangerous approach of vessels should be suggested, which give identical results for both vessels. For example, the method of assessment of the maximum permitted distance of the closest approach suggested can be updated taking into account the accumulated information.

2. With the aim of ensuring correctness of the vessels conduct in the process of crossing it is necessary to elaborate the procedure of identical definition of the region of mutual responsibilities for dangerously approaching vessels. For this purpose a minimax approach can be suggested, i.e. the region of mutual responsibility of both vessels shall be determined from the position of the vessel having less speed, and in this case, depending on the side of relative diversion, the region with lower status of danger is chosen.
3. In the situation of dangerous approach of vessels and the realized first region of mutual responsibilities, which after a time and subject to the lack of action of the active vessel, can transform into the second region, it is recommended for the passive vessel to calculate the manoeuvre of safe crossing in advance in case of falling into the second region, which can ensure quick, critical and correct manoeuvre contributing to safe crossing.
4. For the vessels having less speed in the second region of mutual responsibilities it is

recommended to use calculations of true courses of deviation leading to maximal and minimal relative courses. Such courses ensure maximal values of the distance of the closest approach of vessels which guarantees maximum safety of their passage.

5. It is necessary to elaborate special procedures of coordination for two vessels with equal high priority (Rule 18).
6. To increase the safety of the crossing manoeuvre it is expedient to define the indicator of synchronization of the beginning of joint manoeuvre of

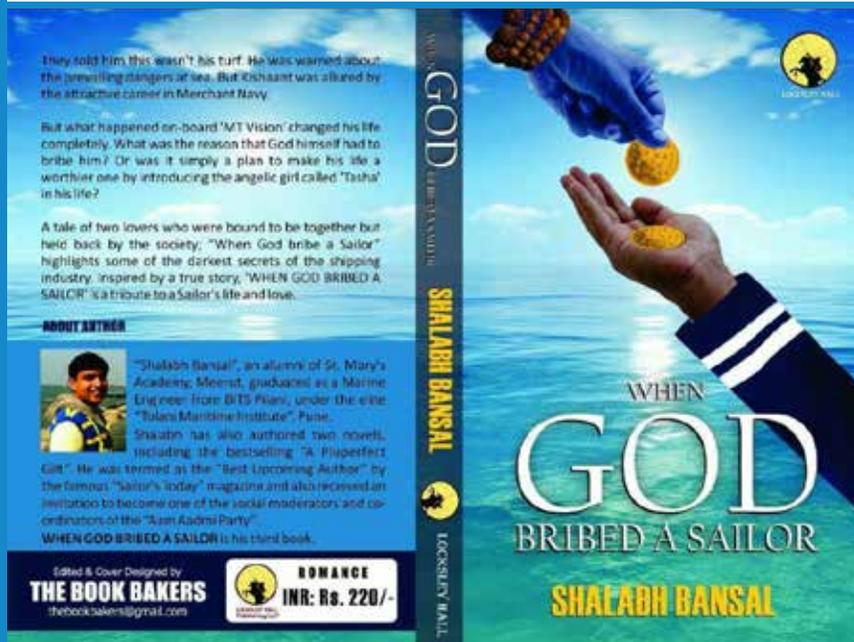
the vessels passage in the situation of Rule 14.

7. It is also necessary to regulate the interaction of dangerously approaching vessels in the situation when power driven vessels moving on opposite courses are not covered by Rules 14 and 15.
8. When calculating the parameters of optimal passage manoeuvre it is necessary to take into account the ambiguity between the forms of true and relative travel lines of the passage.
9. The existing Rules for manoeuvring vessels in the situation of dangerous approach are incomplete because they do

not contain procedures for the cases of approach of several (more than two) vessels. Thus, it is necessary to work out additional procedures of coordination in excess of the binary coordination available in the Rules.

10. A significant drawback of the Rules lies in the absence of registration of navigational dangers in case of interaction of vessels in the areas of excessive approach, which makes the elaboration of corresponding methods of their possible coordination when crossing in stiffened areas most pressing.

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