THE JOURNAL OF NAVIGATION (2006), **59**, 349–363.
Printed in the United Kingdom

Forum

doi:10.1017/S037346330621378X

Restricted visibility: In Search of a Solution

Carlos F. Salinas

(*Spanish Maritime Safety Agency*)
(Email: fsalinas@igijon.com)

In order to avoid a collision it has clearly been proved that for most seafarers there exists a set of possible situations known as head-on, crossing and overtaking, while ignoring in a general way the behaviour they should carry out when their vessel is in conditions of restricted visibility. It is obvious that the existence of two different manoeuvre methods in relation to the prevailing visibility confuses the navigator. But there is still more. With the arrival of AIS, the present wording of paragraph d) of Rule 19 leaves the seafarer in a state of total uncertainty when deciding the appropriate manoeuvre, so its amendment must be dealt with as a maximum priority. The following paper tries to find a solution to the dilemma, even though this does not imply a radical change in the general conception that a mariner may have of collision avoidance.

KEY WORDS

2. COLREGS. 3. ARPA. 4. AIS.

1. INTRODUCTION. For some considerable time now the topic of the current application of the International Regulations for Preventing Collisions at sea has been a matter of vigorous debate (Syms, 2003a). Moreover, case law, the MARS reports and anecdotal evidence all indicate that many of the basic principles of collision avoidance are improperly understood (Stitt, 2002). One of the latest reports has been carried out by Captain Syms inside the scope of the Nautical Institute. His conclusions have revealed the existing distance between what the Rules determine and what actually happens when navigators put them into practice. Concepts such as ''not impede'', the interpretation of Rule 10, and above all, the conduct of vessels in restricted visibility, go unnoticed among mariners. Personally, I have carried out different reports on this subject and from all the dark aspects of the Rules. I would especially highlight the interpretation of Rule 19 (in particular paragraph **d**, which is ignored by a great number of seamen of different origins and levels of training. Captain Syms himself concludes in his report that there is about an 80 per cent misunderstanding of the poor visibility rule (Syms, 2003b). At sea things do not happen spontaneously, so if we identify the problem, we will be able to approach it in search of an effective solution.

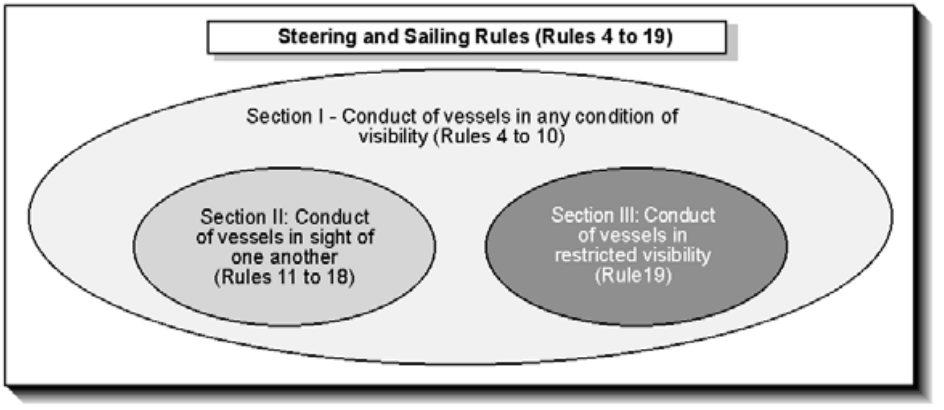

Figure 1. COLREGS Part B – Steering and Sailing Rules.

2. MANOEUVRE METHODS TO AVOID A COLLISION. As has been pointed out at the beginning of this paper, the conflict has its origins in the coexistence in the COLREGS of two different methods to avoid collisions. It is necessary to use a variable that will accurately determine which of them must be used; that variable is the prevailing visibility at the moment. Accordingly, a different behaviour is required dependant on whether the involved vessels can be seen with the eyes or not, as it is considered that there exists no other better tool to avoid collisions than human sight, provided that the observer is fully qualified and has enough experience to interpret what he is seeing.

Figure 1 describes the present structure of the COLREGS' Part B, Steering and Sailing Rules, which is divided into three sections:

- A first section applicable to any condition of visibility (rules 4 to 10 included).
- A second section applicable to vessels in sight of one another (rules 11 to 18 included).
- A third section applicable to vessels not in sight of one another when navigating in or near an area of restricted visibility (it has just one rule, number 19).

According to this classification, a vessel shall comply with section I at any event, as well as the concepts included either in section II or in section III, depending on the visibility; but what she shall never do is apply sections II and III at the same time, a widely extended mistake, as has already been mentioned.

2.1. *Conduct of vessels in any condition of visibility*. There are a set of rules that shall be complied with regardless of the prevailing visibility. These use concepts such as the proper lookout, safe speed, risk of collision, and the actions taken to avoid collisions. According to Cahill in applying these concepts there is one infallible principle that should always govern: is the action or manoeuvre one intends to follow or execute likely to increase or decrease the risk of collision? (Cahill, 1983). Section I also includes the behaviour along the course of a narrow channel or fairway and in a traffic separation scheme, as in such situations there will be good visibility some days, whereas on other occasions you will hardly see further than the stem.

2.2. *Conduct of vessels in sight of one another*. When the vessels are in sight of one another, the COLREGS determine a sequence of privileges depending upon a number of factors. The first determines whether one of the involved vessels finds herself in an inferior position when manoeuvring. This way, Rule 18 forces a power driven vessel underway to keep out of the way of a vessel engaged in fishing. But when it is considered that the vessels are in the same conditions to start an avoiding action, the Rules divide the horizon into three sectors, where a set of rules known as head-on, crossing and overtaking, are applied. These rules have a specific behaviour, for instance, the vessel which has the other on her starboard side shall keep out of the way. It is important to point out that the COLREGS consider that the vessels find themselves in those situations according to the visual aspect they are observed with, but never in reference to an apparent vector crossing on the ARPA screen. And this happens, not only because when the present Collisions Regulations were negotiated the use of ARPA was hardly extended among the vessels, but also because any mistake in the initial data introduced in the radar tracking system can originate significant variations in the real course and speed of tracked targets.

2.3. *Conduct of vessels in restricted visibility*. The manoeuvre method previously described is drastically altered when the navigator does not have the most accurate tool for avoiding a collision: his eyes. Under such circumstances, the Rules use a method based on the way a vessel has of detecting the other's presence. Thus, if the detection is carried out by means of radar, and a close-quarters situation is developing and/or risk of collision exists, the own ship shall take avoiding action regardless of the bearing the other one approaches from. That is, there is neither head-on, crossing and overtaking, nor stand-on or give way vessel, because such situations are considered in section II, and in order to undertake them, the visual observation that allows us to distinguish the lights of the other vessel as well as the category it belongs to is essential. The manoeuvres stated in Rule 19**d** are mainly based on a change of course, although the use of the engine is not excluded (Figure 2). Nevertheless, in case a vessel detects another one by ear, forward of her beam, that is, because she listens to her fog signals, or when for any reason a close-quarters cannot be avoided, the COLREGS state that in such a situation she shall reduce her speed to the minimum, and if necessary take all her way off. Due to the range of the sound signals and their unpredictable propagation, it would be quite dangerous to keep the present speed, as well as to undertake a blind alteration of course when the course of the other vessel has not been ascertained (Cockcroft and Lameijer, 1996, p141) as, among any other consequences, it could make the vessel cross completely. It is important to highlight, that whether in restricted visibility or when the vessels are in sight of one another, all the collision avoidance is undertaken without the need of radio communication between vessels (Weber, 1995). In origin, only in those overtakings carried out along the course of a narrow channel or fairway do the COLREGS determine a sound signal exchange.

Finally, the present wording of paragraph 19**d** is: "A vessel which detects by radar *alone* the presence of another vessel …" It is obvious that with the arrival of AIS, the detection is not carried out by radar exclusively. So, which manoeuvre should be undertaken when, for instance, the detection is carried out by radar and AIS simultaneously? A new example of the COLREGS' ambiguity that must be solved as soon as possible.

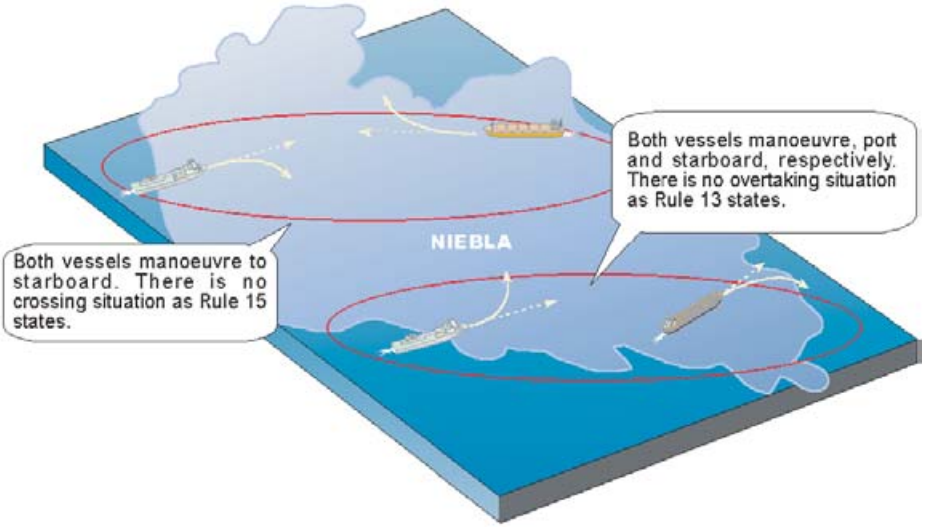

Figure 2. According to the interpretation of paragraph **d** of Rule 19, in case the radars of both vessels display a close quarters situation, both vessels shall take avoiding action.

3. THE NEVER-ENDING CONTROVERSY. So far we have described the behaviour stated in the COLREGS. It must be recognised that the Steering and Sailing Rules have their logical sense and fit to good seamanship. However, it is not difficult to prove that what was foreseen in time past does not agree with the usual practice undertaken on board. One of the essentials of the Collisions Regulations is that they should, so far as possible, eliminate doubt in the minds of the navigator using them (Cooper, 2001). For many years, I have been doing specialized workshops and tests directed to professional seafarers, whose results agree with the last studies carried out by Captain Syms. However, the real motive of the present paper is the result of a later experiment, which I think is quite significant. The first part of my study consisted in the realization of a four situation test, with four options each, to professional seafarers of different training and experience, ranging from masters and pilots to officers with one or two years' experience at sea. The tests, 102 in total, were carried out in the Centro de Seguridad Marítima Jovellanos, in workshops with shipping companies and in the Nautical School of Gijón. The pilot corporation of Barcelona sent the tests back by fax. It is important to point out that in Spain nautical studies belong to the category of university disciplines, equivalent to engineering. In the test the Own Ship sails in the condition of restricted visibility of three cables and a close-quarters situation is developing with another vessel (Figure 3). In each situation, the Own Ship encounters just one vessel. To the targets approaching from port, 82% of subjects interviewed answered that at first they kept course and speed; this option increases to 93% when the other vessel is approaching from starboard or port quarter. In other words, most of them really think they are either in a crossing or overtaking situation, where it is the other vessel that must undertake the manoeuvre. To sum up, Rule 19 despite being part of the COLREGS for some decades still remains a mystery to a significant

Figure 3. Summary of the four situations described.

number of the world's seafarers (Syms, 2003b). But the really surprising aspect is that I decided to repeat the experience, but on this occasion with students from the last year of the Nautical School in Gijón, (24 pupils in total), who had just finished their simulator training to obtain the Radar Observer Automatic Plot (ARPA) certification. 85% of them had similar answers to those of professionals who had been sailing for more than ten years. Though we may not like to recognize it, there seems to be an intrinsic logic that leads the navigator to ignore paragraph **d** of Rule 19, regardless of his training and experience. This forces us to reconsider the real cause of the behaviour.

4. A REASONABLE EXPLANATION. So, as it has clearly been proved there exists complete disagreement between what the COLREGS state and what seafarers really carry out, it is inevitable to think over the following question: Are the Rules inadequate or do modern sailing practices hamper their right application? A very important aspect which should be taken into account is that if, after presenting some of the previously mentioned situations to a group of professional navigators, they are properly told the reason why the Rules state the manoeuvres of Rule 19, most of them agree with the text and they simply answer that if they had chosen the other option, it was just because they thought they had been taught that way. Of course, firstly the problem lies in the fact that perhaps in many nautical schools there is not enough attention paid to the teaching of the COLREGS, by limiting the students to learn the Steering and Sailing Rules by heart, in order to pass an exam, but as these rules are interpretative, misunderstandings are quite likely to happen. We must think that whenever the future officer stands on watch, he will spend four hours (even six!) reading between the COLREGS' lines.

https://doi.org/10.1017/S037346330621378X Published online by Cambridge University Press

Moreover, I think this misinterpretation could be reinforced with the use of the ARPA. In good visibility the ARPA is the main aid most vessels have to analyse and solve traffic situations. The OOW sees reflected on the screen crossing, overtaking, or heading-on targets and acts according to the traffic situation. In restricted visibility the same happens, but now there exists a major dependency on the ARPA as this equipment together with AIS are the unique aids they have to avoid collisions (provided we admit that sound signals give much less information and they cannot be heard further than 2 miles). In both circumstances, good and poor visibility, the screen display is practically the same. So the OOW is again in front of a screen which shows echoes, sometimes crossing, overtaking, or heading-on, and he instinctively wonders why not use the head-on, crossing and overtaking rules that produce quite good results in conditions of good visibility and which are, moreover, quite accurate, to the contrary of what it is stated in paragraph **d** of Rule 19, where instead of saying positively what must be done, it is stated what must be avoided. The fact is that seafarers, like most people, prefer accurate and simple options.

5. IS IT POSSIBLE TO ELIMINATE SECTION III? Considering what has been described, we face the following dilemma: either we modify the content of the Rules so that they adapt to what seafarers interpret, or we use mariners to better interpret the COLREGS by giving the Rules a minimum didactic sense. Because it is not the Rules that prevent collisions, it is people on board who are responsible for making them work. Hence, the Rules ought to be clear in their interpretation and operation to the average mariner (Stitt 2002). Quite logically, the first temptation would be to try to unify the two manoeuvre methods into just one, and specifically, extending the head-on, crossing and overtaking situation to the condition of restricted visibility, just as most navigators claim. In relation to this, Syms says: If dual action is so wrong and so inimical to the conceptual basis of the COLREGS, why have we seen fit to incorporate it in the "not in sight" condition? (Syms, 2003b). So, is it possible to eliminate section III? The main difficulty would be to ignore the variable that has led to the establishment of these two manoeuvre methods: the visibility, or the possibility of seeing the other vessel's visual aspect. Some people think that AIS could be the technological bridge that can solve the problem. Functionally, AIS is identical to light signals albeit applying VHF technologically rather than "colour and aspect" to transmit information from one ship to another (Harding, 2002), with the advantage that it is not affected by the condition of atmospheric visibility. But although AIS is a great aid and a hopeful advance, there are a set of handicaps that prevent the problem from being solved completely. Among others, we can name the following mentioned by other authors:

- Position, course and speed over ground will normally be provided solely by GPS. As a consequence, ARPA information (stabilized over the sea) and AIS information (stabilized over ground) will not be the same. In other words, the navigator will have two information sources with different data for the same target vessel (Ramsvik, 2004). An independent system from radar may have its benefits but the possibility of conflicting and confusing information, either

imposed on the radar or independently displayed, has the potential for disastrous consequences (Graveson, 2004).

- Like the initial radar sets, some AIS equipment is not particularly user friendly (Stitt, 2004). Moreover, it can bring some mistakes which are characteristic of the GPS technology, and we should not forget that the decision-making would be based on an automatic system of data emission, which could be inaccurate.
- Whereas radar is notionally capable of seeing everything in its area of coverage, a transponder can only reveal data about vessels in which the equipment is fitted and properly functioning (Hadley, 1999). Since not all vessels are equipped with AIS, this would force us to establish two different rules: one for vessels detected by means of AIS and another for those vessels that are not equipped with AIS. So instead of just one problem we would have two.

Another possibility of extending the head-on, crossing and overtaking situations could be the modification of Rule 17, in the sense of forcing the stand-on vessel to take action to avoid collision in restricted visibility as soon as it becomes apparent to her that the vessel required to keep out of her way is not taking appropriate action in accordance with the Rules. One advantage of this solution is that it adapts to a great extent to what seafarers declare they really do in this situation. However, there would be other quite important aspects to solve. In addition to shortening the three sections into just one, and eliminating Rules 4, 11, and 19, Rule number 18, Responsibilities between Vessels, would also have to be modified, a not very easy task. At present, this rule shall be applied when the vessels can see the lights and shapes of the others because when they are in restricted visibility, they only know if the other vessel is limited to undertake an avoiding action when hearing her fog signal, a prolonged blast followed by two short blasts, or by means of AIS information. As we have already mentioned not all vessels are equipped with AIS and the sound signals in restricted visibility can unfortunately be heard for just short distances. Moreover, they give much less information than the corresponding lights and shapes. In conclusion, if we want to eliminate section III, we must rewrite the Rules completely, something that could be at least embarrassing but not impossible.

6. A LESS DRASTIC SOLUTION. On the hypothesis that the interpretative misunderstanding arises from the reading of the text, a less drastic possibility would consist of a new drawing up of section III. To do so, it must be assumed that not only for the professional with years of experience but also for pupils who have just finished the COLREGS' study, the distinction of two manoeuvre methods in relation to visibility goes practically unnoticed. It is quite possible that this may happen because the COLREGS lack of didactic sense, so all effort should be focused on solving this gap, a task that must be carried out accurately. In this context, the first step must be directed to highlight the importance of section III. At present, this section has just one rule, unlike sections I and II, which have seven and eight respectively. It is precisely this meanness of the legislator when joining the precepts applicable in restricted visibility in just one rule that leads the reader to think that Rule 19 is an additional one, having precepts that only reinforce the

concepts of section I and II. The proposal for the new drawing up of section III is the following:

Section III – Conduct of Vessels in Restricted Visibility
Rule 19
Application

This section applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

With the conversion of paragraph **a** of Rule 19 into an independent one, the importance of section III is emphasized. Moreover, it is in concordance with the structure of the rest of the Steering and Sailing Rules, because Section I and Section II have rules that clearly specify when they must be applied (Rules 4 and 11, respectively).

Rule 20
Close-quarters situation

A vessel which detects by radar or AIS the presence of another vessel shall determine if a close-quarters situation is developing. If so, she shall take avoiding action, provided that when such action consists of an alteration in course, shall undertake the following:

i. An alteration of course to starboard for a vessel forward of the beam, other than for a vessel being overtaken by starboard side;
ii. An alteration of course that keeps her away from a vessel abeam or abaft the beam.

In relation to paragraph **d** in the original text of Rule 19, AIS has been added so that the application of the rule can still be effective. The expression "and/or risk of collision" has been deleted for the simple reason that close-quarters situations do include a risk of collision. In restricted visibility, in the open sea, a close-quarters situation is generally considered to begin to apply at a distance of at least 2 miles in any direction forward of the beam as this is the typical range of audibility for the whistle of a large vessel in still conditions (Cockcroft and Lameijer, 1996, p132). So before two vessels collide, a close quarters situation will have already developed. The expression "so far as possible" is also deleted, as these kind of sentences do nothing but mislead the reader, and it must be understood that Rule 2 includes the principle that seafarer may make a departure from the Rules in special circumstances (Figure 4). In this sense, Stitt says that additional vague phrasing is unhelpful and is likely to do nothing other than cause further confusion, particularly in the minds of less experienced watch-keepers, or provide a spurious argument to anyone seeking to justify a totally inappropriate manoeuvre (Stitt, 2002). An example to follow is Rule 14, which eliminates expressions such as "if the circumstances of the case admit", which turns it into a simple rule, easy to operate and effective (Belcher, 2002). But the most important aspect of this modification lies in that to the contrary of original Rule 19, now it is stated what the vessel must do, instead of what she must not do. In fact, the manoeuvres are the same, but drawn up in a positive way.

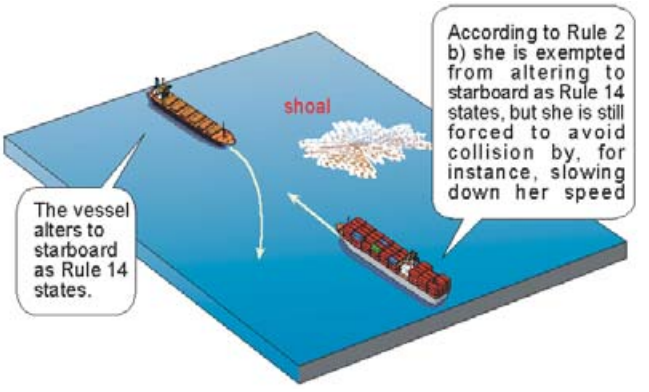

Figure 4. Some authors think that Rule 2 gives the answer to all special circumstances, and, in order to avoid ambiguity, expressions such as ''if the circumstances of the case'' and ''so far as possible'' can be eliminated from the rest of the rules.

Rule 21
Speed reduction

Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to be the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

Nothing to add to this rule, which is no more than the conversion of paragraph **e** of the present Rule 19 to an independent one. Consequently, the rest of the rules must be renumbered.

Note that paragraphs **b** and **c** of the original text have been eliminated. In the present paragraph **b** it is stated that every vessel shall proceed at a safe speed adapted to the prevailing circumstances and condition of restricted visibility; this is already properly expressed in Rule 6, so keeping it is redundant. In paragraph **b** it is also stated that a power-driven vessel shall have her engines ready for immediate manoeuvre, and we do believe this concept must be applied in any situation, not just in restricted visibility. As far as the present paragraph **c** that says every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the rules of section I, it is also redundant, as this principle is mentioned in Rules 5, 6, 7 and 8, and in any case its importance should be highlighted in them. Provided accuracy isn't lost, simplification is the best didactic tool.

7. CONCLUSION. As can be noticed, the proposed amendment does not establish engine or course actions different to the original ones, but what it seeks is to make the understanding of the Rules easier. This way, we do neither discredit the sense of the Steering And Sailing Rules, nor the good practices acquired for decades, we simply reinforce them and with the inclusion of the term AIS, they are

https://doi.org/10.1017/S037346330621378X Published online by Cambridge University Press

updated. To tell the truth they are not the only amendments needed; among others we could include the acronyms ARPA, VHF, VTS in Section I. There still remains the problem of High Speed Craft too. There have always been doubts about modifying the COLREGS. It is argued that the seafarer is by nature opposed to changes, and that there exist countries with a minimum training level, that do not recycle their seafarers and so, they would not adapt to the possible introduced changes. But this attitude is ridiculous, leaving the security of human life and the preservation of the environment in the hands of mere immobility or market speculation. Have we not learnt anything since the Doña Paz or Atlantic Empress collisions?

ACKNOWLEDGEMENTS

English version Mª Victoria Peña. Drawings by Gonzalo Pérez.

REFERENCES

Belcher, P. (2002). A sociological interpretation of the COLREGS. *The Journal of Navigation*. **55**, 213–224.

Cahill, R. (1983). *Collision and their causes*. Fairplay Publications LTD.

Cockcroft, A. N. And Lameijer, J. N. F. (1996). *A Guide to the Collision Avoidance Rules: International Regulations for Preventing Collisions at Sea*. Elsevier Butterworth-Heinemann.

Cooper, R. W. (2001). Removal of ambiguity from the maritime collision regulation. *The Journal of Navigation*, **54**, 479–480.

Graveson, A. (2004). AIS-An Inexact Science. *The Journal of Navigation*, **57**, 339–343.

Hadley, M. (1999). Issues in Remote Pilotage. *The Journal of Navigation*, **52**, 1–10.

Harding, S. J. (2002). The "ALVACAPE" and the Automatic Identification System: the Use of VHF in Collision Avoidance at Sea. *The Journal of Navigation*, **55**, 431–442.

Ramsvik, H. (2004). AIS: safety and security limitation. *Seaways*, **2**, 15–16.

Salinas, C. F. (2002). Collision Regulation Discussions. *The Journal of Navigation*, **55**, 501–505.

Salinas, C. F. (2002). Vessel Traffic Services versus the Independence in the Vessel Decision-Making. *Proceeding of the 3rd. International Congress on Maritime Technological Innovations and Research*, Bilbao.

Salinas, C. F. (2004). *Los abordajes en la mar*. Icg Marge, SL.

Stitt, I. P. A. (2002). The COLREGS – Time for a Rewrite? *The Journal of Navigation*, **55**, 419–430.

Stitt, I. P. A. (2004). AIS and Collision Avoidance – a sense of Déjà Vu. *The Journal of Navigation*, **57**, 167–180.

Syms, R. (2003a). Collision Regulations: improving their application. *Seaways*, **7**, 12–14.

Syms, R. (2003b). Vessels not in sight. NI COLREGS Survey – Scenario 3. *Seaways*, **12**, 8–11.

Weber, H. (1995). Clarification of the steering and sailing rules of the COLREGS. *The Journal of Navigation*, **48**, 289–292.

doi:10.1017/S0373463306223786

Can the Shipping-Aviation Analogy be used as an Argument to decrease the need for Maritime Pilotage?

Patrick van Erve

(*Registered Maritime Pilot*, *Port of Rotterdam Pilotage District*, *The Netherlands*)
(Email: pc-van-erve@hetnet.nl)

Air Commodore Norman Bonnor

(*The University of Nottingham*)

The aviation-shipping analogy cannot be used as an argument for a decrease in the need for maritime pilotage. The increasing complexity and upsizing of modern ships, in combination with a vast variety in ship types, economic maximisation, crewing and technical standards, lead to marginal ship operations that require specialist knowledge and skill. On the other hand, modern commercial aircraft have very standardised equipment and operating procedures and they approach and land at airports which also use standard radio-navigation aids and procedures.

KEY WORDS

1. VTS. 2. ATC. 3. Maritime Pilots.

1. INTRODUCTION. The continuous increase of shipping activity in European waters is generating an ever-increasing traffic density in European coastal waters and ports. An optimal solution to facilitate this increasing shipping traffic density would be to improve existing harbour infrastructure as well as to construct new harbour infrastructure. In practice this proves not to be feasible in an economically attractive manner since it demands huge financial investment and is increasingly restricted by stringent environmental regulations. Another option is therefore to maximise the use of existing port infrastructure by improving workability, usability and suitability of fairways, harbour basins and docking facilities. This can be achieved by introducing Advanced Dynamic Support Systems which facilitate decision making on board by pilots in such a way that optimum use can be made of the existing port infrastructure to facilitate a smooth and continuous traffic flow and thereby maximizing the possibilities of safe passage within the existing fairways. In the meantime, under continuous pressure to reduce port operational costs, representatives of parties external to the local, national or European pilotage organizations, often argue that maritime pilotage is an outdated and costly burden to shipping and port operations. As proof of their cause, they tend to rely on the apparent analogy between aircraft and ships or, in a wider perspective, between aviation and shipping. In a recent publication of Groningen Seaports in The Netherlands, this was called "*nuancing the role of the maritime pilot*" by the managing-director of Groningen Seaports and the Harbourmaster. Remarkably

these "experts" from Groningen Seaports were not able to define this analogy – in this case with Air Traffic Control (ATC) – any further than that the local Vessel Traffic System (VTS) would, with the current technology at hand, be perfectly able to advise or even order ship captains onto a particular "*course to steer*". If, these experts argue, legislation were to be changed such that the VTS-operators are legally allowed to do this remote pilotage, maritime pilots would no longer be needed. A considerable cost for calling ships would then be removed. And furthermore they argue, why is it necessary for ships to board a maritime pilot while aircraft captains do "*the job*" all by themselves. This reasoning is inadequate and shows little proof of common sense or maritime/aviation related expertise. The analogy between aviation and shipping, and ATC and VTS, indeed exists to some extent but, in most aspects, these two domains definitely cannot be compared.

2. ANALOGIES AND DIFFERENCES.

To examine to what extent the apparent analogy between ships and aircraft exists, a detailed look should be taken at the different disciplines and support services that are common between aviation and shipping. A further comparison should be made between crewing of aircraft and ships.

2.1. *VTS vs. ATC.* The major similarities between the environments of VTS and ATC are the basic objectives of both services. These objectives can be stated as follows:

a. To prevent collisions between ships/aircraft.
b. To prevent collisions between ships/aircraft and natural obstructions e.g. the grounding of a ship, an aircraft hitting an obstacle or the terrain.
c. To expedite and maintain a safe and efficient flow of traffic.
d. To provide advice and information useful for the safe and efficient conduct of the passage/flight.
e. To notify and assist the appropriate emergency services regarding shipping/aircraft in distress, within their area of control.

However, while the ATC environment is tightly regulated under the control of one overall organisation, ICAO, the VTS environment under IMO and IALA is less co-ordinated. Agreement over the definition of services and requirements for both shore-based and ship-borne systems is difficult to achieve because of the wide variations of port requirements and local geographic and hydrological footprints.

2.2. *Navigation.* Many general navigation principles, like rhumbline and great circle calculation, are the same at sea and in the air. And this leads many people to believe that the operation and navigation of aircraft and ships is analogous. But what navigation techniques and procedures are being used on board contemporary commercial aircraft and ships?

In aviation, a difference is made between Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions. Simply put, VFR-navigation is obviously such that reference can be made to the terrain below for orientation and course determination while IFR-navigation requires reliance on instruments for position and guidance determination. In shipping, this difference has never been that clearly defined, but a similar example is the difference made between "ocean navigation" and "coastal navigation" techniques and procedures. With the development and use

of GPS/GNSS combined with differential techniques and augmentation systems like WAAS, LAAS, RAAS, RTK and EGNOS, the clear transition in navigational practices when a ship comes into coastal waters, or a plane transfers to VFR-navigation, becomes vague. On board ships, it becomes more and more commonplace to make landfall and approach ports, relying purely on an electronic chart system (ECS – an unauthorized practice) or an electronic chart and display system (ECDIS – an authorized practice) coupled to (usually) a single GPS-input. In aviation a similar process occurs regarding GPS-approach and landings, where these are still subject to a minimum visual pick-up of the airport, whereas approaches using the Instrument Landing System (ILS) are made without any visual cues until the aircraft is rolling down the runway having landed. The difference with shipping in this respect is that ports in general are not equipped with this kind of sophisticated precision guidance systems. Again, this is the result of the wide variations in port requirements, local geographic footprint and hydrological circumstances and the tradition in shipping that the final navigational command stays on board ship.

2.3. *Situation Control.* The commercial airline pilot, flying in instrument conditions in zero or reduced visibility, is almost totally dependent on the ATC service to advise him of the presence of other aircraft and navigational hazards in his vicinity. The airline pilot will operate under ''close control'', where he will follow all ATC instructions with regard to courses, airspeed, altitude, holding patterns etc., unless an onboard aid such as the Traffic Collision Avoidance System (TCAS) advises him against some action. This contrasts with the Marine environment, where there is huge reluctance on the part of ship Masters to ''surrender'' any of the conflict resolutions or decisions with regard to close quarter situations to a third party, such as the VTS operator. This stance is reinforced by IMO resolutions, which state that even when a marine Pilot is embarked, the Master is still wholly responsible for the safe navigation of the vessel. In addition, the non-standardisation of VTS services provided, and the lack of qualifications of operators in certain ports, explains the reluctance of Masters to accept advice with regard to collision avoidance or the safe navigation of their vessel. For the majority of smaller commercial ports, VTS is in effect only an information service, where pre-determined reporting points allow for the identification of all vessel movements. This allows the VTS operator to keep all vessels informed of the intended movements of other shipping. There are few ports providing any form of ''close control'', in part due to the reasons outlined above. In addition, there are questions of litigation should a vessel, which has been identified and contacted by VTS that it was in danger of grounding, subsequently go aground.

2.4. *Standardisation.* As a direct result of ICAO Standards and Recommended Practices (SARPS), the design of aircraft and their navigation and communication equipment tends to be standardised on very tight specifications. A high level of redundancy increases survivability significantly and also Product Life Cycles are commonplace in the airline industry. Furthermore, there are relatively few manufacturers of commercial aircraft, so the majority of civil airliners have similar performance and equipment fits. Airfields also tend to be very similar in layout and design. By contrast, commercial ships tend to be ''one-off'' designs, and their navigation and communications fits are far from standard. To add to this lack of standardisation of shipping, is the fact that ports are variously equipped to deal with the particular estuary or river environments and the associated berthing and handling structures.

2.5. *Leisure & Other Users*. While the airspace around airfields is carefully controlled and regulated with regard to its use by non-commercial traffic such as small, recreational aircraft, the same situation does not exist in the majority of port areas. The problem of non-commercial traffic interfering with the safe navigation of shipping in ports and harbours is considerable. This includes inland barges, fishing vessels and small leisure/recreational craft. Such vessels are generally not required to report their movements to the VTS operator and may not be detected by the radar systems available to him. The movements of such vessels will not be known in advance, and they can be a danger to navigation, particularly as the knowledge of the users of such craft with regard to the manoeuvring requirements of larger vessels tends to be poor. Also the latest SOLAS equipment standards of AIS are not compulsory for these groups of vessels.

2.6. *Concepts & Methods*. Commercial aviation operates to very exacting standards in a closely controlled environment. Airlines tend to run to fixed schedules, and their routes are cleared by the relevant ATC prior to flight. Even on trans-Atlantic routes, aircraft are flying on pre-determined flight paths, where rigorous rules with regard to separation from other aircraft are imposed. In addition, there are clearly defined reporting points to keep ATC informed of the aircraft progress at all stages of the flight. Aircraft are effectively "handed-over" from one ATC to the next. By contrast, commercial shipping is largely operating independently on its departure from a harbour area, until it reaches the coastal and harbour approach stage of its destination port in confined restricted pilotage waters. In addition, shipping is more constrained by environmental factors. Adverse weather can delay a ship's arrival by a matter of days. As a result, this leads to "bottle-necks" developing on busy shipping routes and the approaches to commercial ports. Prior planning of vessel movements in such areas by a VTS operator is rendered very difficult.

2.7. *Collision Avoidance*. Good visibility and radar systems on ships make them more able to act autonomously, thus marine collision avoidance is based on COLREGS with responsibility on board and only advice and information from VTS. Because of poor visibility and speed of closure, aircraft are more reliant on ground surveillance, and while visual "Rules of the Air" exist, they are virtually unused by commercial aviation, where responsibility for collision avoidance is *shared* with the ground controller (remembering TCAS). Aircraft have less time to react to hazardous situations but are relatively easy to manoeuvre in three dimensions; separation tolerances are designed to be wide enough to be dealt with remotely by ATC. Hazardous situations develop more slowly at sea but can be complicated by shallow water, multiple encounters etc., and ships are slower to manoeuvre. Separation tolerances at sea are at least an order lower than in the air, so are best dealt with by those directly involved on board rather than by VTS.

3. REASONS WHY COMPULSORY MARITIME PILOTAGE IS, AND WILL STAY A NECESSITY.

"*As new ships and systems are developed, the demands on pilots increase. It is therefore desirable to put all ships on an equal footing. This can be accomplished by on board installations of suitable technologies that meet appropriate performance objectives, by developing hand-carried systems for use by pilots, or by a combination of the two approaches*"[1]. The contemporary trend in shipping is to build bigger ships, with larger cargo capacities, shorter sailing

https://doi.org/10.1017/S037346330621378X Published online by Cambridge University Press

and port turn-around times, manned by smaller and often less experienced crews. On one hand, this leads to ''marginal ships'' that explore the limits of what is practically possible from a nautical, technical and safety point-of-view. On the other hand, the responsibility and liability for the ship, its cargo and its occupants lie with the master. He is expected to have ''*superior knowledge of the condition of the craft and its capabilities*''[2]. But does the master of a ship, which occasionally trades to different locations in a particular port, have superior knowledge of the local specifics and circumstances that will affect the manoeuvring capabilities and characteristics of his marginal vessel? Or, in other words, is it reasonable to expect him to have this knowledge while his training and work experience limits his ability to become an expert in manoeuvring under all possible circumstances and situations in every possible location in the confined and restricted pilotage waters of a variety of ports?

ACKNOWLEDGEMENT

The views expressed in this paper are the result of personal investigation by the authors and do not represent the views of Dutch Pilots' Corporation. (Nederlandse Loodsencorporatie)

REFERENCES

[1] U.S. National Research Council (1994). *Minding The Helm; Marine Navigation and Piloting*. ISBN 0-309-04829-X.

[2] R. Bootsma & K. Polderman (1987). ATS and VTS – Some Observations Towards a Synthesis. *The Journal of Navigation*, **40**, 42.