

# **Guidelines on the Display of Navigation-Related Information Received by Communication Equipment at Sea**

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## **ABSTRACT**

This paper presents draft guidelines on the display of navigation-related information received by communications equipment elaborated by the International Maritime Organization (IMO) [3]. It aims mainly to ensure that information is displayed in an efficient, reliable and consistent format, in a manner that is easily and accurately interpreted to support decision-making process. These guidelines supplement resolution MSC.191(79) Performance standards for the presentation of navigation-related information on shipborne navigational displays [7] in regard to the presentation of navigation information received via communication equipment. The use of these guidelines will ensure that navigation information received via communications equipment is displayed in a harmonized manner on the ships' navigational bridge. The availability of electronic data that enhances the safe and efficient navigation of ships necessitates that shipborne systems capable of presenting this information to the user should do so in a harmonized and readily assimilated way.

**KEYWORDS: Marine Navigation, IMO, Navigating-related Information, Display, e-Navigation,**

## **1. Introduction**

The e-Navigation aims to provide the needed information by electronic means to and from the ship to enhance the safety and efficiency of navigation. This will involve the integration of new and existing bridge technologies to enable the provision a common data structure on board. e-Navigation will, therefore, help simplify the exchange of information between ships, as well as between ships and shore. e-Navigation is expected to equip shipboard users and those ashore responsible for the safety of shipping with effective, user-friendly, proven tools in order to make marine navigation and communications more reliable and user-friendly. The implementation of e-Navigation is crucial for ships and seafarers to continue being safe and efficient in the world that is undergoing unprecedented technology-driven change [1, 4].

One of the core objectives related to the e-Navigation concept states: integrate and present information on board and ashore through a human-machine interface which maximizes navigational safety benefits and minimizes any risks of confusion or misinterpretation on the part of the user [18, 19].

Integrating of data received via communication equipment into the integrated navigation system makes it possible to optimize control of a vessel and to avoid possible misses and incorrect decisions by the navigator.

An overload of information provided by different displays for navigation, communication and operational information makes an officer of the watch (OOW) unable to prioritize information due to chaotic misplacement of information displays.

## 2. The IMO initiative

The IMO Sub-Committee NCSR at its 4 session held in 2017 agreed to establish a Correspondence Group on the development of Guidelines for the harmonized display of navigation information received via communication equipment under the coordination of Norway [3]. The author was a member of this expert Group.

During the work, a number of issues were identified [3]:

- the amount of information available from communications equipment exceeds the amount of display space available on existing navigation equipment such as radar and ECDIS;
- for ships not fitted with an Integrated Navigation System (INS) it may therefore be necessary to specify guidelines for an additional display;
- there are already a number of IMO and industry standards providing requirements for bridge display, including text size, colour etc. but there are some gaps. These Guidelines need to harmonize the implementation of relevant standards and close the relevant gaps; and
- essential information such as Maritime Safety Information (MSI) should be displayed on appropriate existing equipment, as other information, which will not be immediately essential to the navigation of the ship, could be displayed elsewhere or deselected in order to prevent overloading the user or the display, such as radar or ECDIS.

The Correspondence Group agreed to improve the layout of the draft Guidelines to make them more goal based. As previously stated, there are a number of overlaps with other work items of NCSR Sub-Committee, especially the work on “Additional modules to the Revised Performance Standards for Integrated Navigation Systems (INS) (resolution MSC.252(83) [9]) relating to the harmonization of bridge design and display of information”, as well as the work by the Harmonization Group on Data Modelling (HGDM) on MSPs (Maritime Services Portfolios) [6], and as well as the work on S-mode [5].

In the last round of the Correspondence Group’s work a large number of comments and proposals were received, in particular on the level of detail in the Guidelines, and consequently a restructured version was proposed. During the development of this draft Guideline and the considerations for the need and scope of issues relevant for the development of an additional module F to the Revised performance standards for Integrated Navigation Systems (INS) (resolution MSC.252(83) [9]), it has become clear that, in order to support the display of information received via communication equipment, the distribution to displays of safety information needs its own guidance – “Guidance on the efficient distribution of relevant navigation related information from communications equipment to navigation displays” [3] - and should not be limited to INS.

Therefore, the Correspondence Group concluded that an appropriate guideline should be drafted at a future date to support the developed Guidelines. These future guidelines should include the work already carried out for module F [5] and they could be prepared in combination with the work on additional modules to the Revised performance standards for Integrated Navigation

Systems (INS) (resolution MSC.252(83) [9]) relating to the harmonization of bridge design and display of information.

The work with respect to MSPs (Maritime Services) [6] will affect the amount of information and what information has to be displayed. Some members of the Correspondence Group felt that the Guidelines for the harmonized display of navigation information received via communications equipment could not be completed until the work with respect to MSPs (Maritime Services) is more mature.

Given the amount of work required to finalize the draft Guidelines and the value of coordinating this work with the amendments to the Revised performance standards for integrated navigation systems (INS) (resolution MSC.252(83) [9]), it is recommended to forward the attached draft Guidelines to the to the Navigation Working Group, to be established at NCSR 5, to clarify the way forward, understanding that the Correspondence Group may have more work to do in progressing the work further.

## 3. Purpose, Scope and Applications

Elaborated document provides guidance on the display of navigation-related information received by communications equipment. It aims to ensure that information is displayed in an efficient, reliable and consistent format, in a manner that is easily interpreted to support decision-making. These Guidelines supplement resolution MSC.191(79) [7] Performance standards for the presentation of navigation-related information on shipborne navigational displays in regard to the presentation of navigation information received via communication equipment. The use of these Guidelines will ensure that navigation information received via communications equipment is displayed in a harmonized manner on the ships’ navigational bridge.

The availability of electronic data that enhances the safe and efficient navigation of ships necessitates that shipborne systems capable of presenting this information to the user should do so in a harmonized and readily assimilated way. This information will be presented to shipborne users through a combination of primary navigational displays, such as ECDIS, radar/ARPA and INS, together with any additional display facilities that may be considered appropriate to assist the safe and efficient navigation of the ship. Reception of Maritime Safety Information (MSI) by means of direct printing has always been an important part of the GMDSS. However, it is clear from user requirements, such as those gathered during the user needs analysis of e-Navigation, that there is a need to portray such information in a harmonized way on appropriate navigation displays. To ensure effective decision making and safe navigation, the proper integration and presentation of information received via communication equipment is essential.

This Guideline is applicable to the information obtained from, but not limited to, communications equipment defined in SOLAS and standardized in [7, 8, 9, 10, 11, 12, 13, 14, 15, 17].

## 4. Terminology used in the Guidance

For the purpose of developed Guidance, unless expressly provided otherwise, the following terminology is used [3]:

- Maritime Safety Information (MSI) - Maritime Safety Information (MSI) is defined in the Safety of Life at Sea (SOLAS) Convention, Chapter IV as comprising “navigational and meteorological warnings, meteorological forecasts and other urgent safety related messages broadcast to ships”.
- Selection of Information – Selection is a method which specifies which information should be displayed on the navigational systems and INS tasks.
- Routing - Routing is a technical method to distribute data for navigation equipment.
- Filtering of information – Filtering is a technical method which categorizes and extract the information according to certain parameters, e.g. relevance for navigation, relevance for route, distance to own ship.
- Filter parameters - parameters which present the filter settings. The filter parameters are presented to and set by the user to be used by the technical process.

## 5. General presentation requirements

### 5.1. Human-Centred Design (HCD)

The type and volume of information displayed should be appropriate to the voyage phase and should not overload the user. Therefore, this Guideline should be read in conjunction with MSC.1/Circ.1512 [16, 21] in order to ensure that measures to prevent information overload take into account relevant human-centred design principles.

The type and level of information displayed should complement the user’s capabilities, and should take into consideration human factors principles [19]. Higher levels of integration mean that systems should be carefully evaluated to ensure that complexity and workload are compatible with the ability of the user (OOW).

In designing systems and equipment that will incorporate navigation information received via communications equipment, due consideration should be given for the ability of the operator to manage information. Any information received requires careful prioritization based on human-centred design principles. The receipt, display and use of navigation information received via communications equipment should be tested by the user and incorporated into the HCD process. Navigation information received via communications equipment should be manageable through the application of user preferences. The system should assist the user in reducing clutter and in enhancing situational awareness. The integration of navigation information received via communications equipment should not distract from the user’s primary task of maintaining the safe navigation of the ship.

### 5.2. Display of information

Navigation information received via communications equipment should be displayed in a timely, unambiguous and harmonized manner. Navigation information received via communications equipment should be displayed according to resolution MSC.191(79) [7] and, if applicable, based on the relevant S-100 [2] based Product Specification. Where there are no appropriate symbols defined for display in the relevant S-100 based Product Specification, additional new symbols need to be added to SN.1/Circ.243/Rev.1 [15].

Information should, where applicable, be geo-located and integrated with other navigation and charted information. Where possible, the graphical geo-located display of areas, points, lines and other information received via communications equipment should assist the user in developing greater situational awareness. The additional display of information from communications equipment must not degrade the primary information on a particular display but contribute to the overall navigational safety of the ship. Data should be appropriately filtered according to the selected scale/display range of the display. Only critical information should be displayed at all ranges, if practicable. The source of the received information should be readily identifiable.

Where navigation information indicate a direct risk to the ship’s planned route and or movement, the information should be indicated as an alert. This may be determined based on the safety settings available within the electronic navigation equipment such as ECDIS, radar/ARPA or INS.

One particularly interesting example of the e-Navigation Prototype Display has been described in detail in [20].

## 6. Functional requirements for presentation of information

### *General*

Information that has been received by onboard communication equipment should include an integrity testing process.

### *Routing*

- The user should be able to route information to another display if fitted.
- There should be a clear indication of the routing in use.
- Routing should allow the user to route the information according to the navigational situation and task.

### *Selection and filtering*

- Navigation information should be displayed in such a manner that information overload is prevented. Selectable functions should be included to allow for display of only the required information necessary for safe navigation and the task at hand.
- Navigation information should be displayed in such a manner that information overload is prevented. Selectable functions should be included to allow for display of only the required information necessary for safe navigation and the task at hand.
- It should be possible to select and filter (categorize) of information and data received on board in accordance with urgency and sea area.

- Information relevant to planned route and situation should be identified using adequate filtering processes.
- Means should be available enabling the user to select the information needed for the current operational task and situation.
- There should be a clear indication of the selection and filtering parameters in use.
- It should be possible to manually select the information for automatic presentation on the navigational displays.
- Information that presents a danger to safe navigation and requires an alert should be identified.

#### *Prioritization*

- It should be possible to prioritize information and data received on board. This should be prioritized in accordance with urgency and sea area.

#### *Indication of new information*

- An alert or indication should draw attention to the presence of new and/or relevant information related to the ship's movements or operating area.

## 7. Presentation of navigation-related information

The MSI or other geo-referenced locations impacting safety:

- New information should be indicated on a route planning, route monitoring or collision avoidance display by an icon or symbol and an alert should be given.
- It should be possible to present additional information upon selection (request) via pick-report functionality on ECDIS and radar/ARPA displays or INS tasks route monitoring, route planning and collision avoidance.
- Alterations to own ship route:
- Graphical presentation of alterations received from external source should be clearly displayed and differentiate from the monitored route.
- It should be possible to display additional information of the alterations received from an external source on demand (at least the source of the alterations received).

## 8. Operational display

General:

- Information received from communications equipment should not obscure the primary information of an operational display.
- The overlaid information received from communications equipment should be clearly distinguishable as being additional information that has been added to the display.

Additional display – INS task “status and data display” – or other means:

- The increasing amount of data received from communications equipment may require an additional display on board.
- HMI for displaying and evaluating received information as well as for specifying filtering, routing, and presentation parameters (selection for presentation) should be provided.

- The user should be able to view information items and their filtering, routing, and selection (presentation) properties.
- The user should be able to edit the filtering, routing, and selection (presentation) properties of information items.

## 9. Alternative proposals

During the discussion various points of view appeared, some saw the described issues more broadly, others decidedly narrower. Document [4] proposes the drafting of Guidelines for integration and presentation of available navigation-related information exchange provided via communications equipment by means of integrating VHF/MF/HF DSC in an Information display (Conning Display). This display, in turn, is integrated within an INS (including AIS, ECDIS, and satellite-AIS). All actions on information exchange by means of DSC are performed using software of the Conning Display which may be incorporated in the new module F. In this case, no amendments will be required to the existing ECDIS Performance Standards (resolution MSC.232(82) [8]).

An information display (Conning Display) incorporates all the relevant and important information for the vessel conning together in one place. A Conning Display may be implemented in the frame of INS-Module F for integration and presentation of available navigation-related information exchange provided via communications equipment. This Conning Display should be integrated with appropriate communications equipment and with Integrated Navigational System (INS).

In particular, the Conning Display should be capable of displaying VHF/MF/HF DSC information and therefore should be connected to VHF DSC controller and MF/HF DSC controller. Internal interfaced navigation information between bridge navigation equipment (AIS, ECDIS, INS) are also routed to the INS.

In order to provide a connection to VHF DSC controller and to MF/HF DSC controller the same protocol may be used [4], where instead of the software ECDIS the software of Conning Display is used:

1. clicks on the vessel's AIS mark on the Conning Display for automatically sending the MMSI from Conning Display to DSC controller by transferring controlling commands to DSC for providing DSC call by this;
2. display the calling vessel by a blinking AIS mark on the called vessel's Conning Display (a red blinking mark in case of distress call), transferring MMSI from DSC controller to Conning Display automatically for identification of the calling vessel on Conning Display by this; and
3. open exchange of information, without wasting any time on working out who is who. The working channel (frequency) can be set by default (or maybe chosen manually, if necessary, using standard computer actions).

The additional satellite-AIS connection to the Conning Display should be considered for MF/HF DSC. All actions according to the protocol are fulfilled using special software for the Conning

Display using a common maritime data structure, based on the work of IHO and their S-100 data structure [2]. The principle of multiple layers of information which can be displayed on top of each other may be used. All of the aforementioned proposals avoid introducing changes to the ECDIS Performance Standards [8] for implementation of the communication protocol.

Additional symbols for possible addition to SN.1/Circ.243/Rev.1 [15] when the source is DSC may be used as presented in document NCSR 4/8, appendix. Only two letters may be added to them: MF, when the source is MF DSC, and HF, when the source is HF DSC.

It should be considered to use part of Conning Display screen, if necessary, to interface the area where a vessel is located for MF/HF communication.

The IMO NCSR Sub-Committee was invited to consider the suggested approach for displaying VHF/MF/HF DSC information under development of the draft Guidelines for the harmonized display of navigation information received via communication equipment and to take action as appropriate [4]. This proposal states an important issue which need to be discuss thoroughly at NCSR5.

We should also remember about development of the newly-agreed VHF Data Exchange System (VDES).

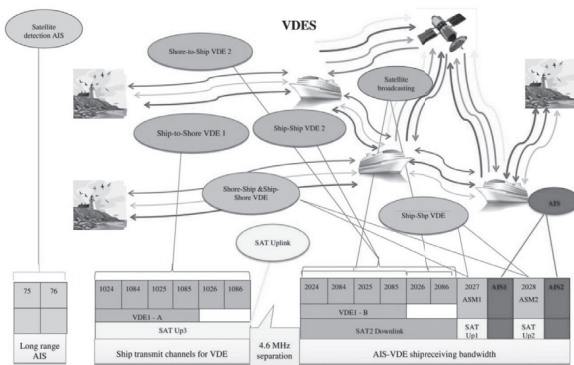


Fig. 1. VHF Data Exchange System (VDES) [22]

VHF Data Exchange System (VDES) is a radio communication system that operates between ships, shore stations and satellites on Automatic Identification System (AIS), Application Specific Messages (ASM) and VHF Data Exchange (VDE) frequencies in the Marine Mobile VHF band. AIS is a component of VHF Data Exchange System (VDES) which operates using the Gaussian Minimum Shift Keying (GMSK) modulation scheme, other components of VDES will use higher capacity modulation schemes. The VHF Data Exchange System (VDES) is seen as an effective and efficient use of radio spectrum, building on the capabilities of AIS and addressing the increasing requirements for data through the system. New techniques providing higher data rates than those used for AIS is a core element of VDES. Furthermore, VDES network protocol is optimized for data communication so that each VDES message is transmitted with a high confidence of reception. VDES supports e-Navigation and provides access to the Maritime Cloud. VHF Data Exchange System (VDES) will continue to be developed over the next few years in accordance with the roadmap published in the VDES Guideline [22].

## 10. Conclusion

This paper describes the outcome of the discussions in the IMO Correspondence Group on the development of the draft Guidelines for the harmonized display of navigation information received via communications equipment. It also contains most important fragments of a draft version of the Guidelines for further consideration.

The Correspondence Group have acknowledged that this is as far as we can come at this stage of the development of the Guidelines for now. And as reflected in the submitted report [3], these Guidelines will be affected of the ongoing process with concern to other outputs to be delivered under the e-Navigation agenda at a later stage. This discussion may or may not lead to a need for an extension of the target completion date, however, it may also reveal that it will not be sufficient to extend it to 2019. If an agenda item is not finalized in time, the NCSR Sub-Committee will automatically ask the Maritime Safety Committee (MSC) for an extension and it should be a realistic time extension, hence it was not needed in the report of the Correspondence Group. As discussed, some members consider that if the draft guidelines are maintained at a high enough level there is a chance they can still be completed at NCSR 5. This would require a willingness of the Navigation Working Group to complete the work and agreement from the plenary of NCSR that the guidelines should be cast at a high level.

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