

No. 111/19, 39–46
ISSN 2657-6988 (online)
ISSN 2657-5841 (printed)
DOI: 10.26408/111.04

Submitted: 02.08.2018
Accepted: 29.10.2018
Published: 23.09.2019

PROGRESS OF WORK ON E-NAVIGATION AND THE MODERNISATION OF GMDSS

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Abstract: The article presents the progress of work on the e-navigation project carried out by the International Maritime Organization (IMO). Progress of the work on the second project carried out by the IMO is also described, related to e-navigation and involving modernization of the Global Maritime Distress and Safety System (GMDSS). In addition to the description of these projects, their mutual relationship is also presented, as well as the timetable for implementing their stages.

Keywords: e-navigation, maritime radio communication, GMDSS, GMDSS modernisation.

1. INTRODUCTION

Technological progress in electronics, radio communications and information technology results in the constant emergence of new proposals for modifications to the equipment and systems used on sea-going vessels. The principles and scope of equipment for these vessels, related to ensuring their safety, are strictly regulated by the International Maritime Organization (IMO), with merit-related support by its committees and sub-committees. In 2006, several countries submitted a proposal to the IMO Maritime Safety Committee (IMO – MSC) for preparing a broad strategy for the inclusion of new technologies in a comprehensive manner, to ensure their compatibility with existing navigation and communication technologies and services [MSC 2006].

In response to this proposal, the MSC took the decision to initiate work on the “E-navigation” project through two IMO technical sub-committees: Sub-Committee on Safety of Navigation (NAV) and Sub-Committee on Radiocommunications, Search and Rescue (COMSAR). The project coordinator became the NAV Sub-Committee [MSC 2006]. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), International

Hydrographic Organisation (IHO) and International Federation of Shipmasters' Associations (IFSMA) were also invited to participate in the project.

After two years of work, in 2008 at the 85th session of the IMO Maritime Safety Committee (MSC85), the “E-navigation Strategy” was adopted. As a consequence of this decision, another project was adopted: “Preparation of the E-navigation Strategy Implementation Plan”, and added to the agenda of the IMO NAV and COMSAR sub-committees, as well as the Sub-Committee on Standards of Training and Watchkeeping (STW), with completion scheduled for 2012.

As a result of the organisational changes in the IMO sub-committees in 2013 coordination over the e-navigation project was entrusted to a new sub-committee formed by merging the NAV and COMSAR sub-committees, i.e. Sub-Committee on Safety of Navigation, Communication and Search and Rescue (NCSR). With a two-year delay, in 2014, MSC approved the results of this project, accepting the document “E-navigation Strategy Implementation Plan” [MSC 2014].

Doubtlessly, one of the key elements of e-navigation will be a radio communication data transmission network based on the systems already in use in maritime communications. The above led to the IMO undertaking work in 2012 on reviewing and modernising the Global Maritime Distress and Safety System (GMDSS) used in maritime radio communications.

The first phase of this project concerned a “High-Level Review”, where fundamental elements of the GMDSS were analysed. During phase two, in 2013–2016, a “Detailed Review” of the GMDSS was performed. Another phase, completed in 2017, concerned the preparation of a “GMDSS Modernisation Plan”. According to this plan, all work conducted by the NCSR sub-committee on modernisation of the system will be completed in 2021 [NCSR 2017].

This paper presents the progress of work on the e-navigation project and related GMDSS modernisation, as conducted by the NCSR sub-committee, the IMO Correspondence Group on the Review of the GMDSS, and the Joint IMO/ITU Experts Group, in which the author of this paper participates.

2. PROGRESS OF WORK ON THE E-NAVIGATION PROJECT

Following lengthy discussions, the following definition of e-navigation was adopted [Korc 2015]:

“E-navigation is the harmonised collection, integration, exchange, visualisation and analysis of maritime information on ships and land, using electronic means, improving navigation from port to port and related safety and ship protection services on the sea, as well as protection of the natural environment.”

According to the above definition, the task of e-navigation is to satisfy current and future needs of the users through the harmonious cooperation of maritime navigation systems and their supporting land-based services. Its overarching

purpose, on the other hand, is to improve navigational safety and reduce general errors, including those caused by humans.

2.1. E-navigation Strategy Implementation Plan

The e-navigation Strategy Implementation Plan (SIP), adopted at the 94th session of the MSC in 2014, presents a vision for e-navigation that includes the general requirements concerning its three fundamental elements: ship, land and communication. It was accepted that complete implementation of the plan requires completion of the following 18 tasks [MSC 2014]:

- 1) preparation of a guideline draft – “*Guidelines on Human Centred Design (HCD) for e-navigation systems*”;
- 2) preparation of a guideline draft – “*Guidelines on Usability Testing, Evaluation and Assessment (UTEA) of e-navigation systems*”;
- 3) preparation of a concept for electronic manuals and harmonising their layout to ensure easy familiarisation of seamen with the relevant equipment;
- 4) preparation of a concept for standard work modes (S-modes) for on-board navigation displays, including recording and readout for various situations, as well as S-mode functioning on appropriate hardware;
- 5) a study on whether an expansion of the existing Bridge Alert Management Performance Standards is necessary;

Work on this subject was split between achieving two goals:

- a) preparation of guidelines for implementing bridge alert management (BAM),
 - b) modification of the BAM operating standards;
- 6) preparation of a methodology for displaying the accuracy and reliability of navigation equipment (this includes a harmonised display system);
 - 7) a study on whether the Integrated Navigation System (INS), defined in resolution MSC.252 (83), is a suitable integrator and navigation data visualisation method for e-navigation and identification of changes, if necessary, including the communication port and the PNT module;

The result of work on this issue shall be:

- a) preparation of a report concerning the suitability of the INS,
 - b) preparation of new or additional operating standard modules for the INS.
- 8) agreement by Member States on an outline for a standard ship reporting format, so that global “one visualisation” is possible (SOLAS Regulation V/28, Resolution A.851(20) and SN.1/Circ.289);
 - 9) finding the best method for automated collection of internal ship data for reporting, including static and dynamic information;
 - 10) a study on the general requirements of Resolution A.694(17) and IEC (International Electrotechnical Commission) 60945 to see how built-in integrity testing (BIIT) could be implemented;

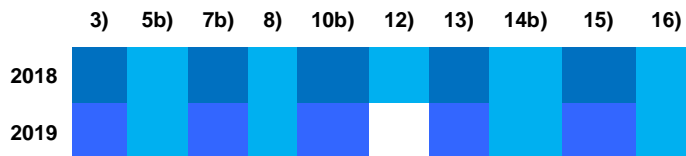
- 11) preparation of a guideline draft – “*Guidelines for Software Quality Assurance (SQA) in e-navigation*”;
- 12) preparation of guidelines for improvement of reliability and resilience of ship PNT systems by integration with external systems;
- 13) preparation of guidelines demonstrating how navigation information received by communication equipment can be displayed in a harmonised manner, and what level of their functionality is needed;
- 14) preparation of a common maritime data structure (CMDS) and inclusion of parameters concerning the priority, source and owner of information based on the IHO S-100 data model;
The result of work on this issue shall be:
 - a) guidelines concerning the CMDS,
 - b) modified IEC standards for exchange of data used aboard ships, including firewalls;
- 15) identification and preparation of a guideline draft for issue-free integration of all currently available communication infrastructures, and how they can be used (e.g. frequency range, band, etc.), and what systems are in development (e.g. maritime cloud) and can be used for e-navigation;
- 16) a study on how best to undertake harmonisation of conventions and regulations concerning navigation and communication equipment;
- 17) further development of maritime services portfolios (MSPs) so that service and responsibility scopes are clear before the interim arrangements are implemented;
- 18) preparation of a guideline draft – “*Guidelines for the Harmonisation of testbed reporting*”.

2.2. Execution of the E-navigation Strategy Implementation Plan

Taking into account the necessary open design and flexibility of the future system, implementation of the e-navigation strategy should be a changing and interactive process [Korcz 2015]. From among the 18 tasks listed in section 2.1, which execute the E-navigation Strategy Implementation Plan, work on the following tasks had been completed by 2018: 1, 2, 4, 5a, 6, 7a, 9, 10a, 11, 14a, 16, 17 and 18.

Table 1 shows the planned completion dates of the remaining tasks, and a correlated schedule for their completion.

Table 1. Deadlines for task completion in the e-navigation implementation process



3. PROGRESS OF WORK ON THE GMDSS MODERNISATION PROJECT

Work on the GMDSS modernisation project can be broken down into tasks concerning the legal and technical aspects related to implementation of new maritime radio communication systems or modification of existing ones [Korc 2017].

3.1. Legal aspects of the GMDSS modernisation

The legal aspects of the GMDSS modernisation mainly concern amendments to the Safety Of Life At Sea (SOLAS) convention and its related documents. The SOLAS Convention defines uniform rules and regulations for the minimum required equipment of marine vessels, with section 4 devoted to radio communication [PRS 2014].

As a result of previous work, the basic functions fulfilled by ships [PRS 2014] were expanded to include the following functions [NCSR 2016]:

- transmission and reception of ship safety-related information, and
- transmission and reception of information to/from land-based systems and networks.

At the same time, the definition of general communications was changed to operating radio communications other than emergency communications.

A new definition for A3 sea areas was also adopted [PRS 2014; NCSR 2016]: *“An A3 area shall mean a region, excluding marine areas A1 and A2, in the range of an acknowledged mobile satellite communications service handled by a land-based ship station installed aboard, in which permanent alarm capability is ensured”*.

Definitions of sea areas A1 and A2 was left unchanged. Sea area A4 was not redefined, but as it is the area outside areas A1, A2 and A3, it will vary for ships using different mobile satellite communication providers. Otherwise, certain regulations of section 4 were modified, as they were simply outdated or incorrect.

3.2. Technical aspects of GMDSS modernisation

The most important proposals for introducing new or modifying existing marine radio communication systems are presented below.

3.2.1. New satellite operators

According to the current regulations, in order for a satellite system (operator) to be considered as meeting the requirements of the SOLAS Convention (GMDSS), it has to meet the requirements specified in IMO A.1001(25) – “Criteria for the provision of mobile satellite communication systems in a global maritime distress

and safety system (GMDSS)”. Current provisions of the SOLAS Convention and the above resolution are very strict, e.g. they require global coverage for operations. In order to change this (see section 3.1), SOLAS section 4 will be modified to ensure actual access to the GMDSS for other satellite service providers. In the above context, the issue of frequency availability for new GMDSS operators will be considered in point 1.8 of the WRC-19 session agenda [Korcz 2017].

All IMO documents currently applicable to Inmarsat will be reviewed to adapt them to new GMDSS satellite service providers. According to the decision taken in June this year at the 99th MSC session, a procedure for acknowledging new GMDSS service providers will be initiated for operators of the Iridium system and the Fleet Safety Inmarsat standard.

3.2.2. Land-based radio communication

Without a doubt, VHF radiotelephones will remain a highly useful component of maritime radio communications. HF radio communications will remain a required communication system for sea area A4. It is well known that HF communication is highly varied and difficult due to variable ionospheric propagation. A solution to this problem is the use of automatic frequency scanning and automatic link establishment (ALE) systems, improving the success of using HF communication. To summarise, the application of technological progress may lead to easier and more effective use of the HF band [Korcz 2017].

Another issue analysed was the use of NBDP in sea areas A3 and A4. It was found that reception of maritime safety information (MSI) in the HF band remains necessary, but it can be acquired by means other than NBDP, and that this technology will not be required to fulfil any other GMDSS function. However, existing NBDP devices can be left to receive MSI if the ship is not equipped with other devices fulfilling this function.

3.2.3. New communication technologies

The detailed GMDSS review clearly indicates the need to use new technologies. An example of such a new technology is the NAVDAT system. The NAVDAT system enables data transmission at a rate of 18 kbps, while the current NAVTEX system only enables 100 bps. It should be noted that to provide the NAVDAT service, MSI providers will have to create the required land-based infrastructure (Fig. 1) [Korcz 2015].

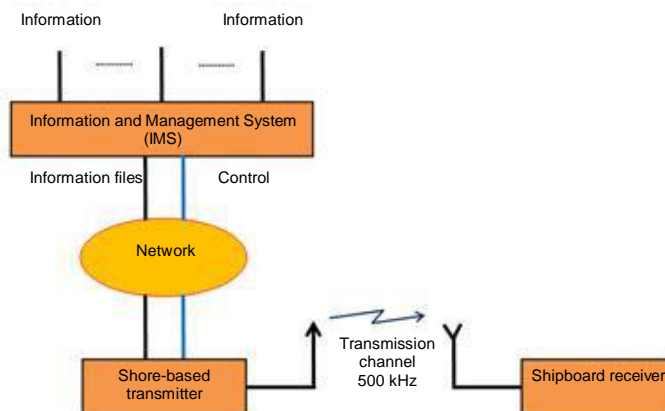


Fig. 1. NAVDAT broadcasting network flowchart

The GMDSS Modernisation Plan includes preparation of NAVDAT management systems for MSI reception on the MF and HF frequencies.

Another new communications technology planned for use in the modernised GMDSS is the VHF Data Exchange System (VDES). VDES enables the exchange of application specific messages (ASMs), which facilitate many applications for navigation protection and safety. In the future, VDES will have a major positive effect on maritime information services, including aids to navigation (AtN) and Vessel Traffic Service systems (VTS). VDES will also be able to provide MSI locally. VDES will include a satellite components, which can be suitable, for example, for MSI transmission in remote areas. The VDES concept will be the subject of point 1.9.2 of the WRC-19 session agenda [Korczyński 2017].

4. CONCLUSIONS

By providing ship-shore and shore-ship data exchange, GMDSS and its new communications technologies will, along with their regular functions, form the foundation of the e-navigation strategy. The GMDSS modernisation plan should provide the framework for developing the communication systems for e-navigation. It should also offer a common shore-based system architecture (CSSA).

In the author's opinion, the current level of work on GMDSS modernisation suggests that the plan for this modernisation remains consistent with the adopted schedule. The complete and timely execution of this plan will enable the timely completion of the e-navigation project, according to the adopted E-navigation Implementation Plan, with work due for completion in 2019 [MSC 2014].

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