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WORK PROGRAMME

Proposal for a new output to realize the full potential of the S-100 Electronic Chart Display and Information System (ECDIS)

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SUMMARY

Executive summary: This document proposes a new output for the Organization to develop guidance to establish a framework for data distribution and global Internet Protocol (IP)-based connectivity to realize the full potential of S-100 capable Electronic Chart Display and Information System (ECDIS).

Strategic direction, if applicable: 2

Output: Not applicable

Action to be taken: Paragraph 73

Related documents: Resolutions MSC.530(106)/Rev.1; A.1173(33) and A.1174(33); MSC 85/26/Add.1; MSC 108/12/4, MSC 108/12/5, MSC 108/20; NCSR 11/19; FAL 48/20; MSC.1/Circ.1310/Rev.2, MSC.1/Circ.1503/Rev.2, MSC.1/Circ.1595 and MSC.1/Circ.1645

Introduction

1 This document is submitted in accordance with the provisions of the *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.5/Rev.5), taking into account resolution A.1173(33) on the *Strategic Plan for the Organization for the six-year period 2024 to 2029* and resolution A.1174(33) on *Application of the Strategic Plan of the Organization*.

2 The Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), at its eleventh session, as instructed by MSC 108 (see MSC 108/20, paragraphs 12.10 to 12.16), considered S-100 implementation matters under "any other business". The Sub-Committee agreed that S-100 matters required urgent consideration due to S-100 ECDIS becoming available for installation as of 1 January 2026 (NCSR 11/19, paragraphs 18.22 to 18.29 and 19.4.20).

3 The IMO World Maritime Day Theme for 2024, "Navigating the future: safety first!", aptly reflects the importance of embracing new technologies and innovations to enhance maritime safety and sustainability. The transition to S-100 products and the broader move towards digitalization aligns neatly with this theme. By facilitating the development of a comprehensive and coordinated implementation strategy for S-100 products, the Organization can ensure that these technological advancements contribute to a safer, more efficient, and environmentally sound maritime industry in the future.

Background

E-navigation and S-100

4 E-navigation is defined as the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment (MSC 85/26/Add.1, annex 20, paragraph 1.1).

5 In 2011, IMO chose IHO's S-100 Universal Hydrographic Data Model¹ (S-100) as the standard for sharing and using digital maritime data,² including electronic navigational charts (ENCs), tides, currents, meteorological forecasts, navigational warnings and route exchange.

6 By adopting S-100 as a common maritime data structure (CMDS) in the *E-navigation Strategy Implementation Plan – Update 1* (MSC.1/Circ.1595), the full potential of digitalization, enabling the integration of diverse data sources into a unified platform for mariners and shore authorities, can be realized.

7 An ECDIS is a computer-based navigation system that complies with IMO regulations and can be used as an alternative to paper navigation charts. It is an automated decision aid capable of continuously determining a vessel's position in relation to land, charted objects, aids to navigation and unseen hazards. SOLAS regulation V/19 outlines the requirement for ships engaged on international voyages to be fitted with ECDIS.

8 ECDIS will benefit from access to the wider range of static and dynamic geospatial data of the S-100 framework to improve navigational safety and situational awareness. Together, S-100 and ECDIS have the potential to fundamentally transform navigation, creating a dynamic, interconnected digital maritime environment that unlocks opportunities to enhance safety, efficiency, and sustainability across the entire maritime sector.

Revision of the ECDIS performance standards and S-100 implementation matters

9 MSC 106 adopted the *Performance standards for Electronic Chart Display and Information Systems (ECDIS)* (resolution MSC.530(106)) which enhanced ECDIS reliability and safety by incorporating technological advancements, such as improved display resolution, advanced sensor integration, implementation of the IHO's S-100 standard, and cyber security measures, as well as lessons learned from operational experience, including human-machine interface optimization.

¹ <https://iho.int/en/s-100-universal-hydrographic-data-model>

² The full suite of S-100 product specifications is available on the IHO website: <https://iho.int/en/s-100-based-product-specifications>

10 MSC 108 adopted a revision of the ECDIS performance standards (resolution MSC.530(106)/Rev.1) which introduced the capability for the digital exchange of ships' route plans (S-421) (MSC 108/20, paragraph 12.15) using secure machine-to-machine communication, standard formats and standard service interfaces, including information security protection.

11 For the Committee's consideration, documents MSC 108/12/4 (IHO) and MSC 108/12/5 (New Zealand) highlighted the progress and ongoing challenges related to S-100 implementation. This underscored the need for a comprehensive approach to S-100 implementation to ensure a smooth transition, widespread adoption, and realization of the full benefits of this transformative technology.

12 The Committee noted the need to address communication protocols, real-time data exchange and training needs (MSC 108/20, paragraph 12.13), and instructed NCSR 11 (MSC 108/20, paragraph 12.16.1) to further consider these issues. Further, the Committee invited interested parties to consider, if necessary, submitting proposals for new outputs to a future session of the Committee (MSC 108/20, paragraph 12.16.2).

13 NCSR 11, having noted the considerations in the Working Group on Search and Rescue and other Technical Matters (NCSR 11/WP.8, paragraphs 38 to 44) and recognizing the urgency, invited interested Member States and international organizations to consider submitting an urgent proposal for a new output to MSC 109 to address S-100 implementation matters.

14 Further, NCSR 11 invited the HTW Sub-Committee to consider revising Model Course 1.27 on Operational use of Electronic Chart Display and Information System (ECDIS) and invited the Committee to include a new output on "Development of operational guidance for route exchange" into the post-biennial agenda of the Committee, noting both tasks were consequential to the adoption of resolution MSC.530(106)/Rev.1 (NCSR 11/19, paragraphs 18.22 to 18.29, and 19.4.20).

IMO's objectives

15 As a specialized agency of the United Nations, IMO's mission is to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation. This will be accomplished by adopting the highest practicable standards of maritime safety and security, efficiency of navigation and prevention and control of pollution from ships, as well as through consideration of the related legal matters and effective implementation of IMO instruments, with a view to their universal and uniform application.

16 The transition of ECDIS from the IHO's S-57 data transfer standard to the IHO S-100 framework represents a significant leap forward in maritime digital data integration and underpins the broader move towards e-navigation. This strongly supports Strategic Direction 2: Integrate new, emerging, and advancing technologies into the regulatory framework. The IHO S-100 framework improves navigational safety and efficiency through the next generation of ECDIS and facilitates the development of new applications and services that contribute to a more sustainable and resilient maritime sector.

17 Furthermore, the implementation of S-100 is expected to play a role in "decarbonization through digitalization". S-100 can enable more efficient voyage planning and optimized routing,³ directly contributing to Strategic Direction 3: Respond to climate change and reduce greenhouse gas emissions from international shipping. This integration not only enhances operational efficiency but also supports the maritime industry's efforts to mitigate its environmental impact.

³ See IHO/CIRM presentation to MSC 108 (May 2024)
<https://docs.imo.org/Category.aspx?cid=49&session=108&dtid=20>

Need

18 To fully realize the potential of S-100 capable ECDIS (resolution MSC.530(106)/Rev.1) and achieve the Organization's e-navigation objectives (MSC 85/26/Add.1, annex 20, paragraph 5), a standardized framework for data distribution, supported by global Internet Protocol (IP)-based connectivity, is essential. A decisive shift towards a goal-based framework⁴ would harness the full potential of this transformation.

19 Such a framework would establish clear objectives and performance requirements for real-time data delivery that can accommodate emerging technologies (flexibility) and evolving industry needs (future-proof). This will stimulate S-100 data production, enhance navigational safety, improve onboard operational efficiency and seafarer welfare, and facilitate the use of S-100 beyond the SOLAS mandate.

20 With S-100 capable ECDIS anticipated on ships as early as 1 January 2026 and mandatory⁵ for new installations from 1 January 2029, urgent proactive action is needed. Failure to do so could lead to a fragmented and ineffective S-100 ecosystem, increasing implementation costs for shore-side organizations and hindering the progress towards IMO's overarching goal of enhancing maritime safety, security, and efficiency.

Analysis of the issue

21 An S-100 capable ECDIS will require a globally accessible, standardized, and secure IP-based infrastructure to facilitate the real-time exchange of S-100 products between shore and ship. This is essential for unlocking the full potential of S-100 and ECDIS, revolutionizing navigation, enhancing safety, and driving operational efficiency throughout the maritime industry.

Exchange of S-100 products and an interface to ECDIS

22 ENC's in the IHO's S-57 format are typically distributed via Regional ENC Coordinating Centres (RENCs), distributors and Value-Added Resellers (VARs) with a (relatively) low update frequency. Increasingly, this distribution is transitioning online, either directly from a hydrographic office's website or via an online platform provided by an ENC subscription service. In most circumstances, the ENC requires manual handling to "upload" the information into the ECDIS via a USB, CD/DVD or networked file location.

23 For the purposes of this document, a distinction is made between the S-100 data products with low update frequency (e.g. S-101 ENC's and S-102 bathymetric surfaces (in most cases)), and dynamic data (e.g. S-421 route plan, S-129 under keel clearance management, S-124 navigational warnings and other S-4XX products (e.g. ice information, weather and wave hazards, conditions and observations)).

⁴ For completeness, the term 'goal-based framework' does not imply the development of a goal-based standard in accordance with MSC.1/Circ.1394/Rev.2.

⁵ SOLAS regulation V/18.2 requires "systems and equipment, including associated back-up arrangements, where applicable, installed on or after 1 July 2002 to perform the functional requirements of regulations 19 and 20 shall conform to appropriate performance standards not inferior to those adopted by the Organization." Further, "for an electronic chart display and information system (ECDIS) to be accepted as satisfying the chart carriage requirement of regulation 19.2.1.4, that system shall conform to the relevant performance standards not inferior to those adopted by the Organization in effect on the date of installation, or, for systems installed before 1 January 1999, not inferior to the performance standards adopted by the Organization on 23 November 1995" (SOLAS regulation V/18.4).

24 With S-100 catering to a broader range of digital products and services compared to S-57 (limited to ENC effectively), the distribution of those products and services becomes more challenging. For example, the ECDIS performance standard (resolution MSC.530(106)/Rev.1) does not acknowledge the need for real-time exchange of all S-100 products, recognizing that not all S-100 products require real-time updates. Further, it does not describe a suitable physical interface to establish a secure and real-time data exchange capability.

Cybersecurity, connectivity and service discovery

25 IP-based connectivity offers a promising avenue for S-100 data distribution, leveraging existing infrastructure and potentially reducing implementation costs. A comprehensive solution is necessary to address the complexities of service discoverability and data authentication within a distributed S-100 ecosystem.

26 This proposal recommends adopting the International Electrotechnical Commission (IEC) 63173-2 – Secure communication between ship and shore (SECOM) protocol.⁶ SECOM provides a standardized and robust interface for secure machine-to-machine communication, enabling seamless bi-directional data exchange between ship and shore-based systems. It is referenced in resolution MSC.530(106)/Rev.1 for S-421 route plan exchange only, therefore, extending SECOM's application to encompass all real-time S-100 products is crucial for ensuring interoperability and preventing investments in potentially incompatible solutions.

27 SECOM, while providing a standardized and secure interface for data exchange, requires a dedicated backend system to manage functionalities such as service discovery and robust cyber security measures. The Maritime Connectivity Platform (MCP),⁷ a decentralized, open-source framework designed to facilitate efficient and secure data exchange in the maritime domain, offers a standardized solution to these challenges.

Relationship between S-100 and the Global Maritime Distress and Safety System (GMDSS)

28 Some S-100 products could contain maritime safety information (MSI) (as defined in SOLAS regulation IV/2.10) as they deal with safety-critical content and direct relevance to navigational safety.

29 For example, S-124 (Navigational Warning) data is a graphical representation of the text-based⁸ navigational warnings that will continue to be disseminated through existing GMDSS platforms (MSC.1/Circ.1645 refers).

30 Regulating the distribution of S-100 products through the GMDSS might be unnecessarily restrictive. Existing regulation does not preclude the dissemination of information via channels outside the GMDSS. For example, many MSI providers already publish information on public websites. Therefore, this proposal advocates for a pragmatic approach.

31 This proposal does not suggest any changes to the way ships currently receive text-based MSI and search and rescue (SAR) related and other urgent safety related information using the radiocommunication capabilities described in SOLAS chapter IV and in MSC.1/Circ.1645.

⁶ IEC 63173-2:2022, Maritime navigation and radiocommunication equipment and systems – Data interfaces – Part 2: Secure communication between ship and shore (SECOM).

⁷ <https://maritimeconnectivity.net/>

⁸ Formatted in accordance with the *Joint IMO/IHO/WMO Manual on Maritime Safety Information* (MSC.1/Circ.1310/Rev.2).

32 S-100 products should be capable of being disseminated via IP-based infrastructure. Any S-100 product considered to contain MSI or SAR related information⁹ will require the MSI or SAR related information to also be promulgated via the GMDSS in text-based format.

33 For example, a navigational warning issued in accordance with the *Joint IMO/IHO/WMO Manual on Maritime Safety Information* (MSC.1/Circ.1310/Rev.2) could include a reference to the equivalent S-124 data set (i.e. machine-readable), providing mariners with immediate recognition that equivalent information has been provided for integration into the navigational information available for display on an S-100 capable ECDIS (and vice-versa).

Establishment of the framework

34 There is no mention in IMO regulations of globally accessible, standardized, and secure IP-based infrastructure to facilitate the real-time exchange of data between shore and ship. This proposal advocates for the establishment of a new guideline to establish a framework for data distribution and global IP-based connectivity.

35 Noting the invitation of NCSR 11 for the HTW Sub-Committee to consider revising the IMO Model Course 1.27 (NCSR 11/19, paragraph 18.28.2), the operational elements of a framework for data distribution and global IP-based connectivity and its application to ECDIS, may also need to be addressed in IMO Model Course 1.27.

36 Future amendments to SOLAS chapter(s) IV and/or V, and associated instruments, may be required but are not considered necessary as part of this new output.

37 A goal-based framework would avoid restricting the implementation to a specific frequency band or communication service provider, fostering innovation and competition while ensuring the necessary infrastructure for safe and efficient navigation in the evolving maritime landscape.

International organization collaboration

38 The successful implementation of S-100 necessitates collaboration beyond IMO. Joint efforts with IHO, WMO, IALA and other organizations are essential for addressing data standardization, harmonizing communication protocols, developing guidance and guidelines, and developing training and familiarization programmes that cater to the diverse needs of stakeholders involved in the production, dissemination, and utilization of S-100 products and services.

Analysis of the implications

39 The broad maritime industry implications of transitioning from S-57 to the S-100 framework, such as the development of new ECDIS units, the integration of new data layers, and associated requirements, have been extensively considered by the Organization. This proposal, having identified the S-100 implementation matters (paragraphs 21 to 38), seeks to provide a framework for real-time data exchange, which constitutes a crucial, yet distinct, aspect of the overall S-100 implementation matters.

⁹ Noting there is no specific S-100 product specification for SAR related information, this may require future consideration in the context of Maritime Service (MS) 16 (SAR Service) and the digital exchange and sharing of information (MSC.1/Circ.1610/Rev.1).

40 New equipment might be necessary (if not already available) on the ship side to establish IP-based connectivity with S-100 capable ECDIS units utilizing appropriate communication bearers.

41 Amendments to the ECDIS performance standard will be necessary to facilitate the standardized and effective implementation of real-time S-100 data exchange. While these amendments may raise concerns regarding potential delays and costs for manufacturers, they are crucial for realizing the full potential of S-100 and ensuring a harmonized approach to e-navigation. The proposed changes, primarily focused on extending the use of the SECOM protocol to encompass all dynamic S-100 products, are not anticipated to require significant alterations to the core ECDIS architecture.

42 As further amendments to the ECDIS performance standards are proposed, flag States may need to amend their legislation/regulations to update references to incorporate the amended resolution, currently resolution MSC.530(106)/Rev.1.

43 Shore-based organizations that intend to produce real-time S-100 products will likely be required to support distribution via SECOM. This may involve investments in new infrastructure and the development of secure and reliable data exchange mechanisms. Furthermore, the production of S-100 data sets will necessitate specialized training for data producers, equipping them with the knowledge and skills to create, test, and validate data sets in S-100 formats. This training will need to encompass an understanding of geographic information system (GIS) layers and data management principles.

44 Whilst outweighed by the long-term benefits of increased navigational safety, efficiency and environmental protection, there are infrastructure and ongoing costs associated with the adoption of advanced technologies and enhanced functionalities. The development of the proposal focussed on identifying the least-cost solution (paragraph 57.1) with the highest benefits (paragraphs 46 to 52).

45 Annex 1 provides an analysis of the administrative requirements of this output in accordance with annex 6 of MSC-MEPC.1/Circ.5/Rev.5.

Benefits

46 The Francis Scott Key Bridge incident near Baltimore, Maryland in March 2024 provides a real-life example¹⁰ of the limitations of traditional paper charts and low update frequency ENC's. Initially, all shipping traffic was diverted until auxiliary navigation channels could be surveyed and charted. Over the course of five weeks, five updates to the ENC were issued, with as little as two days between updates.

47 This scenario underscores the benefit of a system that can deliver real-time updates to navigational systems, a capability that S-100, with its dynamic data layers, is designed to provide. While navigational warnings issued via the GMDSS and ENC updates using the current S-57 distribution methods offer some updating capabilities, they fall short of providing comprehensive and timely data necessary for optimal safety and efficiency in today's complex maritime environment. S-57 charts are typically limited to one update per day and often only support effective release once per week. Additionally, updates outside of this schedule generally require manual interventions, which can be error prone.

¹⁰ <https://nauticalcharts.noaa.gov/updates/the-office-of-coast-surveys-ongoing-response-to-the-francis-scott-key-bridge-disaster/>

48 The development and implementation of the S-100 capable ECDIS offers a range of benefits for the maritime industry, regulatory authorities and the environment. By embracing e-navigation principles and the S-100 framework, maritime safety can be enhanced through improved situational awareness, reduced human error and streamlined operations. Real-time access to critical data such as navigational warnings and meteorological and oceanographic information empowers seafarers to make informed decisions, mitigating risks and preventing accidents.

49 Transitioning to a digital ecosystem necessitates robust cyber security measures. The proposed implementation of digital signatures and encryption within the SECOM framework safeguards sensitive maritime data, reducing vulnerabilities associated with increased reliance on electronic data exchange. For instance, the shift from NAVTEX to SECOM for disseminating navigational warnings inherently strengthens the security of maritime safety information, protecting against manipulation or disruption.

50 Beyond safety, S-100 is a key enabler for environmental sustainability. By optimizing voyage planning and reducing emissions, it contributes to decarbonization efforts and enhances the overall energy efficiency of the shipping industry.¹¹

51 This new work output may be relevant to other IMO work streams:

- .1 As noted in document FAL 48/20, paragraph 6.19, S-100 might also be considered for the IMO Compendium, which is a core element of the Maritime Single Window implementation. This work output proposal would support such an architecture in theory, securing and harmonizing the data exchange for the Maritime Single Window.
- .2 The establishment of a comprehensive S-100 ecosystem is essential for paving the way for the safe and effective integration of Maritime Autonomous Surface Ships (MASS) into the maritime landscape. The successful transition to MASS is contingent upon the availability of robust digital services and data exchange capabilities, which S-100, with its capacity to support a wide range of data products and facilitate real-time and machine-readable data exchange, readily provides. This positions the proposed strategy not just as a solution for current challenges but as a foundation for future innovation in maritime operations.

52 Finally, the recent International Labour Organization (ILO) amendments to the Maritime Labour Convention (MLC), emphasizing improved social connectivity for seafarers, mark a significant step forward for the maritime industry. A globally accessible, standardized, and secure IP-based infrastructure to facilitate the real-time exchange of S-100 products between shore and ship strongly complements the MLC amendments. This synergy between technological advancement and improved working conditions for seafarers is essential for the future of maritime operations. The Organization is well-placed to advance requirements for IP-based connectivity that contribute to the ILO's objectives and those advocated in this proposal.

¹¹ Ecological Benefit and Navigational Safety Study based on S-10X Data - https://portal.iho.int/share/files/zaYwdcyROY4av7nl3BKjONawUfegTnaj/Ecological%20Benefit%20and%20Navigational%20Safety%20Study%20based%20on%20S-10X%20Data/EN_Ecological%20Benefit%20and%20Navigational%20Safety%20Study%20based%20on%20S-10X%20Data.pdf

Industry standards

53 Significant progress has been made in developing and adopting standards that support a transition to a digital maritime environment. The following standards are already available or are in advanced stages of development, and relevant to successfully finalizing this work output in a timely manner:

- .1 IEC 61174 is the international industry standard for ECDIS. It outlines the operational and performance requirements, methods of testing and required test results for ECDIS equipment. The current edition is IEC 61174:2015 (also known as edition 4, published on 19 August 2015), with a new edition under development (edition 5) with a forecast publication date of 30 July 2027.
- .2 IEC 61162 is a collection of standards defining digital interfaces for maritime navigational equipment. It establishes protocols for data communication between devices like GPS, radar and chart plotters on ships. This standardization ensures compatibility and interoperability between different systems, improving overall navigation safety and efficiency.
- .3 IEC 63173-2 defines the SECOM standard. It outlines the interfaces, information security measures, and service discovery mechanisms for secure data exchange between ships and shore-based systems.
- .4 The IHO S-100 Universal Hydrographic Data Model has been under development for almost 15 years and is now a well-established standard for hydrographic and maritime data exchange. Product specifications for various S-100 data products are being actively developed and are nearing finalization for Phase I (route monitoring) of the IHO S-100 implementation plan.

54 Initiatives such as the Maritime Connectivity Platform¹² are gaining traction and contributing to a more connected and interoperable maritime industry. It aims to underpin the development of various maritime services by offering secure communication, service discovery, identity management and data exchange capabilities.

55 The MCP's Maritime Service Registry (MSR)¹³ acts as a comprehensive directory of maritime services, including those providing S-100 data. It allows users to search for services based on various criteria, such as geographical coverage, data type and provider, simplifying and automating service discovery and streamlining access to the required S-100 products. At present, the MCP stands as the only readily available SECOM-compatible backend implementation. Therefore, its integration with SECOM presents a compelling opportunity to create a resilient, secure and user-friendly solution for realizing the full potential of real-time IP-based S-100 data delivery.

56 While significant progress has been made, further work is required to ensure the seamless integration of S-100 data into onboard systems. This includes standardizing the reception and transmission of data via different communication bearers and establishing clear guidelines for importing and exporting various S-100 data sets in ECDIS.

¹² See IALA G1183: Provision of MCP Identities.

¹³ The core data model of the Maritime Service Registry (MSR) is based on IALA G1128: The specification of e-Navigation technical services. The Maritime Connectivity Consortium is currently working on the development of a new IALA guidelines that will standardise the MSR's technical architecture.

Output

57 The proposed work output for NCSR 12 and NCSR 13 is (see paragraphs 61.5 and 68 to 70):

"Development of guidance to establish a framework for data distribution and global IP-based connectivity that realizes the full potential of the S-100 capable ECDIS".

58 The proposed work output requires the following aspects to be addressed:

- .1 Development of new guidance to establish a framework for data distribution and global IP-based connectivity between shore-based facilities and ships. This would address the interfaces and requirements for data exchange between ship and shore, including connectivity and cybersecurity, and any requirements for exchanging S-100 products;
- .2 Two amendments to the ECDIS performance standard (resolution MSC.530(106)/Rev.1) to:
 - .1 support requirements for the real-time exchange of S-100 products beyond S-421 via SECOM (paragraph 26); and
 - .2 ensure interfaces (addressing connectivity and cybersecurity) with the equipment described in paragraph 58.1 are supported, and
- .3 Development of guidance, including possible amendments to existing guidance¹⁴, for the promulgation of internationally and nationally coordinated information using the S-100 product specifications which are necessary for safe navigation.

59 NCSR 11 noted the urgent need for addressing S-100 matters particularly given that S-100 ECDIS will be available for installation starting from 1 January 2026. NCSR 11 invited the Committee to include a new output on its post-biennial agenda to develop operational guidance for route exchange (NCSR 11/19, paragraph 19.4.20). The current proposed new work output could address the following element simultaneously and/or independently:

Revision of MSC.1/Circ.1503/Rev.2 *ECDIS – Guidance for Good Practice* to capture interfaces and requirements for data exchange between ship and shore, including connectivity and cybersecurity, and any requirements for exchanging S-100 products, linked to the implementation and operation of the framework.

60 The following elements may be considered in a future output, once this proposed output is completed, or could be addressed simultaneously and/or independently:

- .1 amendments to SOLAS chapter(s) IV and/or V, and associated instruments, to require systems on ships that support the framework for data distribution and global IP-based connectivity proposed in paragraph 58, and hence fully realize the potential of the S-100 capable ECDIS;

¹⁴ The contributors have identified, *inter alia*:

- resolution A.705(17), as amended.
- resolution A.706(17), as amended.
- resolution A.1051(27), as amended.

- .2 review of the framework guideline against the IMO Model Course 1.27 operational use of ECDIS by HTW will be required;
- .3 because of this proposed output, revision of MSC.1/Circ.1595 *E-navigation Strategy Implementation Plan – Update 1* would be appropriate; and
- .4 a draft assessment of capacity-building implications (appendix 1 to annex 2 of MSC-MEPC.1/Circ.5/Rev.5) could be undertaken as a part of this proposed output to identify capacity-building implications ahead of potential SOLAS amendments (see also paragraph 60.1).

61 The new output is expressed in SMART terms:

- .1 **Specific:** Develop and amend guidance and performance standards to implement a framework for data distribution and global IP-based connectivity to fully utilize the potential of the S-100 capable ECDIS;
- .2 **Measurable:** The success of this proposal can be measured by the effective development and implementation of a framework for data distribution and global IP-based connectivity so that appropriately equipped ships can receive real-time S-100 products no later than 1 January 2029;
- .3 **Achievable:** The development of the framework within two sessions of NCSR is achievable as it extensively leverages existing standards and technologies, such as the IHO S-100 Universal Hydrographic Data Model, the SECOM protocol, and MCP. Further, the contributors propose proactive progress on the development of the framework by establishing an intersessional correspondence group ahead of NCSR 12 (see paragraph 70);
- .4 **Relevant:** The proposal to implement a framework for S-100 data distribution and global IP-based connectivity is highly relevant to the maritime industry. It aligns with the IMO World Maritime Theme for 2024, "Navigating the future: safety first!", contributes to enhancing navigational safety and improving onboard operational efficiency. Strengthening this synergy is essential for the future of maritime operations; and
- .5 **Time-bound:** The proposal is time-bound with the expectation of having S-100 capable ECDIS on ships as early as 1 January 2026 and mandatory for new installations from 1 January 2029. The proposal advocates for the work to be included in the agenda of NCSR 12 (2025) and NCSR 13 (2026) and subsequent approval by MSC 112 (late 2026). This time frame allows for both the development of robust guidance and recommendations and for Contracting Governments and manufacturers to have adequate time to implement the necessary changes.

Human element

62 S-100 enhances seafarer situational awareness by integrating data on ECDIS. The Organization is committed to ensuring that technological advancements, such as the implementation of the S-100 capable ECDIS, are designed and implemented with the human element in mind.

63 Defining the framework to support data distribution and global IP-based connectivity as laid out in this work proposal will have limited impact on training and supporting manuals. The wider S-100 service implementation will require further consideration to address the training and familiarization implications for training organizations, shore authorities, and seafarers during the implementation process and is outside the scope of this new work output.

64 Annex 2 of this document contains the completed checklist for the consideration of human element issues by IMO bodies.

Urgency

65 With S-100 capable ECDIS expected on ships as early as 1 January 2026, the IHO is committed to ensuring that Phase 1 (Route monitoring) standards are ready in time for Member States to produce official S-100 data in 2025 (MSC 108/12/4 paragraphs 14 and 15).

66 ECDIS equipment installed on or after 1 January 2029, must be S-100 compatible. The absence of established objectives and performance requirements for real-time data exchange currently precludes ECDIS from fully realizing the potential of S-100 services, representing a critical gap in the system's capabilities.

67 MSC 109 must take urgent action to ensure the timely development of a globally unified framework for real-time S-100 data exchange. If this new work is not prioritized, it is highly unlikely that a standardized and effective solution will be available by the 2026 deadline and fully operational by the 2029 deadline, as outlined in resolution MSC.530(106)/Rev.1, when S-100 capable ECDIS becomes mandatory for new-builds.

68 Therefore, the output (paragraph 57.1, the aspects to be addressed in paragraph 58, and potentially the aspect to be addressed in paragraph 59) should be included in the current biennial agenda, for consideration by the NCSR Sub-Committee at its twelfth session (2025), and in the 2026-2027 biennial agenda, for consideration by the NCSR Sub-Committee at its thirteenth session (2026). Two NCSR sessions would allow sufficient time to complete the output for consideration at MSC 112 (late 2026) for adoption and/or approval.

69 This timeline should give manufacturers, S-100 data producers, distributors and Member States adequate time to implement any necessary technical, operational or regulatory changes prior to the mandatory installation requirements of an S-100 capable ECDIS for new-builds from 1 January 2029.

70 To assist with the volume of work anticipated at NCSR 12, MSC 109 is invited to establish an intersessional correspondence group to progress the work ahead of NCSR 12,¹⁵ and likewise, NCSR 12 to establish an intersessional correspondence group to finalize the work ahead of NCSR 13.

71 Delaying the development of a framework for real-time S-100 data delivery risks creating a heterogeneous landscape of ECDIS equipment with varying capabilities. Without clear requirements and guidelines in place, producers, distributors and manufacturers may implement differing solutions for receiving and displaying real-time data, potentially leading to compatibility issues and challenges in upgrading existing S-100 ECDIS units installed after 2026 or 2029. This lack of standardization could impede the seamless integration of S-100 data into onboard navigational systems, limiting the effectiveness of future advancements and hindering the realization of a truly harmonized digital maritime environment.

¹⁵ NCSR 11 established two correspondence groups.

72 This represents a critical opportunity to proactively address the timely implementation of a globally unified framework for real-time S-100 data exchange. While delaying action might not entirely preclude the eventual realization of e-navigation, it could significantly hinder the development of a cohesive and interoperable digital maritime environment, potentially limiting the full benefits for safety, efficiency, and environmental protection that the e-navigation strategy promises to deliver.

Action requested of the Committee

73 The Committee is invited to note the information provided, consider the proposals in paragraphs 57 to 60, 67, 68 and 70, and take action as appropriate.

ANNEX 1

CHECKLIST FOR IDENTIFYING ADMINISTRATIVE REQUIREMENTS

This checklist should be used when preparing the analysis of implications required in submissions of proposals for inclusion of outputs. For the purpose of this analysis, the term "administrative requirements" is defined in resolution A.1043(27), i.e. administrative requirements are an obligation arising from future IMO mandatory instruments to provide or retain information or data.

Instructions:

- (A) If the answer to any of the questions below is **YES**, the Member State proposing an output should provide supporting details on whether the requirements are likely to involve start-up and/or ongoing costs. The Member State should also give a brief description of the requirement and, if possible, provide recommendations for further work (e.g. would it be possible to combine the activity with an existing requirement?).
- (B) If the proposal for the output does not contain such an activity, answer **NR** (Not Required).
- (C) For any administrative requirement, full consideration should be given to electronic means of fulfilling the requirement in order to alleviate administrative burdens.

1. Notification and reporting? Reporting certain events before or after the event has taken place, e.g. notification of voyage, statistical reporting for IMO Members	NR <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> Start-up <input type="checkbox"/> Ongoing
2. Record-keeping? Keeping statutory documents up to date, e.g. records of accidents, records of cargo, records of inspections, records of education	NR <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> Start-up <input type="checkbox"/> Ongoing
3. Publication and documentation? Producing documents for third parties, e.g. warning signs, registration displays, publication of results of testing	NR <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> Start-up <input type="checkbox"/> Ongoing
4. Permits or applications? Applying for and maintaining permission to operate, e.g. certificates, classification society costs	NR <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> Start-up <input type="checkbox"/> Ongoing
<p>As the ECDIS performance standard will require amendments (i.e. resolution MSC.530(106)/Rev.1) to implement the framework proposed in the new work output, a test-standard development process and type-approval process will need to be undertaken.</p> <p>Following publication by the IEC of a new edition of IEC 61174, the test-standard for ECDIS, classification societies will commence their processes to assess the design, construction, and maintenance of each ECDIS to ensure it meets the specific safety and operational requirements.</p> <p>Upon successful completion of the assessment, the classification society issues a type-approval certificate, validating that the product meets the required standards. It is important for this process to be completed by 1 January 2029 to enable new installations on ships to meet the applicable regulatory deadlines in resolution MSC.530(106)/Rev.1.</p>		
5. Other identified requirements?	NR <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> Start-up <input type="checkbox"/> Ongoing

ANNEX 2

CHECKLIST FOR CONSIDERING HUMAN ELEMENT ISSUES BY IMO BODIES

MSC-MEPC.1/Circ.5/Rev.5, annex 5

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
	Workload		Other relevant references may be added Strike out references that are not relevant	If the answer to question is "yes" identify considerations. If the answer is "no" make proper justification	Identify how human element considerations should be addressed in the output
1	Does the "output" affect workload?		Revised guidelines for the operational implementation of the International Safety Management (ISM) Code by Companies (MSC-MEPC.7/Circ.8) Guidelines on fatigue (MSC.1/Circ.1598) Principles of minimum safe manning (Resolution A.1047(27)) Guidelines for the investigation of accidents where fatigue may have been an issue (MSC/Circ.624)		
1.1	On board, especially in the already intensive phases of the voyage and port operations to:	No		S-100 ECDIS is intended to reduce bridge team workloads	N/A
1.1.1	Operations including navigation, cargo and engineering	No		No impact to cargo and engineering. Intended to consolidate navigation information into a one stop shop.	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
1.1.2	Maintenance of the ships structure and its equipment	Yes		Potentially extra cyber security updates/checks. The solution architecture will aim to avoid/minimize the impact.	Procedures and training captured in section 5
1.1.3	Onboard administration in support of the ships' management systems	No		Navigation system, not linked to ships management systems	N/A
1.1.4	Onboard administration related to regulation involving flag States, classification societies, port State and other bodies such as charterers and port authorities	No		Does not impact current processes.	N/A
1.1.5	Increased workload or time pressure on personnel if involved in implementation of changes prior to the implementation date	No		minor system install required	N/A
1.2	Ashore, in a manner that would affect the ships operation to:				
1.2.1	Companies' administration	Yes	STCW Ch1 Regulation I/14.1.5	ISM obligation to ensure their fleet personnel are duly trained/familiarized and fit to operate S-100 equipment. May have a cost financially to train staff.	N/A
1.2.2	Flag State, port State and classification societies administration such that certification and other processes are compromised or delayed	No		Should not impact	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
	Decision-making		<i>Other relevant references may be added</i> <i>Strike out references that are not relevant</i>	<i>If the answer to the question is "yes" identify considerations. If the answer is "no" make proper justification</i>	<i>Identify how human element considerations should be addressed in the output</i>
2	Does the "output" impact decision-making on board the ship?				
2.1	By confusion with existing requirements and regulations	No		Should simplify requirements	N/A
2.2	By changing responsibilities as laid out in the ISM Code	No		Covered under existing responsibilities	N/A
2.3	By creating complexity in its implementation and/or in the safety management systems	No		Not relevant to safety system management.	N/A
2.4	By requiring increased mental effort, such as the need to find, transform and analyse data or result in the need to make judgements based on incomplete information	No		S-100 ECDIS by design will reduce mental effort and display key information in one place.	N/A
2.5	By limiting the time available to establish situational awareness, decide, communicate (possibly across time zones) or check	No		S-100 ECDIS should increase situational awareness and decision-making by providing key information in one picture in one system.	N/A
2.6	By increasing reliance on judgement and administrative controls to manage major risks such as oil spills and collisions	No		System is for e-navigation services, not relevant	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
	Living and Working Environment		Other relevant references may be added Strike out references that are not relevant	If the answer to the question is "yes" identify considerations. If the answer is "no" make proper justification	Identify how human element considerations should be addressed in the output
3	Does the "output" affect the living and working environment?		Guidelines on the basic elements of a shipboard occupational health and safety programme (MSC-MEPC.2/Circ.3) Guidelines on fatigue (MSC.1/Circ.1598)		
3.1	By interfering with existing arrangements for abandonment, fire-fighting and other emergency plans or procedures	No		System does not impact these arrangements. Is a bridge navigation system	N/A
3.2	By introducing new materials that could create an explosion, fire, environmental or occupational health risk	No		Does not introduce any new risks.	N/A
3.3	By introducing new high energy sources such as high-voltage, high pressure fluids	No		No change to existing power supplies.	N/A
3.4	By affecting access or egress and causing lack of ventilation in working spaces	No		Does not impact. Is a bridge navigation system	N/A
3.5	By affecting the habitability of accommodation spaces owing to noise, vibration, temperatures, dust and other contaminants	No		Bridge navigation system, no impact to accommodation spaces.	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
	Operation and Maintenance		<p><i>Other relevant references may be added</i></p> <p><i>Strike out references that are not relevant</i></p>	<p><i>If the answer to the question is "yes" identify considerations. If the answer is "no" make proper justification</i></p>	<p><i>Identify how human element considerations should be addressed in the output</i></p>
4	Does the "output" affect the operation and maintenance of the ship, its structure or systems and equipment?		<p>Revised guidelines for the operational implementation of the International Safety Management (ISM) Code by Companies (MSC-MEPC.7/Circ.8)</p> <p>Guidelines for bridge equipment and systems, their arrangement and integration (BES) (SN.1/Circ.288)</p> <p>Principles of minimum safe manning (Resolution A.1047(27))</p> <p><i>Issues to be considered when introducing new technology on board ships (MSC/Circ.1091)</i></p> <p><i>Guideline on software quality assurance and human-centred design for e-navigation (MSC.1/Circ.1512)</i></p> <p><i>Guidelines for the standardization of user interface design for navigation equipment (MSC.1/Circ.1609)</i></p>		

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
4.1	By introducing equipment that the user may find difficult to operate or maintain or may be unreliable	No		Minor modifications to system architecture	N/A
4.2	By introducing new and/or novel technology, or technology that changes the role of the person	No		There is no change to operation or maintenance roles. Anyone who currently operates or maintains ECDIS will continue to do so irrespective of equipment type.	N/A
4.3	By introducing requirements for new competencies and roles	No		No change to existing roles.	N/A
4.4	By overloading existing infrastructure such as power generation and ventilation systems	No		No impact. Is a bridge navigation system	N/A
4.5	By poor integration with existing systems and controls	No		Is independent to other systems	N/A
4.6	By introducing new and unfamiliar operations/procedures	No		system architecture change will have minor impacts on operation and maintenance procedures	N/A
4.7	By introducing new and unfamiliar operating interfaces?	No		There might be minor changes in the ECDIS user interface for managing subscriptions to real-time services and manage data exchange.	Manufacturer's user manual will address this.
4.8	By introducing risks to the ship during any modifications required prior to the implementation date of the output	No		Existing services remain unchanged and will have a dual fuel period.	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
	Measures to address the human element		Other relevant references may be added Strike out references that are not relevant	If the answer to the question is "yes" identify considerations. If the answer is "no" make proper justification	Identify how human element considerations should be addressed in the output
5	Does the "output" require changes to:		Shipboard technical operating and maintenance manuals (MSC.1/Circ.1253) Revised guidelines for the operational implementation of the International Safety Management (ISM) Code by Companies (MSC-MEPC.7/Circ.8)		
5.1	Training	Yes	IMO model course 1.27 – Operational use of ECDIS.	Identified by NCSR 11 the need to include S-100 ECDIS. The same course will also need to capture the new framework guidelines.	S-100 requirements referred to the HTW Sub-Committee by NCSR 11. Recommendation for the HTW Sub-Committee to capture framework guidance into the course when completed.
5.2	Practical skill development and competences	No	STCW code Part A Ch I: 1. Reg I/2 – Certificates and endorsements 2. Reg I/6 training and assessment Ch II and Ch III references tables listed in 5.1	No change to STCW guidelines. Type approval requirement covers change to equipment.	N/A

	1 Question	2 Yes/No	3 IMO references	4 Considerations	5 Instructions
5.3	Operating, management and/or maintenance procedures	Yes		New procedures are required for overall system architecture operation and management. S-100 ECDIS equipment operation and maintenance should be captured by manufacturers' manuals.	Capture in the framework guidance and MSC.1/Circ.1503/Rev.2 (ECDIS – Guidance for Good Practice)
5.4	Information/manuals for operation and maintenance	Yes		As above	As above
5.5	Spares outfit	No		No change to existing requirements	N/A
5.6	Occupational safety requirements including guarding and PPE	No		No change to existing requirements	N/A
5.7	Shore support	Yes		S-100 producers will require training on how to produce, test and distribute data sets.	Agencies who are responsible for S-100 product specifications such as IHO, and IALA will need to ensure training/procedures are developed for shoreside producers.