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**REGULATORY SCOPING EXERCISE FOR THE USE OF
MARITIME AUTONOMOUS SURFACE SHIPS (MASS)**

Comments and proposals on the way forward for the regulatory scoping exercise

Submitted by IFSMA and ITF

SUMMARY

Executive summary: This document provides comments on issues that may need to be considered in the regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS) and proposals on a way forward

Strategic direction, if applicable: 2

Output: 2.7

Action to be taken: Paragraph 21

Related documents: MSC 98/20/2, MSC 98/20/13, MSC 98/23 and MSC 99/INF.5

General

1 This document is submitted in accordance with paragraph 6.12.4 of MSC-MEPC 1/Circ.5 on *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies*. MSC 98 agreed to include in the provisional agenda for MSC 99 an output on a "*Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)*" with a target completion date of 2020 and requested Member States and international organizations to submit substantive proposals and comments on this agenda item to MSC 99. This document is submitted in response to that request.

Introduction

2 The ITF submitted comments on this agenda item to MSC 98 and the Committee agreed that there was a need for a work plan where a proper consideration of those comments in paragraph 11 of document MSC 98/20/13 (ITF) are taken into account. Those comments are ongoing in nature.

3 The line between the high-level regulatory scoping exercise and the lower-level revision of regulations to be carried out is not completely clear. Some of the following comments and proposals may fall into the latter category. In that event, it is requested that they be considered for inclusion in the terms of reference of the appropriate working or correspondence group.

4 A lack of precision in the meaning of MASS can create confusion and misunderstandings, as outlined in paragraph 5 that follows. In order to provide clarity, proposed definitions of "Autonomous ships" and "Automated ships and systems" are provided in the annex. Those definitions are used in the following discussion.

Discussion

5 As it is currently being used, the term MASS encompasses a wide range of autonomous or automated ships and systems. It may mean a truly autonomous ship using artificial intelligence or pre-programmed systems to manage and control shipboard functions independent of human control or intervention. If it were a truly "autonomous ship" it would not need a communication link or remote control. It could also mean a semi-autonomous automated ship with a mix of integrated automated systems providing decision support and/or performing some or all shipboard operating functions. It may mean supervision and management of the automated systems remains on-board or it may mean they are remotely located. It may mean the ship is fully or partially manned or unmanned. Further complicating the issues, individual ships may utilize different combinations and levels of autonomous or automated systems and manning, either periodically or continuously, depending on economic feasibility, risk assessment, regulatory constraints and the ship owner's business model.

6 There is a need to differentiate between truly autonomous ships operated by artificial intelligence and/or pre-programmed systems completely independent of human control, and semi-autonomous automated ships using automated systems capable of providing decision support and/or performing ship board functions under the supervision and management of a human operator.

7 Given the large number of possible configurations, it may be difficult to fit individual ships into a precise definition by type of autonomy or level of automation for regulatory purposes. Definitions and effective regulation may be dependent on focusing on the functionality of the autonomous or automated systems and subsystems controlling specific shipboard functions. The system modules controlling a specific function should be assessed as to their capacity to match or exceed current regulatory standards, and a determination made as to their reliability and when, and to what extent, human monitoring and control is appropriate or required.

8 The human/machine interface capability of humans in the loop may also require consideration based on the functional approach. This may include consideration of the physical location of the human and the means of access and nature of the sources of information used as the basis for both human and automated decisions and, in addition, whether the human's situational awareness includes onboard observation of the actual environment to validate sensor displays or is limited to situational awareness based solely on the technical capability and reliability of sensors and communication links.

9 It is implausible to believe that a remote operator limited to displays of information provided by sensors and a communication link can attain the same level of situational awareness and safety as an onboard operator monitoring the same displays. The onboard operator has the additional ability to validate the displayed information against actual observation of the real-world environment and feel of the ship with the ability to physically intervene. Whether the human decision maker is on board or remotely located should be treated as different levels of automation with appropriate regulatory standards for personnel and equipment.

10 An appropriate regulatory framework will require more than just identifying and removing negative regulatory barriers to the operation of unmanned ships. The unique issues raised by unmanned ships that are remotely controlled and those controlled by artificial intelligence or pre-programmed systems should be identified and addressed in a positive regulatory framework. This should include harmonization in the regulations of the interaction and communication between conventional ships and unmanned ships operating in the same environment.

11 There is concern that non-mandatory guidelines or industry codes of practice may lead to self-regulation. As a commercial enterprise in a competitive environment, there is a need for a mandatory regulatory framework to avoid compromising standards to gain competitive advantage, and to protect the safety and security of shipping and ports. Consideration should be given to a circular, or other means, to affirmatively establish that remotely controlled or unmanned ships are not in compliance with existing international regulations, and not permitted to operate on international voyages, on the high seas or international waters, until such time as an international regulatory framework governing their operation has been adopted and is in effect.

12 As with the regulatory framework for conventional manned ships, developing a regulatory framework for unmanned ships cuts across all aspects of the work of IMO. It involves, at the least, construction and engineering standards for enhanced redundancy and reliability; the human element requirements for both ship board and shore based personnel, including system developers and programmers; security issues including cybersecurity; safety matters including specifically navigation safety and collision avoidance; measures aimed at preventing pollution from ships; the legal implications regarding jurisdiction, responsibility and accountability for remotely controlled operations; as well as regulatory standards and accountability for the technology suppliers, including the reliability, transparency and suitability of autonomous or automated systems, their software and algorithms, and communication links.

13 There is still the threshold question of whether the United Nations Convention on the Law of the Sea (UNCLOS) on the specific obligations of flag States concerning the operation of ships in article 94 and article 98 on the duty to render assistance can be satisfied by unmanned ships. Attempts to satisfy UNCLOS requirements with a creative interpretation of the ordinary meaning of its provisions may be inconsistent with the Vienna Convention on the Law of Treaties.

14 A major issue is not one of whether the ship is partially or fully capable of automated operation. It is whether monitoring, decisions and control are to be shifted from onboard crew to shore based remote operators. And, what standards should exist in a regulatory framework to provide a comparable level of safety and acceptable risks that will justify operation of a ship by a remote control centre. Or, progressing to the next step of managing the operation using artificial intelligence or a pre-programmed system with no human supervision and control.

15 Currently, small unmanned ships are being trialled under national regulations in nearby national territorial sea and internal waters. The trials primarily place national assets and environment at risk, not foreign coastal or port States. Unlike international regulations developed at IMO, the national regulations can be readily changed to address emerging problems or risks with unmanned operations as they become apparent. The operation takes place in nearby waters within a tightly controlled environment and close to support facilities in the event of a system failure or accident. It would be ill-advised to accept these trials as validating the feasibility of operating unmanned ships in the very different international setting of the high sea and international waters.

16 Unmanned ships are being promoted by technology suppliers as a transformative force in the industry on a narrative that is aspirational rather than experienced based. As a consequence, the maritime media is creating unrealistic expectations leading to calls for immediate and drastic action to address the regulation of unmanned ships. At the same time, there is scepticism within the community of potential users that both the technical and economic feasibility, or business model, for unmanned ships in international shipping is lacking.

17 A degree of caution is needed to ensure that an inappropriate regulatory framework is not hastily put in place in a leap of faith by IMO on the assurances of technology suppliers. There is no critical emergency or urgent commercial need for the IMO to prematurely accelerate the introduction of unmanned ships into international trade. There is no compelling reason to bypass the usual evolutionary process – the introduction of new concepts in phases with evaluation of the experience gained at each level as the foundation for further progress.

18 The primary focus has been on navigation. But of equal concern are the engineering issues with main propulsion, auxiliary machinery and fuel, lubrication and cooling systems having to operate for extended periods of time without the possibility of servicing or maintenance by onboard crew on long international voyages. While a flag State may certify that a ship is capable of unmanned navigation, an engineering failure could lead to accidents placing the marine environment and the safety of shipping at risk. There is a need for international standards not only for navigation, but for engineering standards including levels of reliability and redundancies as well as abilities to respond to, and mitigate, shipboard emergencies and pollution incidents.

19 Autonomous and automated systems will undoubtedly play a major role in the future of the maritime industry. But, the focus at this stage would be better placed in an emphasis on automated systems as a means of increasing efficiency, reducing emissions and pollution, accident prevention and safety rather than a revolutionary leap to unmanned autonomous ships.

Proposal

20 The proposed scoping exercise work plan should consider:

- .1 a scoping exercise of UNCLOS provisions to identify potential gaps or non – compliance;
- .2 in a scoping exercise of UNCLOS that the United Nations Division for Ocean Affairs and the Law of the Sea be consulted on the capability of remotely controlled or unmanned ships to comply with UNCLOS provisions;

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- .3 all relevant committees within IMO that have technical experts within their delegations are invited to undertake scoping the potential impact of autonomous or automated ships on the human element factors and technical matters related to international instruments that fall under their purview, i.e. MEPC, LEG, FAL;
 - .4 all MSC sub-committees that have technical experts within their delegations are tasked with scoping the potential impact of autonomous ships on the human element factors and technical matters related to international instruments within their areas of competency;
 - .5 terms of reference for the scoping exercise, or any relevant Working or Correspondence Group, are not limited to the removal of barriers on the operation of remotely controlled or autonomous ships, but include identifying subject matter that may need to be addressed in a regulatory framework to address the unique issues raised by remotely controlled or unmanned ships including specific functions that may utilize autonomous and/or automated systems and the corresponding extent of human monitoring and control;
 - .6 identify the human element components within autonomous and automated systems, i.e. shipboard personnel, shore-based operators, remotely located marine engineers, system designers, software programmers, and others, and identify their functions and means of ensuring competency and accountability;
 - .7 given the volume of existing international instruments that need to be subjected to a scoping exercise, as well as identifying new issues raised by autonomous or automated unmanned ships, consideration should be given to amending the target completion date to 2023; and
 - .8 to protect the safety of shipping and the marine environment from the risk of unregulated activities, as well as risk of collision between conventional ships and remotely controlled or unmanned ships, affirmatively establish by circular, or other means, that remotely controlled or unmanned ships are not in compliance with existing international regulations, and not permitted to operate on international voyages until an international regulatory framework governing their operation has been adopted and is in effect.

Action requested of the Committee

21 The Committee is requested to consider the comments above, in particular the proposals in paragraph 20 and take action, as appropriate.

ANNEX

PROPOSED DEFINITION OF AUTONOMOUS AND AUTOMATED SHIP

There is a need to differentiate between a truly autonomous ship that operates independently of human action and therefore may not require a human operator and communication link and an automated ship that operates under the supervision and management of a human operator either on board or remotely via a communications link.

The below definitions are offered as a starting point for consideration. Under the below definition of "Automated system" in subparagraphs 4.1 and 4.2 further consideration may be given to establishing various levels of automation dependent upon the degree of human element/system interaction.

1 Autonomous ship: a ship whose operating functions are entirely managed and controlled by autonomous systems.

2 Autonomous system: a system capable of managing and controlling shipboard functions using artificial intelligence or programs independent of human supervision and control.

3 Automated ship: a ship where decision support and/or one or more functions are performed by automated systems.

4 Automated system: a system capable of providing decision support and/or performing a ship board function under the supervision and management of a human operator.

.1 Automated onboard system: an automated system under the supervision and management of a human operator on board the ship.

.2 Automated remote system: an automated system under the supervision and management of a remotely located human operator not on board the ship.
