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**OUTCOME OF THE REGULATORY SCOPING EXERCISE AND GAP ANALYSIS OF  
CONVENTIONS EMANATING FROM THE LEGAL COMMITTEE WITH RESPECT TO  
MARITIME AUTONOMOUS SURFACE SHIPS (MASS)**

1 The Legal Committee (LEG), at its 108th session (26 to 30 July 2021), approved the *Outcome of the Regulatory Scoping Exercise and Gap Analysis of Conventions emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships (MASS)*, as set out in the annex, which provides an overview of the extent to which the existing regulatory framework under the purview of the Committee might require amending or interpreting to address MASS operations. It further provides guidance to LEG and interested parties to identify and decide on future work on MASS and, as such, facilitate the preparation of requests for, and consideration and approval of, new outputs.

2 Member States and international organizations are invited to take the annex into account when proposing future work on MASS for consideration by LEG and bring it to the attention of shipowners, operators, academia, and all other parties concerned.

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## ANNEX

### OUTCOME OF THE REGULATORY SCOPING EXERCISE AND GAP ANALYSIS OF CONVENTIONS EMANATING FROM THE LEGAL COMMITTEE WITH RESPECT TO MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

#### 1 INTRODUCTION

1.1 This document presents the outcome of the regulatory scoping exercise (RSE) and gap analysis of conventions emanating from the Legal Committee (LEG) with respect to maritime autonomous surface ships (MASS).

1.2 The outcome of the LEG RSE, approved by LEG 108 (26 to 30 July 2021), provides an overview of the extent to which the existing regulatory framework under its purview might require amending or interpreting to address MASS operations. It further provides guidance to LEG and interested parties to identify and decide on future work on MASS and, as such, facilitate the preparation of requests for, and consideration and approval of, new outputs.

1.3 This outcome document follows the content and structure of the *Outcome of the regulatory scoping exercise for the use of MASS* developed and approved by the Maritime Safety Committee (MSC) for conventions under MSC's purview (MSC.1/Circ.1638) in order to ensure a consistent approach to the MASS RSE across IMO's organs. However, where appropriate, deviations have been made in order to accommodate the particular nature of the conventions under LEG's purview.

#### 2 BACKGROUND

2.1 MSC 98, in June 2017, noted that the maritime sector was witnessing an increased deployment of MASS to deliver safe, cost-effective and high-quality results. In this context, MASS could include ships with different levels of automation, from partially automated systems, which assisted the human crew, to fully autonomous systems, which were able to undertake all aspects of a ship's operation without the need for human intervention. Significant academic and commercial research and development (R&D) was ongoing on all aspects of MASS, including remotely controlled and autonomous navigation, vessel monitoring and collision avoidance systems.

2.2 Although technological solutions were being developed and deployed, delegations were of the view that there was a lack of clarity on the correct application of existing IMO instruments to MASS. Delegations believed that IMO needed to ensure that MASS designers, builders, owners and operators had access to a clear and consistent regulatory framework, guided by the *Principles to be considered when drafting IMO instruments* (resolution A.1103(29)), in order to be able to demonstrate compliance with IMO instruments.

2.3 Following consideration, MSC 98 agreed to include in its 2018-2019 biennial agenda an output on "Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)" with a target completion year of 2020.

2.4 In April 2018, LEG 105 also agreed to include a new output entitled "Regulatory scoping exercise and gap analysis of conventions emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships (MASS)" in its 2018-2019 biennial agenda with a target completion year of 2022.

2.5 At MSC 99, in May 2018, the Committee started to develop a framework for the RSE and defined the aim, the objective, the preliminary definition of MASS and degrees of autonomy, the list of mandatory instruments to be considered and the applicability in terms of type and size of ships.

2.6 MSC 100, in December 2018, approved the framework for the RSE, which contained definitions, a methodology consisting of a two-step approach and a plan of work and procedures (MSC 100/20/Add.1, annex 2) and invited interested Member States and international organizations to participate actively in the exercise. The Committee also approved the holding of an intersessional meeting of the Working Group on MASS between MSC 101 and 102, with the aim of finalizing the RSE at MSC 102. Furthermore, the Committee requested the Secretariat to develop a web platform as part of the Global Shipping Information System (GISIS) to facilitate the RSE.

2.7 LEG 106, in March 2019, approved the framework for the LEG RSE and a plan of work and procedures (LEG 106/16, annex 3), following the same two-step approach and the same methodology developed by MSC 100, i.e. an initial review of the LEG instruments with the agreed methodology and an analysis of the most appropriate way of addressing MASS operations.

2.8 The LEG RSE followed the timeline set out in annex 3 to document LEG 106/16, which was subsequently updated and circulated through Circular Letter No.4030. LEG used the MASS module on GISIS as a web platform to share the initial review and analysis, provide comments and revise the initial review and the analysis based on the comments received.

2.9 LEG decided not to hold an intersessional Working Group on MASS, but instead requested the volunteering Member States which had conducted the initial review and subsequent analysis of the most appropriate way of addressing MASS operations to report the results of both steps of the LEG RSE to LEG 107.

2.10 The Facilitation Committee (FAL), at its forty-third session in April 2019, also agreed to include in its 2020-2021 biennial agenda a new output on "Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)" with a target completion year of 2020. Like LEG, FAL decided to use the framework for the RSE for the use of MASS approved by MSC 100, and to use the MASS module on GISIS as a medium to share the initial review and analysis, provide comments and revise the initial review and the analysis based on the comments received. The FAL RSE was scheduled to be finalized at FAL 44 in April 2020.

2.11 Owing to the COVID-19 pandemic, both MSC 102 and LEG 107, in November and December 2020, respectively, deferred consideration of this matter to MSC 103 and LEG 108, respectively. FAL 44 (April 2020) and FAL 45 (June 2021) also postponed the consideration of its agenda item on MASS; instead FAL 45 decided to hold an intersessional Working Group on MASS in October 2021 to complete the FAL RSE.

2.12 MSC 103, in May 2021, finalized the RSE for the conventions under its purview and approved the outcome as set out in *Outcome of the regulatory scoping exercise for the use of MASS* (MSC.1/Circ.1638).

2.13 LEG 108, in July 2021, also finalized the RSE for the conventions emanating from LEG and approved the outcome as set out in this document.

### 3 FRAMEWORK AND PROCESS OF THE LEG RSE

#### Aim and objective

3.1 The aim of the LEG RSE was to determine how safe, secure and environmentally sound MASS operations and the related legal matters might be addressed in IMO instruments.

3.2 The objective of the RSE on MASS conducted by LEG was to assess the degree to which the existing regulatory framework under its purview might be affected in order to address MASS operations.

#### Glossary

3.3 LEG used the glossary developed by MSC for the RSE of instruments under its purview to ensure a consistent approach throughout the Organization. The glossary, in particular the degrees of autonomy, was developed specifically for the purpose of the RSE and does not pre-empt future definitions that may be considered at the later stage.

3.4 For the purpose of the RSE, "MASS" was defined as a ship which, to a varying degree, can operate independent of human interaction.

3.5 To facilitate the process of the RSE, the degrees of autonomy were organized as follows:

Degree one: *Ship with automated processes and decision support*: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

Degree two: *Remotely controlled ship with seafarers on board*: The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.

Degree three: *Remotely controlled ship without seafarers on board*: The ship is controlled and operated from another location. There are no seafarers on board.

Degree four: *Fully autonomous ship*: The operating system of the ship is able to make decisions and determine actions by itself.

3.6 The above list does not represent a hierarchical order. It should be noted that MASS could be operating at one or more degrees of autonomy for the duration of a single voyage.

#### Instruments

3.7 The list of mandatory instruments that were considered as part of the LEG RSE is set out in appendix 1. These instruments were reviewed on an article or sub-paragraph level, as decided by the volunteering Member State. Some instruments emanating from the Legal Committee were not reviewed as part of the RSE, as no volunteer could be identified. Instruments that were not negotiated under the auspices of IMO were not considered as part of the LEG RSE, even though conventions dealing with the carriage of goods by sea, e.g. the Hague-Visby Rules or the Rotterdam Rules, and conventions dealing with the rights and working conditions of seafarers, such as the Maritime Labour Convention, 2006, may require attention in the context of MASS.

3.8 While the United Nations Convention on the Law of the Sea (UNCLOS) was not considered as part of the LEG RSE, as it is not an IMO Convention, MASS will need to operate within the legal framework set out in UNCLOS. As a result, UNCLOS will need to be considered in IMO's future work on MASS, particularly if IMO develops an instrument regulating MASS operations.

### **Type and size of ships**

3.9 The application of the RSE was restricted to the applicability of the instruments under consideration.

### **Web platform for the conduct of the RSE**

3.10 A web platform as part of GISIS was developed by the Secretariat to facilitate the RSE. The web platform was connected to the IMO web accounts, providing access only to registered IMO Members.<sup>1</sup> All IMO Members have read-only access to the web platform and the information contained in the web platform will be retained for future reference until the Committee decides otherwise.

### **Methodology**

3.11 The review of instruments was conducted by volunteering Member States in two steps. The list of mandatory instruments, as set out in appendix 1, also contains the names of the volunteering Member States which undertook and supported the review of instruments. IMO Members were able to submit comments on the work done by the volunteering Member States through the web platform.

3.12 As a first step, an initial review of each article or sub-paragraph of each instrument was undertaken and, for each degree of autonomy, one of the following answers was allocated to each provision:

- A apply to MASS and prevent MASS operations; or
- B apply to MASS and do not prevent MASS operations and require no actions;  
or
- C apply to MASS and do not prevent MASS operations but may need to be amended or clarified, and/or may contain gaps; or
- D have no application to MASS operations.

3.13 Once the first step was completed, a second step was conducted to analyse and determine the most appropriate way of addressing MASS operations, taking into account the human element,<sup>2</sup> by:

- I developing interpretations; and/or
- II amending existing instruments; and/or

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<sup>1</sup> Whenever the term "IMO Member" is used in this document, it includes Member Governments, associated Member Governments, intergovernmental organizations with observer status and non-governmental organizations in consultative status.

<sup>2</sup> Refer to resolution A.947(23), *Human element vision, principles and goals for the Organization*.

- III developing new instruments; or
- IV none of the above as a result of the analysis.

#### 4 RESULTS OF THE REGULATORY SCOPING EXERCISE AT INSTRUMENT LEVEL

4.1 The results of the RSE at instrument level are set out in appendix 2, which provides for all degrees of autonomy:

- .1 the most appropriate way(s) of addressing MASS operations in those instruments;
- .2 the reason for selecting the most appropriate way(s); and
- .3 an identification of potential gaps/themes that require addressing.

4.2 In general, the LEG RSE concluded that MASS could be accommodated within the existing regulatory framework of LEG conventions without the need for major adjustments.

4.3 While the introduction of MASS appears to be entirely unproblematic under some conventions under LEG's purview, others may require additional interpretations or amendments to address the common potential gaps and themes. It appears that a new instrument is not required for conventions emanating from LEG.

4.4 An overview of the most appropriate way of addressing MASS operations (I, II, III, or IV)<sup>3</sup> for all instruments reviewed under the LEG RSE is set out in table 2 below:

IMO instruments	Degrees of autonomy <sup>4</sup>			
	1	2	3	4
BUNKERS 2001	IV	IV	I, II	I, II
CLC 1969	I, II, III	I, II, III	I, II, III	I, II, III
CLC PROT 1976	IV	IV	IV	IV
CLC 1992 (unofficial consolidated text)	I, II, III	I, II, III	I, II, III	I, II, III
FUND 1992 (unofficial consolidated text)	IV	IV	IV	IV
FUND PROT 2003	IV	IV	IV	IV
NUCLEAR 1971	IV	IV	IV	I, II
PAL 1974	I	I	I, II	I, II
PAL 2002 (certified consolidated text)	I	I	I, II	I, II
PAL PROT 1976	IV	IV	IV	IV

<sup>3</sup> See paragraph 3.12 for the different options of addressing MASS operations.

<sup>4</sup> See paragraph 3.5 for a description of the degrees of autonomy.

IMO instruments	Degrees of autonomy <sup>4</sup>			
	1	2	3	4
LLMC 1976	IV	II	II	II
LLMC PROT 1996 (unofficial consolidated text)	IV	II	II	II
HNS 2010 (unofficial consolidated text)	IV	I	I, II	I, II
SALVAGE 1989	IV	IV	I	I
NAIROBI WRC 2007	IV	I	I, II	I, II
SUA 1988	IV	IV	IV	IV
SUA 2005 (certified consolidated text)	IV	IV	IV	IV
SUA PROT 1988	IV	IV	IV	IV
SUA PROT 2005 (certified consolidated text)	IV	IV	IV	IV

Table 2 – Overview of the analyses of the most appropriate way of addressing MASS operations (second step analysis of LEG RSE)

## 5 COMMON POTENTIAL GAPS AND/OR THEMES AND POTENTIAL LINKS BETWEEN INSTRUMENTS

### Common potential gaps and/or themes

5.1 Having reviewed the results of the RSE for the different conventions emanating from the Legal Committee, as set out in appendix 2, the following issues were identified as the main potential common gaps and/or themes that may require clarification to accommodate MASS within the existing regulatory framework:

- .1 the role and responsibility of the master;
- .2 the role and responsibility of the remote operator;
- .3 questions of liability;
- .4 definitions/terminology of MASS; and
- .5 certificates.

5.2 It should be noted that these potential gaps and themes are not exhaustive and that the order in which they are presented does not reflect any order of priority.

### *The role and responsibility of the master*

5.3 The RSE identified those provisions that require an action by the master of the ship. It was concluded that, in these cases, it may be necessary to clarify who, if anybody, would have to satisfy the role of the master in the case of a MASS with no master on board; If an owner (or charterer) would have additional duties or liabilities when operating a semi-autonomous or fully autonomous vessel; or if certain responsibilities that would normally belong to the master would transfer to those actually on board a vessel in cases of semi-autonomous vessels with limited crews, or could be carried out by personnel not on board the MASS.



### ***The role and responsibility of the remote operator***

5.4 The RSE also showed that it may be necessary to clarify the role and responsibility of the remote operator. In particular, it may be necessary to clarify whether the remote operator might fall within the scope of the terms, including but not limited to, "operator" or "servant or agent", which are used within the liability and compensation regime, in order for the liability, channelling and subrogation provisions in those conventions to clearly accommodate MASS. While the view was expressed that the term "operator" used in the conventions was intended to refer to the commercial operator of a ship, and not a remote operator in the context of MASS, it appears that a clarifying discussion on this issue may be needed. It was noted in document LEG 106/8/4 that the role of the remote operator within the liability regime would have to be considered by the Legal Committee at some stage but was not considered as part of the RSE.

### ***Questions of liability***

5.5 New technologies relating to MASS will introduce new actors, e.g. remote operators, remote control centres/stations, providers of network or computer systems, or system developers. In this regard, the RSE indicates that it may be necessary to decide whether and how these actors should be involved in the liability and compensation regime. Specifically, it may be necessary to consider whether the current list of exonerations, the provisions on channelling of liability and the provisions regarding subrogation are sufficient. While it was highlighted that the strict liability of the shipowner, as an overriding principle of the liability and compensation regime, should be maintained, it was also felt that the introduction of new actors and technologies raised policy questions regarding the apportionment of liability under the LEG conventions, which may have to be addressed in the future.

### ***Definitions/terminology***

5.6 In the context of new technologies and actors, existing definitions and general terminology of the liability and compensation regime must be examined to ensure they remain relevant. In this regard, it was noted that it may need to be clarified that MASS (in particular, those at degrees 3 and 4) fall within the various definitions of "ship" and that those conventions that do not contain a definition of "ship" also apply to MASS. Also, just as it was considered necessary to clarify whether a remote operator would fall within the scope of "manager and operator" or "any person", there might be uncertainty about whether the manufacturer or programmer of a MASS or its components would fall within the scope of "manager and operator" or "any person". Finally, it appears that the concepts "fault", "negligence" and "intention" may require consideration in the context of harm caused by autonomous technology. However, it was agreed that these considerations should not prevent the operation of MASS under the current framework of LEG conventions.

### ***Certificates***

5.7 A cross-cutting issue for most liability conventions was how the insurance certificate, which must be kept on board for port State control purposes, would be accessed on a MASS without any seafarers on board. This is a question across other IMO conventions with such a requirement.

### Potential links between instruments

5.8 Table 1 shows the instruments under the remit of the Legal Committee, in which the common potential gaps and/or themes were identified, thus indicating the potential links between instruments.

	Master	Remote operator	Liability questions	Definitions/terminology	Certificates
<b>BUNKERS 2001</b>		✓	✓	✓	✓
<b>CLC 1969</b>		✓	✓		✓
<b>CLC PROT 1976</b>					
<b>CLC 1992 (unofficial consolidated text)</b>		✓	✓	✓	✓
<b>FUND 1992 (unofficial consolidated text)</b>			✓	✓	
<b>FUND PROT 2003</b>					
<b>NUCLEAR 1971</b>		✓		✓	
<b>PAL 1974</b>		✓	✓	✓	
<b>PAL 2002 (certified consolidated text)</b>		✓	✓	✓	✓
<b>PAL PROT 1976</b>					
<b>LLMC 1976</b>		✓	✓	✓	
<b>LLMC PROT 1996 (unofficial consolidated text)</b>		✓	✓	✓	
<b>HNS 2010 (unofficial consolidated text)</b>		✓	✓	✓	✓
<b>SALVAGE 1989</b>	✓	✓		✓	
<b>NAIROBI WRC 2007</b>	✓	✓			✓
<b>SUA 1988</b>	✓	✓		✓	
<b>SUA 2005 (certified consolidated text)</b>	✓	✓		✓	
<b>SUA PROT 1988</b>		✓			
<b>SUA PROT 2005 (certified consolidated text)</b>		✓			

Table 1 – Overview of potential common gaps and themes

### Potential links with MSC instruments

5.9 The RSE undertaken by MSC for the instruments under its purview identified the following common potential gaps and/or themes (MSC.1/Circ.1638, paragraph 5.2):

- .1 meaning of the terms master, crew or responsible person;
- .2 remote control station/centre;
- .3 remote operator as a seafarer;
- .4 provisions containing manual operations, alarms to the bridge;

- .5 provisions requiring actions by personnel (fire, spillage cargo management, onboard maintenance, etc.);
- .6 certificates and manuals on board;
- .7 connectivity, cybersecurity;
- .8 watchkeeping;
- .9 implication of MASS in SAR;
- .10 information to be available on board and required for the safe operation; and
- .11 terminology.

5.10 It has been recognized that not all of these common potential gaps and/or themes are of the same nature. Some of them are critical and fundamental issues which may shape the course of addressing MASS operations, while others concern more technical aspects.

5.11 Some of these common potential gaps and/or themes are at the core of how to introduce MASS operation safely and effectively in the regulatory framework and are regarded as high-priority issues that cut through several IMO instruments and may require a policy decision before addressing individual instruments. Among these are, for instance:

- .1 meaning of the terms master, crew or responsible person;
- .2 remote control station/centre; and
- .3 remote operator designated as seafarer.

5.12 MSC concluded that the many common potential gaps and/or themes, which cut across several instruments, could preferably be addressed holistically through a new instrument (e.g. a MASS Code), which can be made mandatory by means of amending an existing IMO convention, such as SOLAS (MSC.1/Circ.1638, paragraph 6.2).

5.13 It was also recognized that consideration of amendments to instruments, or development of a new instrument, requires agreement on the use of terminology and is a policy decision. One of the issues to be addressed was considered to be the re-evaluation of the degrees of autonomy, taking into account the lessons learned during the RSE. This work could include the development of a glossary (MSC.1/Circ.1638, paragraph 6.4).

5.14 MSC agreed that any future proposals for changes in the regulatory framework required justification and, consequently, it was recognized that any future work on MASS needed to be approved following a proposal for a new output (MSC.1/Circ.1638, paragraph 6.10).

## **6 PRIORITIZATIONS OF COMMON POTENTIAL GAPS AND THEMES IDENTIFIED BY THE LEG RSE AND POTENTIAL NEXT STEPS**

### **Prioritization of common gaps and themes**

6.1 As identified by MSC, some common potential gaps and/or themes are at the core of how to introduce MASS operation safely and effectively in the regulatory framework and are regarded as high-priority issues that cut through several IMO instruments and may require a policy decision before individual instruments can be addressed.

6.2 Both MSC and LEG have concluded that the role and responsibilities of the master and the remote operator are such high-priority issues that must be addressed as a foundation for any further work. Any discussion on liabilities of different new actors that are introduced through the new technology related to MASS would rely on clear definitions of these new actors, including their roles and responsibilities.

6.3 In addition, it has been recognized by both committees that the terminology needs to be revisited and agreed. While a lot of the terminology requiring clarification overlaps between the committees, there are some specific legal terms that require consideration in the context of harm caused by autonomous technology, like the concepts of "fault", "negligence" and "intention". However, this could be done as a second step once the core terminology has been agreed, especially once the degrees of autonomy have been revisited.

6.4 One of the cross-cutting issues for most liability conventions is how the insurance certificate, which must be kept on board for port State control purposes, would be accessed on a MASS without any seafarers on board. While this is a question to be addressed across all IMO conventions with such a requirement, it is not one that must be addressed with the highest priority; instead, it can be addressed when the regulatory framework is adjusted or clarified in light of MASS operations.

6.5 The priorities identified by MSC link well with those priorities identified by LEG. At the core of the high-priority issues to be decided are general policy decisions on terminology and the roles and responsibilities of new actors concomitant with the introduction of new technologies relating to MASS. The consideration of these issues would best be addressed jointly between the committees, so that both technical and legal aspects and questions of liability are taken into account, when these terms are defined, while keeping in mind the different purposes and functions of conventions under the purview of LEG and those under MSC.

### **Potential next steps**

6.6 The Legal Committee should invite proposals for a new output on MASS for those issues identified to be specific to LEG. To ensure a coordinated approach, LEG should also be involved in any MASS-related work with IMO's other committees, particularly with regard to MASS-related definitions and terminology.

## **7 REFERENCES TO THE MATERIAL PRODUCED BEFORE AND DURING THE LEG RSE**

### **IMO documents**

7.1 A list of all IMO documents related to the LEG RSE is provided in appendix 3.

7.2 A list of all IMO documents related to the MSC RSE is set out in appendix 3 of the *Outcome of the regulatory scoping exercise for the use of MASS* by the Maritime Safety Committee for conventions under its purview (MSC.1/Circ.1638).

### **The MASS module of GISIS**

7.3 The detailed analyses by the volunteering Member States of the instruments reviewed in the course of the RSE, and all comments made by IMO Members, have been recorded in the MASS module of GISIS. This web platform is connected to the IMO web accounts, providing access to registered IMO Members only.

**APPENDIX 1**

**List of instruments and volunteering Members undertaking  
or supporting the review of instruments**

<b>Instrument</b>	<b>Member State preparing the initial review</b>	<b>Supporting/assisting</b>
BUNKERS 2001	China	Republic of Korea
CLC 1969	Japan	
CLC PROT 1976	Japan	
CLC PROT 1992	Japan	Singapore
FUND PROT 1992	Germany	Japan
FUND PROT 2003	Germany	Japan
NUCLEAR 1971	Australia	
PAL 1974	France	Marshall Islands
PAL PROT 1976	France	Marshall Islands
PAL PROT 2002	France	Marshall Islands
LLMC 1976	Republic of Korea	United Kingdom
LLMC PROT 1996	Republic of Korea	United Kingdom
SUA 1988	United States	Switzerland
SUA PROT 1988	United States	Switzerland
SUA 2005	United States	Switzerland
SUA PROT 2005	United States	Switzerland
SALVAGE 1989	Finland	CMI
NAIROBI WRC 2007	Sweden	Luxembourg and Netherlands
HNS PROT 2010	Canada	
INTERVENTION 1969	*	*
INTERVENTION PROT 1973	*	*
International Convention on Maritime Liens and Mortgages, 1993	*	*
International Convention on Arrest of Ships, 1999	*	*

\* No volunteers came forward to review these instruments.

**APPENDIX 2**

**Results of the regulatory scoping exercise at instrument level**

The application of IMO instruments, as currently drafted, is divided in the following categories:

- A applied to MASS and prevented MASS operations; or
- B applied to MASS and did not prevent MASS operations and required no actions; or
- C applied to MASS and did not prevent MASS operations but might need to be amended or clarified, and/or might contain gaps; or
- D had no application to MASS operations.

The most appropriate way(s) of addressing MASS operations are categorized with the following four options:

- I developing interpretations; and/or
- II amending existing instruments; and/or
- III developing a new instrument; or
- IV none of the above as a result of the analysis.

**1 International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 (BUNKERS 2001)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	The analysis indicates that the existing provisions of the Convention are effective for MASS at degree one and require no further action.	Whether the list of exonerations in article 3 is sufficient for the owner of MASS? Should the shipowner be held liable if the damage is caused by the fault of the decision support system?
DEGREE TWO	IV	The analysis indicates that the existing provisions of the Convention are effective for MASS at degree two and require no further action.	Whether the list of exonerations is sufficient for the owner of MASS? Should the shipowner be held liable if the damage is caused by failure of the remote-controlled system?

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE THREE	I, II	It may need to develop amendments in order to address how can an unmanned MASS (without seafarers on board) carry on board the certificate and produce the certificate when entering or leaving ports or arriving at or leaving from offshore facilities. In this case, the most appropriate way of addressing MASS operation is II. As some comments indicate, the certificates do not have to be carried on board or produced on request, provided the certificate is instead provided in electronic format and accessible to all States Parties. This may be an alternative for MASS without amending the Convention. In this case, the most appropriate way is I.	Although the definition of operator is not provided in the Convention, it is intended to be commercial operator. Thus, a remote operator should not fall within the scope of ship operator in article 1(3). However, the meaning of the remote operator may need to be clearly prescribed separately to avoid ambiguity. Whether the list of exonerations is sufficient for the owner of MASS? Should the owner be held liable if the damage is caused by failure of the remote-controlled system?
DEGREE FOUR	I, II	It may need to develop interpretations or amendments in order to address how can an unmanned MASS (without seafarers on board) carry on board the certificate and produce the certificate.	Whether the list of exonerations is sufficient for the owner of MASS? Should the shipowner be held liable if the damage is caused by a wrong decision made by artificial intelligence or failure of the technical infrastructure?

**2 International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 1969)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
GENERAL		A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Otherwise, consideration in the Working Group and the Committee can be wandering. Among others, the Legal Committee	

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		<p>should decide whether or not to include persons or entities engaged in the new technological aspect of navigation, such as a remote controller, a provider of network or computer system, or a programmer of software, into the scope of the "channelling of liability" under CLC. If the Legal Committee thinks that these parties should be excluded from the liability for oil pollution, then that should be made explicit by amending article III(4) of CLC. In this case, the most appropriate solution is "II". However, taking into account the practice of quasi-amendment of some provisions of CLC, the Committee can make protocol to amend some provisions of CLC, including article III(4). In this case, the most appropriate way is "III". In contrast, if the Committee decides that such parties should not be excluded from the liability for oil pollution, CLC article III(4) can be left as it is ("IV"), just as manufacturers and classification societies are not mentioned there, or the Committee can develop an interpretation of article III(4) on this matter ("I"). Indeed, the Committee can also decide that such parties should be liable for oil pollution in some cases, then making new instrument ("III") can be the most appropriate way. But this choice can be beyond the scope of the "channelling of liability." While it is possible for the Committee not to make a clear decision at this point of time and leave the issue to domestic courts of the States, such an approach will produce legal uncertainty for the parties mentioned above, which might impede the</p>	



Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		development, or the commercial operations, of the MASS.	
DEGREE ONE	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS on whether or not to include persons or entities engaged in the new technological aspect of navigation, such as a remote controller, a provider of network or computer system, or a programmer of software, into the scope of the "channelling of liability" under CLC.
DEGREE TWO	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	<p><i>1. New technology will introduce new actors providing such technology and new causes of exoneration relating to such technology</i></p> <p>It would be necessary for the Legal Committee to make a decision on the policy of whether the current lists in the clause of exoneration (article III(2)), the channelling clause (article III(4)), and the clause of subrogation (article V(5)) are sufficient.</p> <p><i>2. Consideration of "intention to cause damage," "negligence" and "recklessness"</i></p> <p>As to article III(3), it would be necessary for the Legal Committee to make a policy decision about what the owner of the tanker is required to prove to be exonerated from his/her liability in case that the vessel that suffers damages is a MASS. Suppose that a MASS collided with a tanker and suffered oil pollution damage since it has made a wrong manoeuvre without any human action due to an error in its program. In such a situation, there is no intention to cause damage nor negligence of the owner of the MASS. Should the owner of the tanker fully compensate for the oil pollution</p>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
			<p>damage of the owner of the MASS, even in such a case? As to article V(2), it would be necessary for the Legal Committee to make a policy decision about what conduct of the owner of a tanker that is a MASS would constitute its "act or omission, committed with the intent to cause such loss, or recklessly and with knowledge that such loss probably result". For example, would the owner of a MASS tanker be denied of limitation when he/she had some knowledge on the error in the program of the MASS? If yes, knowledge about what facts will deprive the owner of a tanker of right to limit its liability? It would be beneficial either to have an interpretation or a new provision to introduce a clear-cut rule on this issue.</p>
DEGREE THREE	I, II, III, IV	<p>A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.</p>	<p>1. <i>New technology will introduce new actors providing such technology and new causes of exoneration relating to such technology</i> Please refer to the general comments and the comments in degree 2.</p> <p>2. <i>Consideration of "intention to cause damage," "negligence" and "recklessness"</i> Please refer to the comments in degree 2.</p> <p>3. <i>Others – Certificate (article VII(2), (4) and (12))</i> The Committee may need to reinterpret Article VII which provides the duty to carry the certificate on board of unmanned MASS. As many comments by IMO Members at the first step indicated, this issue might be resolved by developing interpretation. In this case, the most appropriate way is "I", considering the current widespread adoption of electronic certificates in the</p>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
			<p>maritime sector. However, the Legal Committee may have an option to update the provisions of CLC, as article 7(13) of the Bunker Convention and article 12(13) of the Wreck Removal Nairobi Convention. In this case, the most appropriate way is "II". If the Committee decides to amend CLC for other reasons, the provisions of CLC related to the certificate should also be updated. In addition, it is also possible that the Legal Committee (or the FAL Committee) makes the legally binding instrument for resolving all the problem related to the certificate. In this case, the most appropriate way is "III", developing new instruments. The Committee may want to see different forms and formats of certificate, which are more suitable for unmanned MASS. In this case, there would be several choices for most appropriate way of doing so, i.e. I, II, III and IV.</p>
DEGREE FOUR	I, II, III, IV	<p>A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.</p>	<p>Please refer to the comments in degree 3.</p>

**3 Protocol [of 1976] to the International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC PROT 1976)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	Has no application to MASS operations.	
DEGREE TWO	IV	Has no application to MASS operations.	
DEGREE THREE	IV	Has no application to MASS operations.	
DEGREE FOUR	IV	Has no application to MASS operations.	

**4 International Convention on Civil Liability for Oil Pollution Damage, 1992 (CLC PROT 1992)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
GENERAL		A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Otherwise, consideration in the Working Group and the Committee can be wandering. Among others, the Legal Committee should decide whether or not to include persons or entities engaged in the new technological aspect of navigation, such as a remote controller, a provider of network or computer system, or a programmer of software, into the scope of the "channelling of liability" under CLC. If the Legal Committee thinks that these parties should be excluded from the liability for oil pollution, then that should be made explicit by amending article III(4) of CLC. In this case, the most appropriate solution	

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		<p>is "II". However, taking into account the practice of quasi-amendment of some provisions of CLC, the Committee can make protocol to amend some provisions of CLC, including article III(4). In this case, the most appropriate way is "III". In contrast, if the Committee decides that such parties should not be excluded from the liability for oil pollution, CLC article III(4) can be left as it is ("IV"), just as manufacturers and classification societies are not mentioned there, or the Committee can develop an interpretation of article III(4) on this matter ("I"). Indeed, the Committee can also decide that such parties should be liable for oil pollution in some cases, then making new instrument ("III") can be the most appropriate way. But this choice can be beyond the scope of the "channelling of liability." While it is possible for the Committee not to make a clear decision at this point of time and leave the issue to domestic courts of the States, such an approach will produce legal uncertainty for the parties mentioned above, which might impede the development, or the commercial operations, of the MASS.</p>	

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS on whether or not to include persons or entities engaged in the new technological aspect of navigation, such as a remote controller, a provider of network or computer system, or a programmer of software, into the scope of the "channelling of liability" under CLC.
DEGREE TWO	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	<p><i>1. New technology will introduce new actors providing such technology and new causes of exoneration relating to such technology</i></p> <p>It would be necessary for the Legal Committee to make a decision on the policy of whether the current lists in the clause of exoneration (article III(2)), the channelling clause (article III(4)), and the clause of subrogation (article V(5)) are sufficient.</p> <p><i>2. Consideration of "intention to cause damage," "negligence" and "recklessness"</i></p> <p>As to article III(3), it would be necessary for the Legal Committee to make a policy decision about what the owner of the tanker is required to prove to be exonerated from his/her liability in case that the vessel that suffers damages is a MASS. Suppose that a MASS collided with a tanker and suffered oil pollution damage since it has made a wrong manoeuvre without any human action due to an error in its program. In such a situation, there is no intention to cause damage nor negligence of the owner of the MASS. Should the owner of the tanker fully compensate for the oil pollution damage of the owner of the MASS, even in such a case? As to article V(2), it would be necessary for the Legal Committee to make a policy decision about what</p>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
			<p>conduct of the owner of a tanker that is a MASS would constitute its "act or omission, committed with the intent to cause such loss, or recklessly and with knowledge that such loss probably result". For example, would the owner of a MASS tanker be denied of limitation when he/she had some knowledge on the error in the program of the MASS? If yes, knowledge about what facts will deprive the owner of a tanker of right to limit its liability? It would be beneficial either to have an interpretation or a new provision to introduce a clear-cut rule on this issue.</p> <p>3. <i>Others – Definition of Ship (article I(1))</i> The IOPC Funds have the Guidance Document for the Definition of Ship, which presupposes the existence of competent seafarers on board and has not considered the emergence of remote-controlled ships or highly automated ships. The Legal Committee might wish to notify the Funds to deal with this issue.</p>
DEGREE THREE	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	<p>1. <i>New technology will introduce new actors providing such technology and new causes of exoneration relating to such technology</i> Please refer to the general comments and the comments in degree 2.</p> <p>2. <i>Consideration of "intention to cause damage," "negligence" and "recklessness"</i> Please refer to the comments in degree 2.</p> <p>3. <i>Others</i> (1) <i>Definition of Ship (article I(1))</i> Please refer to the comments in degree 2. (2) <i>Certificate (article VII(2), (4) and (12))</i> The Committee may need to reinterpret article VII which</p>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
			<p>provides the duty to carry the certificate on board of unmanned MASS. As many comments by IMO Members at the first step indicated, this issue might be resolved by developing interpretation. In this case, the most appropriate way is "I", considering the current widespread adoption of electronic certificates in the maritime sector. However, the Legal Committee may have an option to update the provisions of CLC as article 7(13) of the Bunker Convention and article 12(13) of the Wreck Removal Nairobi Convention. In this case, the most appropriate way is "II". If the Committee decides to amend CLC for other reasons, the provisions of CLC related to the certificate should also be updated. In addition, it is also possible that the Legal Committee (or the FAL Committee) makes the legally binding instrument for resolving all the problem related to the certificate. In this case, the most appropriate way is "III", developing new instruments. The Committee may want to see different forms and formats of certificate, which are more suitable for unmanned MASS. In this case, there would be several choices for most appropriate way of doing so, i.e. I, II, III and IV.</p>
DEGREE FOUR	I, II, III, IV	A policy choice must be made on some issues in order to decide the most appropriate way to address MASS. Thus, it is appropriate to select all the possible ways, i.e. I, II, III and IV.	Please refer to the comments in degree 3.



**5 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992 (FUND PROT 1992)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	No changes necessary.	<p>Japan provided the following comments:</p> <p>Article 4(2) for all degrees: The Legal Committee may wish to consider whether the current list of exoneration is sufficient for the Fund in cases in which a MASS is involved. In particular, it might wish to closely examine whether the Fund should be exonerated when a wrong decision by the artificial intelligence or a failure of the network, computer or other technological infrastructure caused the incident. For this reason, article 4(2) as a whole is classified as C.</p> <p>Article 4(3) for all degrees: It is not clear whether and how this provision is applied to cases in which a MASS suffers the damage. LEG may wish to clarify intent to cause damage when it comes to AI or systems of MASS. Therefore, vessels of degree 2 to 4 are classified as C.</p>
DEGREE TWO	IV	No changes necessary.	
DEGREE THREE	IV	No changes necessary.	
DEGREE FOUR	IV	No changes necessary.	

**6 Protocol of 2003 to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992 (FUND PROT 2003)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	No changes necessary.	
DEGREE TWO	IV	No changes necessary.	
DEGREE THREE	IV	No changes necessary.	
DEGREE FOUR	IV	No changes necessary.	

**7 Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971 (NUCLEAR 1971)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	Generally, no change needed, except in relation to article 3. In regard to article 3, please refer to comments under degree four.	
DEGREE TWO	IV	Generally, no change needed, except in relation to article 3. In regard to article 3, please refer to comments under degree four.	
DEGREE THREE	IV	Generally, no change needed, except in relation to article 3. In regard to article 3, please refer to comments under degree four.	
DEGREE FOUR	I, II	There are two options for proceeding: 1) In relation to articles 1 and 2, a provision could clarify which entities/individuals are included within the term 'any person'. In relation to article 3, a	Clarification as to who is the 'operator' and individuals/entities to be included in 'any person'.

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		<p>provision could clarify who is the 'operator' (e.g. shipowner, operating company or another entity as appropriate).</p> <p>2) Developing an interpretation or interpretative document that provides for:</p> <p>a. articles 1 and 2 – clarification as to which individuals/entities are included within the term 'any person' if deemed appropriate. Consideration should be given to whether the term 'any person' requires clarification or narrowing due to MASS.;</p> <p>b. article 3 – clarification as to who is the 'operator'. The operator could be interpreted as either the 'shipowner' or the 'operating company, as appropriate. This article may require a policy decision as to whether liability should prima facie lie with the shipowner or the operating company or whether they should be jointly and severally liable. The development of an interpretation or interpretative document would be easier to implement but amending the Convention would provide a more permanent result. Considering this Convention only requires clarification, and many other Conventions may require significant amendment, we propose developing an interpretation as the preferred option.</p>	

**8 Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 1974 (PAL 1974)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	I	No specific difficulty has been identified for the application of the Athens 1974 Convention as regards ships with degree one of autonomy.	None.
DEGREE TWO	I	<p>Few difficulties have been identified for the application of the Athens 1974 Convention with regard to ships with degree two of autonomy. These difficulties could be resolved through developed interpretations, but there was no consensus on whether such interpretations were actually really needed, or if the 1974 Convention is providing enough clarity. The points on which clarifications may be necessary are listed below:</p> <p>Does the notion of "servants or agent of the carrier, acting within the scope of their employment" cover the persons or entity that would supervise the autonomous operation of the ship (such as persons in charge of shore based remote control)? Could an accident caused by a defect in a MASS system be regarded as a "fault or neglect of the carrier"? Could a defect of the autonomous systems of a MASS – including on the shore side – be considered as a "defect of the ship"? Could accidents caused by autonomous systems and equipment lead to a loss of the right to limit liability?</p>	<p>The following notions require specific care:</p> <ul style="list-style-type: none"> <li>- servants or agents of the carrier;</li> <li>- fault or neglect of the carrier; and</li> <li>- defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.</li> </ul>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE THREE	I, II	Some difficulties have been identified for the application of the Athens 1974 Convention with regard to ships with degree three of autonomy. These difficulties could be addressed by developing interpretations or amendments; however, there was no consensus on whether such interpretations or amendments are actually necessary. The points on which clarifications may be necessary are below listed: Could the remote operator be considered as the performing carrier? Would a defect of a MASS system, including its land-based components, be considered a "defect of the ship" within the meaning of the Convention? Would those who supervise the autonomous operations of the ship be considered as "servant or agent of the carrier"? Could the carrier lose its right to limit liability in relation with an accident caused by a MASS system? Does the liability of the MASS designer need special consideration?	<p>The following notions require specific care:</p> <ul style="list-style-type: none"> <li>- servants or agents of the carrier;</li> <li>- fault or neglect of the carrier; and</li> <li>- defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.</li> </ul> <p>The question of the liability of the MASS designer requires specific consideration.</p>
DEGREE FOUR	I, II	Some difficulties have been identified for the application of the Athens 1974 Convention with regard to ships with degree four of autonomy. These difficulties could be addressed by developing interpretations or amendments; however, there was no consensus on whether such interpretations or amendments are actually necessary. The points on which clarifications may be necessary are below listed: Could the remote operator be considered as the performing carrier? Would a defect of a MASS system, including its land-based components, be considered a "defect of the ship" within the meaning of	<p>The following notions require specific care:</p> <ul style="list-style-type: none"> <li>- servants or agents of the carrier;</li> <li>- fault or neglect of the carrier; and</li> <li>- defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.</li> </ul> <p>The question of the liability of the MASS designer requires specific consideration.</p>

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		the Convention? Would those who supervise the autonomous operations of the ship be considered as "servant or agent of the carrier"? Could the carrier lose its right to limit liability in relation with an accident caused by a MASS system? Does the liability of the MASS designer need special consideration? Difficulty of conceiving certain obligations of the carrier arising from the status of luggage in a fully autonomous context, unless it is understood that catering personnel could be aboard despite a fully autonomous navigation.	

**9 Protocol of 1976 to the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 1974 (PAL PROT 1976)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	IV	<i>Question raised:</i> Does the introduction of the Special Drawing Right as the Unit of Account in place of the gold franc impact the future MASS liability regime? <i>Analysis:</i> There is no impact in the MASS context. <i>Conclusion:</i> No amendment required.	
DEGREE TWO	IV	See comment under degree one.	
DEGREE THREE	IV	See comment under degree one.	
DEGREE FOUR	IV	See comment under degree one.	

10 Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 2002 (PAL PROT 2002)

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	I	No difficulty was identified for the application of the Athens 2002 Convention in case of ships with level one autonomy.	None.
DEGREE TWO	I	Few difficulties were identified for the application of the Athens 2002 Convention in case of ships with level two autonomy. They could be addressed by developing interpretations, but there was no consensus on whether such interpretations were actually really needed, or if the Convention was clear enough. The points that may need clarification were: Whether the notion of "servants or agent of the carrier, acting within the scope of their employment" covers the persons or entity that would supervise the autonomous operation of the ship (such as persons in charge of shore based remote control)? Whether an accident caused by a defect in a MASS system could be counted as a "fault or neglect of the carrier"? Whether a defect of the autonomous systems of a MASS, including on the shore side, could be considered a "defect of the ship? Whether accidents caused by autonomous systems and equipment could lead to a loss of the right to limit liability?	Notions of servants or agents of the carrier, of fault or neglect of the carrier, of defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE THREE	I, II	Some difficulties were identified for the application of the Athens 2002 Convention in case of ships with level three autonomy. They could be addressed by developing interpretations or amendments, but there was no consensus on whether such interpretations or amendments were actually really needed. The issues that may need clarification were: Could the remote operator be considered as the performing carrier? Could a defect of a MASS system, including its land-based components, be considered a "defect of the ship" within the meaning of the Convention? Would those who supervise the autonomous operations of the ship be "servant or agent of the carrier"? Could the carrier lose its right to limit liability in relation with an accident caused by a MASS system Does the liability of the MASS designer need special consideration?	<p>Notions of servants or agents of the carrier, of fault or neglect of the carrier, of defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.</p> <p>Liability of the MASS designer</p>
DEGREE FOUR	I, II	Some difficulties were identified for the application of the Athens 2002 Convention in case of ships with level four autonomy. They could be addressed by developing interpretations or amendments, but there was no consensus on whether such interpretations or amendments were actually really needed. The issues that may need clarification were: Could the remote operator be considered as the performing carrier? Would a defect of a MASS system, including its land-based components, be considered a "defect of the ship" within the meaning of the Convention? Would those who	<p>Notions of servants or agents of the carrier, of fault or neglect of the carrier, of defect of the ship and of loss of the right to limit liability, as related to the operations of the autonomous system and to the person supervising it.</p> <p>Liability of the MASS designer</p>



Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		supervise the autonomous operations of the ship be "servant or agent of the carrier"? Could the carrier lose its right to limit liability in relation with an accident caused by a MASS system? Difficulty of conceiving certain obligations of the carrier in relation to luggage in a fully autonomous context, unless it is understood that catering personnel could be aboard despite a fully autonomous navigation. Does the liability of the MASS designer need special consideration?	

**11 Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	IV	All of the MASS applications at degree one are categorized as "B", which means that it requires no actions.	
DEGREE TWO	II	In particular, there is ambiguity about the remote operator. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether the remote operator might fall within the scope of "manager and operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE THREE	II	In particular, there is ambiguity about the remote operator. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether the remote operator might fall within the scope of "manager and operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.
DEGREE FOUR	II	In particular, there is ambiguity about the manufacturer or other programmers. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether a manufacturer or other programmers of a MASS at degree 4 might fall within the scope of "operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.

**12 Convention on Limitation of Liability for Maritime Claims, 1976, as amended by the 1996 Protocol (LLMC PROT 1996)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	All of the MASS applications at degree one are categorized as "B", which means that it requires no actions.	
DEGREE TWO	II	In particular, there is ambiguity about the remote operator. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether the remote operator might fall within the scope of "manager and operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE THREE	II	In particular, there is ambiguity about the remote operator. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether the remote operator might fall within the scope of "manager and operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.
DEGREE FOUR	II	In particular, there is ambiguity about the manufacturer or other programmers. Some provisions (e.g. articles 1(2), 1(4)) may need to be amended or clarified, and/or may contain gaps.	It is necessary to clarify whether a manufacturer or other programmers of a MASS at degree 4 might fall within the scope of "operator", or the definition of "any person". There is no definition of "ship" in the Convention. A definition might be preferable to remove doubt over whether a MASS at degrees 3 and 4 is a ship.

**13 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988 (SUA 1988)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	IV	As a result of the analysis, no amendment or new instrument is necessary to maintain the applicability of the Convention with respect to MASS degree 1. The Convention is enacted and enforced by signatory Member States through domestic legislation and prosecutions. To the extent any signatory Member State has jurisdictional, terminological, or other MASS-related legal concerns, those are matters that may be addressed in that signatory Member	

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
		State's legal system and domestic implementation of the Convention. Australia, the United Kingdom, and Switzerland recommended category I, i.e. that no changes be made to the Convention, but interpretative guidance be created. The United States carefully considered all positions, but recommends category IV, i.e. that no changes are needed.	
DEGREE TWO	IV	See comment under degree one.	
DEGREE THREE	IV	See comment under degree one.	
DEGREE FOUR	IV	See comment under degree one.	

**14 Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf, 1988 (SUA PROT 1988)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV	As a result of the analysis, no amendment or new instrument is necessary to maintain the applicability of the Convention with respect to MASS degree 1. The Convention is enacted and enforced by signatory Member States through domestic legislation and prosecutions. To the extent any signatory Member State has jurisdictional, terminological, or other MASS-related legal concerns, those are matters	

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		<p>that may be addressed in that signatory Member State's legal system and domestic implementation of the Convention.</p> <p>Although the United Kingdom recommended that guidance or amendment clarify that offences against a fixed platform can be perpetrated on land, such as by a land-based remote operator, a remote operator could be prosecuted in a domestic legal system through a variety of means, including, but not limited to, the passage of domestic legislation that expressly holds remote operators liable; through any aiding and abetting provisions of existing criminal provisions; or through a Member State's criminal provisions on conspiracy. Moreover, with respect to jurisdiction, article 3(4) and article 3(5) expressly provide that the jurisdictional provisions do not exclude additional means of exercising criminal jurisdiction in accordance with national law. No effort by IMO is required.</p>	
DEGREE TWO	IV	See comment under degree one.	
DEGREE THREE	IV	See comment under degree one.	
DEGREE FOUR	IV	See comment under degree one.	

**15 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 2005 (SUA 2005)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	IV	<p>As a result of the analysis, no amendment or new instrument is necessary to maintain the applicability of the Convention with respect to MASS degree 1. The Convention is enacted and enforced by signatory Member States through domestic legislation and prosecutions. To the extent any signatory Member State has jurisdictional, terminological, or other MASS-related legal concerns, those are matters that may be addressed in that signatory Member State's legal system and domestic implementation of the Convention.</p> <p>Alternatively, Australia, Switzerland and the United Kingdom support guidance to clarify that SUA offences can be perpetrated on land, such as by a land-based remote operator. Switzerland further recommends guidance that unmanned law enforcement vessels have indicia or markings that indicate its status as a law enforcement vessel.</p>	
DEGREE TWO	IV	See comment under degree one.	
DEGREE THREE	IV	See comment under degree one.	
DEGREE FOUR	IV	See comment under degree one.	

**16 Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf, 2005 (SUA PROT 2005)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
DEGREE ONE	IV	<p>As a result of the analysis, no amendment or new instrument is necessary to maintain the applicability of the Convention with respect to MASS degree 1. The Convention is enacted and enforced by signatory Member States through domestic legislation and prosecutions. To the extent any signatory Member State has jurisdictional, terminological, or other MASS related legal concerns, those are matters that may be addressed in that signatory Member State's legal system and domestic implementation of the Convention.</p> <p>Although the United Kingdom recommended that guidance or amendments clarify that offences against a fixed platform can be perpetrated on land, such as by a land-based remote operator, a remote operator could be prosecuted in a domestic legal system through a variety of means, including, but not limited to, the passage of domestic legislation that expressly holds remote operators liable; through any aiding and abetting provisions of existing criminal provisions; or through a Member State's criminal provisions on conspiracy. Moreover, with respect to jurisdiction, articles 3(4) and 3(5) make express that the jurisdictional provisions do not exclude additional means of exercising criminal jurisdiction in accordance with national law. No effort by IMO is required.</p>	
DEGREE TWO	IV	See comment under degree one.	

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE THREE	IV	See comment under degree one.	
DEGREE FOUR	IV	See comment under degree one.	

**17 International Convention on Salvage, 1989 (SALVAGE 1989)**

<b>Degree of autonomy</b>	<b>The most appropriate way(s)</b>	<b>Reason for selecting the most appropriate way(s) of addressing MASS operations</b>	<b>Potential gaps/themes that require addressing</b>
DEGREE ONE	IV		
DEGREE TWO	IV		
DEGREE THREE	I	The issue of the remote operator/master is an overriding issue that needs to be solved taking into account all instruments in coordination with all responsible committees.	
DEGREE FOUR	I	The issue of the master is an overriding issue that needs to be solved taking into account all instruments in coordination with all responsible committees.	



18 **Nairobi International Convention on the Removal of Wrecks, 2007 (NAIROBI WRC 2007)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
GENERAL		Some States have expressed the wish to discuss the need to increase the list of cases of exoneration regarding liability claims in article 10 of the Convention.	
DEGREE ONE	IV	There seems to be no need for changes, i.e. there should be no problem with applying the Convention as it is for ships with degree one autonomy.	
DEGREE TWO	I	Some clarification may be needed regarding the role of the master and remote operator concerning certain reporting obligations.	
DEGREE THREE	I, II	The analysis has shown that some articles of the Convention will need to be clarified or amended before they can be applied to remotely controlled ships without seafarers on board. This includes the obligation to carry certificates on the vessel and the requirements relating to the reporting of wrecks.	
DEGREE FOUR	I, II	For fully autonomous ships amendments and clarifications will be needed in relation to the same articles as for degree three.	

**19 International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 2010 (HNS PROT 2010)**

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
GENERAL		MASS can be accommodated within the existing HNS 2010. However, MASS do raise certain policy questions, such as how to appropriately classify the remote operator for the purposes of the channelling provisions in the Convention that may benefit from further consideration. Depending upon the outcomes of these discussions it may be necessary to develop common interpretations and/or consider amendments to the conventions to more clearly implement the desired policy outcome.	
DEGREE ONE	IV	The Convention can accommodate MASS at this degree of autonomy without the need for further changes.	Product liability: should the owner be held liable if the pollution damage results from a fault by an automated system? Is there a need to consider further exemptions to the owner's liability in articles 7 and 14?
DEGREE TWO	I	MASS can be accommodated at this degree of autonomy without the need for further changes. It may be necessary to consider whether it is necessary to clarify if a remote operator can be considered a servant or agent of the owner for the purpose of the channelling provisions in article 7.	Product liability: should the owner be held liable if the pollution damage results from a fault within the remote-controlled system? Is there a need to consider further exemptions to the owner's liability in articles 7 and 14?
DEGREE THREE	I, II	MASS can be accommodated at this degree of autonomy.  It may be necessary to either develop interpretations or consider amendments (e.g. to article 12) in order to address the requirement for	Product liability: should the owner be held liable if the pollution damage results from a fault within the remote-controlled system? Is there a need to consider further exemptions to the owner's liability in articles 7 and 14?

Degree of autonomy	The most appropriate way(s)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
		<p>the certificate of insurance to be on board the vessel if there are no seafarers on board.</p> <p>It may be necessary to consider interpretations or amendments to clarify whether the remote operator may be considered a servant or agent of the owner for the purpose of the channelling provisions in article 7.</p>	
DEGREE FOUR	I, II	<p>It may be necessary to either develop interpretations or consider amendments (e.g. to article 12) in order to address the requirement for the certificate of insurance to be on board the vessel if there are no seafarers on board.</p> <p>It may be necessary to consider interpretations or amendments to clarify whether the remote operator may be considered a servant or agent of the owner for the purpose of the channelling provisions in article 7.</p>	<p>Product liability: should the owner be held liable if the pollution damage results from a fault within the remote-controlled system? Is there a need to consider further exemptions to the owner's liability in articles 7 and 14?</p>

**APPENDIX 3**

**IMO documents related to the LEG RSE**

LEG 105/11/1	Canada, Finland, Georgia, Marshall Islands, Norway, Republic of Korea, Turkey, Comité Maritime International, International Chamber of Shipping, and International Group of Protection and Indemnity Associations	Proposal for a regulatory scoping exercise and gap analysis with respect to Maritime Autonomous Surface Ships (MASS)
LEG 105/14	Secretariat	Report of the Legal Committee on the work of its 105th session
LEG 106/8	Secretariat	List of instruments under the purview of the Legal Committee
LEG 106/8/1	Secretariat	Outcomes of MSC 99 and MSC 100 regarding MASS
LEG 106/8/2	Canada, Denmark, Finland, France, Georgia, Germany, Marshall Islands, Netherlands, Norway, Republic of Korea, United Arab Emirates, United Kingdom, and International Group of Protection and Indemnity Associations	Proposed framework, methodology and work plan for the regulatory scoping exercise
LEG 106/8/3	China	Proposal on the action plan for the regulatory scoping exercise for MASS
LEG 106/8/4	Republic of Korea	Considerations on the instruments, framework and methodology for the Legal Committee's regulatory scoping exercise
LEG 106/WP.5	Secretariat	Report of the LEG Working Group on MASS
LEG 106/16	Secretariat	Report of the Legal Committee on the work of its 106th session
LEG 107/8	Comité Maritime International	Summary of results of analysis of IMO instruments under the purview of the Legal Committee

LEG 107/8/Corr.1	Comité Maritime International	Summary of results of analysis of IMO instruments under the purview of the Legal Committee
LEG 107/8/1	Sweden	Summary of results of the first and second steps of the RSE for the Nairobi International Convention on the Removal of Wrecks, 2007
LEG 107/8/2	Japan	Summary of results of the LEG regulatory scoping exercise for the International Convention on Civil Liability for Oil Pollution Damage, 1992 (1992 CLC)
LEG 107/8/3	Australia	Summary of results of the LEG regulatory scoping exercise for the Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971
LEG 107/8/4	Secretariat	Progress on regulatory scoping exercise and gap analysis by MSC and FAL
LEG 107/8/5	United States of America	Summary of results of the LEG regulatory scoping exercise for the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988
LEG 107/8/6	United States of America	Summary of results of the LEG regulatory scoping exercise for the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 2005
LEG 107/8/7	United States of America	Summary of results of the LEG regulatory scoping exercise for the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms located on the Continental Shelf, 1988
LEG 107/8/8	United States of America	Summary of results of the LEG regulatory scoping exercise for the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms located on the Continental Shelf, 2005
LEG 107/8/9	China and Republic of Korea	Summary of results of the LEG regulatory scoping exercise for the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001
LEG 107/8/10	Republic of Korea and United Kingdom	Summary of results of the LEG regulatory scoping exercise for the Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976) and the Protocol of 1996 to amend LLMC 1976 (LLMC PROT 1996)
LEG 107/8/11	Finland	Summary of results of the LEG regulatory scoping exercise of the International Convention on Salvage, 1989

LEG 107/8/12	France and Marshall Islands	Summary of results of the LEG regulatory scoping exercise for the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 1974
LEG 107/8/13	France and Marshall Islands	Summary of results of the LEG regulatory scoping exercise for the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 2002
LEG 107/8/14	France and Marshall Islands	Summary of results of the LEG regulatory scoping exercise for the Protocol of 1976 to the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea, 1974
LEG 107/8/15	Canada	Summary of results of the LEG regulatory scoping exercise for the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 2010
LEG 107/8/16	Germany	Summary of results of the LEG regulatory scoping exercise for the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992
LEG 107/8/17	Secretariat	Summary of main gaps and common themes in instruments under the purview of the Legal Committee
LEG 107/8/18	International Federation of Shipmasters' Associations	Comment on documents LEG 107/8, LEG 107/8/1, LEG 107/8/5, 107/8/6 and LEG 107/8/11 regarding the role of the master
LEG 107/18/2	Secretariat	Report of the Legal Committee on the work of its 107th session
LEG 108/7	Secretariat	Finalization of regulatory scoping exercise and gap analysis by MSC 103
LEG 108/7/1	Russian Federation	Comments on documents LEG 107/8 and LEG 107/8/17 in respect of legal regulation of MASS trials in the Russian Federation
LEG 108/WP.7	Secretariat	Report of the LEG Working Group on MASS
LEG 108/16/1	Secretariat	Report of the Legal Committee on the work of its 108th session