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

1 The Maritime Safety Committee, at its 103rd session (5 to 14 May 2021), approved the *Outcome of the regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)*, as set out in the annex, which provides the assessment of the degree to which the existing regulatory framework under purview of the Maritime Safety Committee (MSC) might be affected in order to address MASS operations. It further provides guidance to the MSC and interested parties to identify, select 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 the MSC 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 FOR THE USE OF MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

1 INTRODUCTION

1.1 This document presents the outcome of the regulatory scoping exercise **(**RSE) for the use of Maritime Autonomous Surface Ships (MASS), conducted by the Maritime Safety Committee (MSC).

1.2 The outcome of the RSE, approved by MSC 103 (5 to 14 May 2021), provides the assessment of the degree to which the existing regulatory framework under its purview might be affected in order to address MASS operations. It further provides guidance to MSC and interested parties to identify, select and decide on future work on MASS and, as such, facilitate the preparation of requests for, and consideration and approval of, new outputs.

Content of this document

1.3 The Intersessional Working Group on MASS, which met from 2 to 5 September 2019, agreed that the outcome of the RSE to be finally approved by MSC should contain (MSC 102/5/1, paragraph 4.17):

.1 a background section, including the process followed during the RSE;

.2 information for all degrees of autonomy for every instrument expected to be affected by MASS operations under the purview of the MSC;

.3 the most appropriate way(s) of addressing MASS operations in those instruments, as appropriate;

.4 identification of themes and/or potential gaps that require addressing;

.5 identification of possible links between instruments;

.6 identification of priorities for further work, including terminology and the order in which instruments could be addressed taking into account common themes and potential gaps; and

.7 references to the material produced before and during the RSE, in particular IMO documents.

1.4 Taking into account the information in paragraph 1.3, the document is arranged in the following manner.

1.5 Section 2 contains the background section and section 3 provides a summary of the process followed during the RSE with reference to the framework as agreed at MSC 100 (MSC 100/20/Add.1, annex 2). The list of mandatory instruments related to maritime safety and security considered as part of the RSE is set out in appendix 1.

1.6 Section 4 provides an overview of the assumptions made, by the volunteering Member States, for the purpose of the RSE and refers to appendix 2 for the results of the RSE at instrument level.

1.7 Appendix 2, being the most substantial part of this document, provides the summary of the outcome of the first and second step of the RSE as available in IMO documents published during the RSE (see appendix 3) and the web platform (see paragraph 3.9), and includes:

.1 information for all degrees of autonomy for every instrument expected to be affected by MASS operations under the purview of MSC;

.2 the most appropriate way(s) of addressing MASS operations in those instruments, as appropriate; and

.3 identification of themes and/or potential gaps that require addressing.

1.8 Section 5 provides an overview of the common potential gaps and/or themes that require addressing for MASS operations and potential links between instruments. This overview has been developed by using the available information in appendix 2.

1.9 In section 6, priorities for further work are identified, including terminology and the order in which instruments could be addressed taking into account common themes and potential gaps. This section has been developed by using the available information in appendix 2.

1.10 Finally, section 7 provides references to the material produced before and during the RSE, in particular IMO documents (see also appendix 3).

2 BACKGROUND

2.1 MSC 98 (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 that 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 At MSC 99 (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[1] to be considered and the applicability in terms of type and size of ships.

[1] According to resolution A.911(22), "instrument" encompasses mandatory and non-mandatory conventions, codes, guidelines, recommendations, etc.

2.5 MSC 100 (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 Working Group on MASS between MSC 101 and 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.

2.6 MSC 101 (June 2019) noted the progress made with the RSE and invited volunteering Member States to submit the result of the first step to the intersessional Working Group on MASS (ISWG/MASS). MSC 101 further developed and approved *Interim guidelines for MASS trials* (MSC.1/Circ.1604).

2.7 As instructed by the Committee, ISWG/MASS (September 2019) considered and agreed on the result of the first step of the RSE, and commenced the second step. The Group also developed the guidance on the required format and content of the necessary input to MSC 102.

2.8 Owing to the COVID-19 pandemic, MSC 102 (November 2020) deferred consideration of this matter to MSC 103.

2.9 MSC 103 (May 2021) finalized the RSE and approved the outcome as set out in this document.

3 FRAMEWORK AND PROCESS OF THE RSE

Aim

3.1 The aim of the regulatory scoping exercise was to determine how safe, secure and environmentally sound MASS operations might be addressed in IMO instruments.

Objective

3.2 The objective of the RSE on MASS conducted by MSC 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 For the purpose of the RSE, "MASS" was defined as a ship which, to a varying degree, can operate independent of human interaction.

3.4 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.

3.5 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

3.6 The list of mandatory instruments related to maritime safety and security considered as part of the RSE is set out in appendix 1. These instruments have been reviewed on a regulation or rule level. Subsidiary mandatory instruments established under each parent instrument have also been considered to the level necessary to establish how they would be affected.

3.7 The review of mandatory instruments was prioritized. In instruments containing both mandatory and non-mandatory parts, non-mandatory parts have been considered as part of the RSE, when deemed necessary, to obtain a complete understanding of how the mandatory provisions would be affected in order to address MASS operations (e.g. STCW Convention and Code).

Type and size of ships

3.8 The application of the regulatory scoping exercise was restricted to the applicability of the instruments under consideration.

Web platform for the conduct of the RSE

3.9 A web platform was developed by the Secretariat as part of GISIS to facilitate the RSE. The web platform was connected to the IMO web accounts, providing access only to registered IMO Members.[2] 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

3.10 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. At present intervals, IMO Members were authorized to submit comments on the work done by the volunteering Member States through the web platform.

3.11 As a first step, containing the "initial review of IMO instruments", provisions in IMO instruments were identified which, as currently drafted:

A applied to MASS and prevented MASS operations; or

[2] 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.

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.

3.12 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, inter alia, human element,[3] technology and operational factors by:

I equivalences as provided for by the instruments or developing interpretations; and/or

II amending existing instruments; and/or

III developing new instruments; or

IV none of the above as a result of the analysis.

3.13 The terminology for the purpose of the RSE was agreed to at MSC 99 (documents MSC 99/22, paragraph 5.27 and MSC 99/WP.9). References to degrees of autonomy in this document refer only to the definitions considered within the scope of the RSE and do not prevent potential future definitions that should be discussed at the later stage.

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 and provide for all degrees of autonomy, for every instrument expected to be affected by MASS operations under the purview of the Maritime Safety Committee, the:

.1 most appropriate way(s) of addressing MASS operations in those instruments;

.2 reason for selecting the most appropriate way(s); and

.3 identification of potential gaps/themes that require addressing.

Assumptions made for the purpose of the RSE

4.2 The assumptions listed in table 1 should be considered when interpreting the results in appendix 2, they will not necessarily be used during subsequent work. Any future assumptions would need to be agreed.

[3] Refer to resolution A.947(23), *Human element vision, principles and goals for the Organization*.

	Assumptions	**Instruments**
1	*Degree of autonomy Four* means no crew on board	SOLAS chapters III and V, 1966 LL Convention and 1988 Protocol, 2008 Intact Stability Code, III Code
2	Alternative arrangement, equivalent arrangement would be allowed and available	SOLAS chapter XI-2
3	Passenger transports without seafarers on board cannot be performed	SOLAS chapters XI-2 and XIV and Polar Code
4	The instrument applies to seafarers serving on board seagoing ships	STCW Convention and Code, STCW-F Convention
5	Determination of whether "remote operator" is a seafarer and whether "remote operator" encompasses all personnel working aboard of a ship or those individuals capable of operational control of the ship are outside of the remit of the RSE	STCW Convention and Code, STCW-F Convention
6	For degrees One and Two, seafarers are on board and available to take control of shipboard systems	SOLAS chapters II-1, II-2, VI, VII IBC, FSS, FTP, IMSBC, Grain, CSS, IMDG, IGC, INF
7	For degrees Three and Four, persons may stay on board during berthing, cargo handling and anchoring	SOLAS chapters II-1, II-2, VI, VII IBC, FSS, FTP, IMSBC, Grain, CSS, IMDG, IGC, INF
8	For degree Four, supervision by person is provided at a remote location	SOLAS chapters II-2, VI and VII IBC, FSS, FTP, IMSBC, Grain, CSS, IMDG, IGC, INF
9	MASS of degree one is considered as a conventional ship with some additional functions to support human decision-making. However, no particular automated process or function of decision support was considered owing to their diversities.	SOLAS chapter V
10	As long as MASS is not fully autonomous; the role of master is still required. For degree Three (higher degrees), the responsibility of the master will be extended/amended.	SOLAS chapter V
11	The Safety Management of MASS relates, inter alia, to functions which are autonomous	SOLAS chapter IX

Table 1: List of assumptions used for the RSE

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

5.1 The RSE identified the common potential gaps and/or themes that are required for MASS operations, as shown in table 2, and these gaps and themes were developed by using the available information in appendix 2. It should be noted that the potential gaps and themes outlined below are not exhaustive and that the first column on "Common potential gaps and/or themes" does not reflect any order of priorities.

5.2 Table 2 also shows the instruments under the remit of the Maritime Safety Committee, including SOLAS chapters, where the common potential gaps and/or themes were identified, thus indicating the potential links between instruments.

	Common potential gaps and/or themes	**Instruments**
1	Meaning of the terms master, crew or responsible person	SOLAS chapters II-2, III, V, VI, VII IX and XI-1, COLREG, TONNAGE 1969, 1966 LL Convention and 1988 Protocol, Intact Stability Code, III Code, STCW Convention and Code
2	Remote Control Station/Centre	SOLAS chapters II-1, II-2, III, IV, V IX and XI-1, STCW Convention and Code, FSS, ISM, 1966 LL Convention and 1988 Protocol, Casualty Investigation Code
3	Remote Operator as a seafarer	STCW, STCW-F, SOLAS chapter IX, ISM
4	Provisions containing manual operations, alarms to the bridge	SOLAS chapters II-1, II-2, VI and IX, 1966 LL Convention and 1988 Protocol, Intact Stability Code, III Code
5	Provisions requiring actions by personnel (Fire, Spillage Cargo Management, onboard maintenance, etc.)	SOLAS chapters II-2, VI, VII, IX and XII
6	Certificates and manuals on board	SOLAS chapters III, XI-1, XI-2 and XIV
7	Connectivity, Cybersecurity	SOLAS chapters IV, V and IX
8	Watchkeeping	SOLAS chapters IV and V, COLREG
9	Implication of MASS in SAR	SOLAS chapters III, IV and V, SAR
10	Information to be available on board and required for the safe operation	SOLAS chapters II-1and II-2
11	Terminology	SOLAS chapters II-1, IV and V, COLREG, FSS, IBC, IGC, Grain, INF, 1966 LL Convention and 1988 Protocol, Intact Stability Code, SAR, TONNAGE, CSS, Casualty Investigation Code

Table 2: List of common potential gaps and/or themes

5.3 It has been recognized that not all common potential gaps and/or themes in table 2 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.

High-priority issues

5.4 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 addressing individual instruments.

5.5 Meaning of the terms master, crew or responsible person

It was recognized that in a substantial number of instruments there was a need to clarify the meaning of the terms master, crew or responsible person. The role, responsibility and definition of master, especially for degrees of autonomy Three and Four where personnel on the shore side might control the ship, were considered to be a common theme identified in several instruments as a potential gap.

5.6 Remote control station/centre

MASS may be operated by a remote control station/centre. It was noted that the functional and operational requirements of the remote control station/centre, as well as for monitoring, needed to be addressed. It was further noted that this was a new concept to be implemented in IMO instruments and a common theme identified in several instruments as a potential gap.

5.7 Remote operator as seafarer

The RSE revealed that the possible designation of a remote operator as seafarer was considered to be a common theme identified in several instruments as a potential gap. Qualifications, responsibility and the role of remote operator as seafarer was one of the most complex issues to be addressed.

5.8 Terminology

Following consideration of terms that should be avoided, some recommended terms and a draft glossary for future work submitted by Finland and France (MSC 101/5/4), MSC 101 agreed that the matter of a glossary should be further considered after the RSE had been completed, together with information from ISO concerning new standards, as appropriate. During step 2, as reported to MSC 102, views were expressed for the degrees of autonomy to be re-evaluated, taking into account the lessons learned during the RSE. New definitions were proposed in several places, which need to be further considered and decided upon.

6 PRIORITIES FOR FURTHER WORK

6.1 Given the complex and extensive output of the RSE (section 4 and appendix 2), establishing priorities for further work is important. This section has been developed by using the available information in appendix 2, to identify the priorities of work on several issues cutting across a number of individual IMO instruments. The main high-priority items include the need to consider the development of a new instrument, review of terminology and definitions and consideration of high-priority common gaps and themes. It should be noted, however, that the identified priorities are non-exhaustive.

Development of a new instrument

6.2 In line with the outcome on "the most appropriate ways of addressing MASS operations" in appendix 2, 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). Addressing every instrument or SOLAS chapter separately could lead to inconsistencies, confusion and raise potential barriers for the application of existing regulations to conventional ships. Therefore, a MASS instrument, instead of amending individual instruments, may be considered which can be made mandatory by means of amending an existing IMO convention, such as SOLAS. This instrument could preferably be developed following a goal-based approach,[4] in line with the Guidelines developed by the Organization.[5]

6.3 In order to facilitate the operation of MASS at an early stage, establishing interim guidelines for MASS may be beneficial for ensuring safe, secure and environmentally-friendly MASS operations.

Terminology and definitions

6.4 It was 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.

Common gaps and themes

6.5 As mentioned in the previous section, some common potential gaps and/or themes were regarded as high-priority issues that cut across several IMO instruments and might require a policy decision before addressing individual instruments. Among those 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.

Possible order to address the instruments

6.6 If the decision is made to amend existing instruments rather than to develop a new instrument the following order of priorities is proposed:

It was concluded that the order to address the instruments for further work should be classified into three groups, as follows:

.1 High-priority: the group of instruments which contain the common potential gaps and/or themes listed in section 5 that need to be addressed before all others;

.2 Medium-priority: the group of instruments which require consideration of the impact of the use of MASS but which have not been identified as high-priority; and

.3 Low-priority: the group of instruments that require no significant action for the use of MASS.

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4 See *Generic guidelines for developing IMO goal-based standards* (MSC.1/Circ.1394/Rev.2).

5 See resolution *Uniform wording for referencing IMO instruments* (resolution A.911(22)).

High-priority instruments

6.7.1 The RSE concluded that the following IMO instruments under the purview of MSC were classified as "High-priority":

SOLAS chapters II-1, II-2, III, IV, V, VI, VII, IX, XI-1and XI-2;

COLREG;

STCW Convention and Code;

STCW-F Convention;

1966 LL Convention and 1988 Protocol thereto;

1979 SAR Convention;

FSS Code;

IMSBC Code;

IMDG Code;

TONNAGE 1969;

IBC Code; and

IGC Code.

6.7.2 The most appropriate way(s) of addressing MASS operations in the instruments classified as high-priority is set out in the table 3, with the following four options:

I equivalences as provided for by the instruments or 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.

IMO Instruments	The most appropriate way(s) of addressing MASS operations			
Degree of Autonomy	**One**	**Two**	**Three**	**Four**
SOLAS II-1	IV	II	II - III	II - III
SOLAS II-2	IV	II - III	II - III	II - III
SOLAS III	IV	II - III	III	III
SOLAS IV	II	II - III	III	III
SOLAS V	II	II - III	III	III
SOLAS VI	IV	II - III	II - III	II - III
SOLAS VII	IV	II - III	II - III	II - III
SOLAS IX	IV	III	III	III
SOLAS XI-1	IV	III	I - III	I - III
SOLAS XI-2	I - II	II - III	II - III	II - III
COLREG	I	I - II	I - II	II
STCW	I - II	I - II - III	I - II - III	IV
STCW-F	I - II	I - II - III	I - II - III	IV
LL 1966 + 1988 Protocol	IV	II	II	II
SAR 1979	IV	II	II	II
TONNAGE 1969	IV	I	I	I
IMDG Code	IV	II- III	II - III	II - III
IMSBC Code	IV	II- III	II - III	II - III
FSS Code	IV	II- III	II - III	II - III
IBC Code	IV	II- III	II - III	II - III
IGC Code	IV	II- III	II - III	II - III

Table 3: List of high-priority instruments

Instruments to be addressed at the same time

6.7.3 Among the high-priority instruments, some may need to be addressed in parallel with others in order to address the common potential gaps and/or themes.

Medium-priority instruments

6.8.1 The RSE concluded that the following IMO instruments under the purview of MSC were classified as "Medium-priority":

SOLAS chapter XII
CSS Code;
Casualty Investigation Code;
III Code;
Grain Code;
INF Code;
2008 Intact Stability Code; and
Standards for owners' inspection and maintenance of bulk carrier hatch covers.

6.8.2 The most appropriate way(s) of addressing MASS operations of the medium-priority instruments is set out in table 4 below.

IMO Instruments	**The most appropriate way(s) of addressing MASS operations**			
Degree of Autonomy	One	Two	Three	Four
SOLAS XII	IV	II - III	II - III	II - III
CSS Code	IV	II - III	II - III	II - III
Casualty Investigation Code	IV	II	II	II
III Code	IV	II	II	II
Grain Code	IV	II - III	II - III	II - III
INF Code	IV	II - III	II - III	II - III
IS Code	IV	II	II	II
Standards for owners' inspection and maintenance of bulk carrier hatch covers	IV	IV	II - III	II - III

Table 4: List of medium-priority instruments

6.8.3 Almost all of the medium-priority instruments were concluded to be addressed by amending the instruments individually (i.e. the most appropriate way of addressing MASS operations was option II (paragraph 6.8.2)).

Instruments to be addressed at the same time

6.8.4 Among the medium-priority instruments, some might need to be addressed in parallel with others in order to address the common potential gaps and/or themes.

Low-priority instruments

6.9.1 The RSE concluded that the following remaining instruments under the purview of MSC were classified as "low-priority" and required no significant action for the use of MASS.

6.9.2 The most appropriate way(s) of addressing MASS operations of the low-priority instruments are set out in the table 5 below, showing that no action is required for the use of MASS.

6.9.3 It was, however, recognized that some of the low-priority instruments might need to be considered in future in relation to the introduction of new technologies.

IMO Instruments	The most appropriate way(s) of addressing MASS operations			
Degree of Autonomy	One	Two	Three	Four
SOLAS chapter XIII	IV	IV	IV	IV
SOLAS chapter XIV	IV	IV	IV	IV
CSC Code	IV	IV	IV	IV
ESP Code	IV	IV	IV	IV
RO Code	IV	IV	IV	IV
FTP Code	IV	IV	IV	IV
Polar Code	IV	IV	IV	IV
LSA Code	IV	IV	IV	IV
ISM Code	IV	IV	IV	IV
ISPS Code	IV	IV	IV	IV
Standards for the evaluation of scantlings of the transverse watertight vertically corrugated bulkhead between the two foremost cargo holds and for the evaluation of allowable hold loading of the foremost cargo hold	IV	IV	IV	IV
Standards and criteria for side structure of bulk carriers of single-side skin construction	IV	IV	IV	IV

Table 5: List of low-priority instruments

Proposals for new outputs

6.10 The need for justification in relation to any future proposals for changes in the regulatory framework was agreed and, consequently, it was recognized that any future work on MASS need to be approved following a proposal for a new output. Therefore, all activities described below requires new outputs to be agreed by MSC.

Addressing MASS operations in IMO instruments under the remit of the Maritime Safety Committee

6.11.1 When addressing the high-priority issues identified above, coordination and delegation of work between committees and sub-committees should be considered.

High-priority issues for addressing MASS operations in IMO instruments

6.11.2 Commencement of developing and establishing rules and regulations to address MASS operations may require certain issues of high priority, as set out in paragraphs 6.2 to 6.6, to be considered in order to determine what, how and when to address MASS operations and to provide a foundation for future work. This effort would benefit from the sharing of experience gained by early MASS operations.

6.11.3 A possible way forward in addressing MASS operations in IMO instruments under the remit of the Maritime Safety Committee is set out in table 6.

Issue		Planned activities and result
1	**Consideration of a holistic approach to MASS operations in IMO instruments**	
	Development of a goal-based MASS instrument	Consideration on how to develop a new MASS instrument and draft amendments to the applicable instruments through which it can be made mandatory
	Definition of MASS	Consideration on the need to revise definition and/or degrees and if revision is deemed necessary, agreeing on the definition and/or degrees
	Terminology for MASS operations in the IMO regulatory framework	Consideration on the need of supplementing terminology, and if deemed necessary, agreeing on such terminology
	High-priority common gaps and themes in relation to MASS operations and IMOs regulatory framework: - Meaning of Master, crew or responsible person - Remote control station/centre - Remote operator designated as seafarer	Consideration of the high-priority common gaps and themes
	Non-mandatory instrument	Consideration of the development of guidelines for MASS operations such as guidelines for installation and guidelines for system application

Table 6: Addressing MASS operations in IMO instruments under the remit of the Maritime Safety Committee

7 REFERENCES TO THE MATERIAL PRODUCED BEFORE AND DURING THE RSE

IMO documents

7.1 A list containing a reference to IMO documents published before and during the RSE is provided in appendix 3.

The MASS module of GISIS

7.2 All detailed information, including analysis by the volunteering Member States and 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

Instrument	Volunteering Member State(s)	Supporting Member(s)
International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS 1974)		
Chapter II-1 (Construction – structure, subdivision and stability, machinery and electrical installations)	France	China, Iran (Islamic Republic of) and Sweden
Chapter II-2 (Construction – fire protection, fire detection and fire extinction), including: - International Code for Fire Safety Systems (FSS Code); and - International Code for Application of Fire Test Procedures, 2010 (2010 FTP Code)	Japan	China and IACS
Chapter III (Life-saving appliances and arrangements), including: - International Life-Saving Appliance Code (LSA Code)	Netherlands	Belgium and China
Chapter IV (Radiocommunications)	Turkey	China and Japan
Chapter V (Safety of navigation)	China	Denmark, Japan and Singapore
Chapter VI (Carriage of cargoes and oil fuels), including: - International Maritime Solid Bulk Cargoes Code (IMSBC Code); - Code of Safe Practice for Cargo Stowage and Securing (CSS Code); - International Code for the Safe Carriage of Grain in Bulk (Grain Code) - Part A "Specific requirements"; and - Part B "Calculation of assumed heeling moments and general assumptions".	Japan	China

Instrument	Volunteering Member State(s)	Supporting Member(s)
Chapter VII (Carriage of dangerous goods), including: - International Maritime Dangerous Goods Code (IMDG Code); - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code); - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code); and - International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code).	Japan	China
Chapter IX (Management for the safe operation of ships), including: - International Safety Management (ISM) Code.	Norway	China, Nigeria, Republic of Korea and Russian Federation
Chapter XI-1 (Special measures to enhance maritime safety), including: - Code for Recognized Organizations (RO Code); - International Code on the Enhanced Programme of Inspections during Surveys of Bulk and Oil Tankers, 2001 (2011 ESP Code); and - Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code).	Finland	China
Chapter XI-2 (Special measures to enhance maritime security), including: - International Ship and Port Facility Security Code (ISPS Code)	Finland	China
Chapter XII (Bulk Carrier), including: - Bulk carrier bulkhead and double bottom strength standards; - Standards for owners' inspection and maintenance of bulk carrier hatch covers; and - Standards and criteria for side structures of bulk carriers of single-side skin construction.	Japan	
Chapter XIII (Verification of Compliance)	Japan	

Instrument	Volunteering Member State(s)	Supporting Member(s)
Chapter XIV (Safety measures for ships operating in polar waters), including: - International Code for Ships Operating in Polar Waters (Polar Code)	Finland	
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW 1978) and Seafarers' Training, Certification and Watchkeeping Code (STCW Code)	United States	China, Cyprus, Japan, New Zealand, Republic of Korea, Russian Federation and Spain
International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel, 1995 (STCW-F 1995)	Japan	New Zealand and Spain
Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended (COLREG 1972)	Marshall Islands	China, Japan, Singapore, Spain, Sweden and United States
International Convention for Safe Containers (CSC), 1972	Japan	Finland
International Convention on Load Lines, 1966 (LL 1966), including: - IMO Instruments Implementation Code (III Code); and - International Code on Intact Stability, 2008 (2008 IS Code) – Part A.	India	China and Liberia
Protocol of 1988 relating to LL 1966 (LL PROT 1988)	India	Liberia
International Convention on Maritime Search and Rescue, 1979 (SAR 1979)	Spain and France	Turkey
International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE 1969)	Liberia	

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 equivalences as provided for by the instruments or 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.

Instrument: SOLAS Chapter II-1

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General	II	Specific definitions could be added in Reg. 2 and 3 for MASS operations (e.g. master, operator, Remote Control Centre, unmanned, etc.)	Reg. 2 and 3 mention no specific definitions for MASS operations
	III	Specific requirements on remote monitoring and remote control may be developed (e.g. requirements on Remote control centre, including facility and manning, communication network and system, human machine interface, etc.)	No specific requirements on remote monitoring and remote control in the existing instruments

Degree One	**IV**	MASS application (initial review) = B or D	None
Degree Two	**II**	Specific definitions could be added in Reg. 2 and 3 to clarify that the Remote Control Centre could be a substitute to the bridge	Reg. 13, 13-1, 14, 15-1, 17-1, 22-1, 25, 29, 30, 31, 37, 49, 50, 51, 53 mention indications, alarms, controls in the bridge or communication means with the bridge
		Reg. 22 could be amended considering that the control could be performed remotely	Reg. 22 mentions control of doors and other devices
		Reg. 5, 5-1, 8-1, 20, 23, 24 and 28 could be amended considering that the master and/or the officer of the watch could be on board or not on board	Reg. 5, 5-1, 8-1, 28 mention information to be available on board for the use of the master or information to be supplied to the master
			Reg. 20, 23, 24 mention actions to be done by the master and/or the officer of the watch
Degrees Three and Four	**II or III**	Could be amended considering no crew and no master (or officer of the watch) on board or Considering the number of gaps identified involving a lot of regulations, developing a separate and dedicated instrument could be the solution with less complexity and easier to conduct	Reg. 3-3 mentions means to enable the crew to gain safe access to the bow
			Reg. 3-4, 3-6, 3-8, 12, 13, 13-1, 15, 17, 17-1, 19-1, 21, 22, 26, 29, 31, 33, 35-1, 41, 44, 48, 49 mention manual operation done on board
			Reg. 3-6, 3-7, 3-10, 5, 5-1, 8-1, 19, 28 mention information available on board or information supplied to the master
			Reg. 6 and 7.3 take into account the presence of the crew in the stability calculation (index R and permeability)
			Reg. 13, 13-1, 14, 15-1, 17-1, 22-1, 25, 29, 30, 31, 37, 49, 50, 51, 53 mention indications, alarms, controls or communication means in the bridge, engine room or centralized control position
			Reg. 20, 22, 23, 24 mention actions done by the master (or officer of the watch)
			Reg. 32 mentions a direct reading gauge glass
			Reg. 38 mentions an alarm in the engineers' accommodation
			Reg. 40, 41 mention habitable conditions
			Reg. 42, 42-1, 43 mention emergency consumers, lighting, muster and embarkation station related to crew evacuation
			Reg. 54 mentions periodically unattended machinery spaces

Instrument: SOLAS chapter II-2

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. On the other hand, it could also be considered to amend the regulations or develop new instruments to ensure fire safety based on another concept. In such a case, one of the future issues to be addressed is how to evaluate the reduction of fire risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required. However, some considerations might be needed depending on the conditions or premises of this degree of autonomy.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in a consistent manner. Regarding the other potential gaps and/or themes, the provisions regarding definitions and the provisions regarding facilities such as alarms, indications and operational booklets should be amended to safely introduce remote operations with seafarers on board. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • Provisions regarding definitions (control stations and safety centre) should be amended. • Provisions regarding facilities such as alarms, indications and operational booklets should be amended so that remote operators can also be notified.

Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to apply regulation 17 "Alternative design and arrangements" to the provisions for systems and appliances which need manual operations or provisions requiring actions by personnel on board in regulations 4 to 23 other than 17 of SOLAS chapter II-2. On the other hand, regarding the provisions for systems and appliances which need manual operations and provisions requiring actions by personnel on board, especially for fire fighting, it may be more appropriate to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) rather than amending them one by one since there are a lot of provisions in the same themes or potential gaps in this chapter. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• The meanings of "master", etc. • Functional requirements of remote/ automated system to detect and control fire. • Definitions of manned spaces, control stations and safety centre. • Facilities such as alarms, indications, notification and means of escape, and operational booklets. • Systems and appliances which need manual operations. • Actions by personnel on board, such as fire fighting. • Accommodations and accessibility. • Safe return to port and its casualty threshold.

Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to apply regulation 17 "Alternative design and arrangements" to the provisions for systems and appliances which need manual operations or provisions requiring actions by personnel on board in regulations 4 to 23 other than 17 of SOLAS chapter II-2. On the other hand, regarding the provisions for systems and appliances which need manual operations and provisions requiring actions by personnel on board, especially for fire fighting, it may be more appropriate to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) rather than amending them one by one since there are a lot of provisions in the same themes or potential gaps in this chapter. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: FSS Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the themes/potential gaps identified in the first step. On the other hand, it could also be considered to amend the regulations or develop new instruments to ensure fire safety based on another concept. In such a case, one of the future issues to be addressed is how to evaluate the reduction of fire risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required. However, some considerations might be needed depending on the conditions or premises of this degree of autonomy.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in a consistent manner. Regarding the potential gaps and/or themes, the provisions should be amended to safely introduce remote operations with seafarers on board. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • The meanings of control stations and safety centre should be clarified. • Provisions regarding facilities such as alarms and indications should be amended so that remote operators can also be notified.

Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to apply regulation 17 "Alternative design and arrangements" to the provisions for systems and appliances which need manual operations or provisions requiring actions by personnel on board in regulations 4 to 23 other than 17 of SOLAS chapter II-2. On the other hand, regarding the provisions for systems and appliances which need manual operations, especially for fire fighting, it may be more appropriate to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) rather than amending them one by one since there are a lot of provisions in the same themes or potential gaps in this code. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• Since "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • The meanings of manned spaces, control stations and safety centre should be clarified. • Provisions regarding facilities such as alarms, indications, notification and means of escape should be amended. • Provisions regarding systems and appliances which need manual operations should be amended. • Provisions regarding accommodations and accessibility should be amended.

Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to apply regulation 17 "Alternative design and arrangements" to the provisions for systems and appliances which need manual operations or provisions requiring actions by personnel on board in regulations 4 to 23 other than 17 of SOLAS chapter II-2. On the other hand, regarding the provisions for systems and appliances which need manual operations, especially for fire fighting, it may be more appropriate to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) rather than amending them one by one since there are a lot of provisions in the same themes or potential gaps in this code. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: FTP Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Three	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Four	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.

Instrument: SOLAS Chapter III

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	Scored MASS application B for all regulations in the first step.	None

Degree Two	**I, II or III**	More than one way possible in order to capture the concept of remote control, the altered status of the navigation bridge therein, and the definition/role of the master in such a concept, related to the (emergency) process of evacuating persons on board and rescuing persons from the water.	Communications between remote operator and crew on board, definition and status of the navigation bridge, definition and role of the master (either on board or at the remote operator station).
Degree Three	**III**	The concept of unmanned MASS requires principle assumptions and new concept thinking related to the process of evacuating persons on board a ship carrying passengers and rescuing persons from the water that cannot just be accommodated by amending existing instruments or applying equivalents.	Availability of sufficient and qualified persons. Manning of survival craft and supervision of evacuation. Definition and role of the master. Definition and status of the navigation bridge. How to render assistance to other ships in distress, or recover persons from the water without crew on board. Goal and function of rescue boat and line-throwing appliance.
Degree Four	**III**	The concept of unmanned MASS requires principle assumptions and new concept thinking related to the process of evacuating persons on board a ship carrying passengers and rescuing persons from the water that cannot just be accommodated by amending existing instruments or applying equivalents.	Availability of sufficient and qualified persons. Manning of survival craft and supervision of evacuation. Definition and role of the master. Definition and status of the navigation bridge. How to render assistance to other ships in distress, or recover persons from the water without crew on board. Goal and function of rescue boat and line-throwing appliance.

Instrument: SOLAS chapter IV – Radiocommunications

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**II**	Potential gaps may be addressed by amending existing instrument, possibly as they are introduced.	• New terms and definitions • New requirements for automated processes and decision support system
Degree Two	**II, III**	Since remotely controlled operations have not been a part of this instrument, *developing a new instrument* would be the most appropriate way to address the requirements for remote control centres. In addition, necessity for new requirements and frequencies could be addressed by developing new instrument as well.	• New terms and definitions • Requirements for remote control stations' technical issues • Functional and maintenance requirements
Degree Three	**III**	Since remotely controlled operations have not been a part of this instrument, *developing a new instrument* would be the most appropriate way to address the requirements for remote control centres. In addition, necessity for new requirements and frequencies could be addressed by developing a new instrument as well.	• New terms and definitions • Requirements for remote control stations' technical issues • Functional and maintenance requirements • Radio watch requirements and radio personnel • Distress, safety and urgency calls and related requirements
Degree Four	**III**	Since fully autonomous ships with most probably having main control centre ashore have not been foreseen in this instrument, *developing new instrument* would be the most appropriate way to	• New terms and definitions Requirements for main control stations' technical issues • Functional and maintenance requirements • Radio watch requirements and radio personnel

		address the requirements for potential main control centres. In addition, necessity for new requirements and frequencies could be addressed by developing new instrument as well.	• Distress, safety and urgency calls and related requirements

Instrument: SOLAS chapter V

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**II**	For MASS of degree One, crew on board will still be responsible for ship operation including decision-making. For general application of decision-making functions and automated processes, a basic principle for adopting them are required to be developed and included in SOLAS (e.g. in Ch. I). If there are any specific decision-making functions or automated processes, such as "periodically unmanned bridge", then new regulations and performance standards are to be developed and included in SOLAS chapter V. Also, amendments/additions to definitions will be needed to accommodate the concept of MASS. In light of the above, modification to current instruments (option II) are considered as the most appropriate way for addressing the operation of degree One MASS.	1. Definitions 2. General provisions for decision-making functions and automated processes 3. Provisions and performance standards for defined specific decision-making functions and automated processes 4. Relationship between manning level and specific automated processes
Degree Two	**II, III**	For degree Two MASS, there are quite a few potential gaps identified involving many regulations.	1. Definitions 2. Requirements for remote control (location)

		Some require amendments to current provisions (items 1, 3, 4, 6, 7), while others require the reconstruction of regulations (for item 5). Moreover, new regulation/provisions will also need to be developed (requirements for remote control). In terms of this, two paralleled tracks are suggested: 1. Modify existing regulations for gaps require amendments; and 2. Accommodate functions of remote control and those require reconstruction in a new and dedicated instrument. Additional performance standards for some navigational equipment of remotely controlled MASS most likely also need to be developed. Separate guidelines (mandatory or non-mandatory) for these performance standards are suggested.	3. Definition, roles, responsibilities and qualification of Ship Master 4. Roles, responsibilities and qualification of crew or responsible personnel 5. Manning requirements (on board and at remote control location) 6. Carriage of equipment and the related performance standards 7. Ship-shore communications
Degree Three	**III**	For degree Three MASS, there are quite a few potential gaps identified involving many regulations. Some require amendments to current provisions (items 1, 3, 4, 5, 6, 7, 9, 13), while others require the reconstruction of regulations (for items 8, 10, 11, 12). Moreover, new regulation/provisions will also need to be developed (requirements for remote control). In terms of this, conducting large scale amendments to existing provision will not be an optimized way to address the issue. Remotely controlled MASS certainly will appear in the future. However, for a very long period, the large majority of the world's fleet will still be conventional ship. Therefore, large scale amendments of current regulations only to accommodate MASS operation seem to be unwise, which will also cause confusion and potential barriers for the application of existing provisions to conventional ships. On the other hand, developing a separate and dedicated mandatory instrument for MASS of this level to encompass all	1. Definitions 2. Requirements for remote control (location) 3. Definition, roles, responsibilities and qualification of Ship Master 4. Roles, responsibilities and qualification of crew or responsible personnel 5. Implication of MASS in SAR 6. Certificates and manuals on board 7. Carriage of equipment and the related performance standards 8. Manning requirements 9. Ship reporting and reporting method 10. Bridge design and visibility 11. Training and drilling 12. Onboard manual operation

		the provisions to mitigate gaps identified will be the solution with less complexity and easier to realize. Additional performance standards for some navigational equipment of remotely controlled MASS will also need to be developed. Separate guidelines (mandatory or non-mandatory) for these performance standards are suggested.	
Degree Four	**III**	For degree Four MASS, there are quite a few potential gaps identified involving many regulations. Some require amendments to current provisions (items 1, 2, 3, 4, 5, 7, 10), while others require the reconstruction of regulations (items 6, 8, 9). New regulation/provisions might also need to be developed. In terms of this, conducting large scale amendments to existing provision will not be an optimized way to address the issue. Autonomously operated MASS certainly will appear in the future. However, for a very long period, the large majority of world's fleet will still be conventional ship. Therefore, large scale amendments of current regulations only to accommodate MASS operation seem to be unwise, which will also cause confusion and potential barriers for the application of existing provisions to conventional ships. On the other hand, developing a separate and dedicated mandatory instrument for MASS of this level to encompass all the provisions to mitigate gaps identified will be the solution with less complexity and easier to realize. Additional performance standards for some navigational equipment of autonomously operated MASS will also need to be developed. Separate guidelines (mandatory or non-mandatory) for these performance standards are suggested.	1. Definitions 2. Definition, roles, responsibilities and qualification of Ship Master 3. Implication of MASS in SAR 4. Certificates and manuals on board 5. Carriage of equipment and the related performance standards 6. Bridge design and visibility 7. Ship reporting and reporting method 8. Training and drilling 9. Onboard manual operation (steering) and action (maintenance, pilot transfer) 10. Information transfer/ship-shore communication

Instrument: SOLAS chapter VI

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. On the other hand, another way could also be considered to amend the regulations or develop new instruments to introduce absolutely different emergency procedures in the case that there are no persons on board and the cargo does not include any harmful substances for the marine environment. In such a way, one of the future issues to be addressed is how to evaluate the reduction of risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have a huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in a consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) not amending them one by one, especially for the	• The meanings of "master", etc. • Systems and appliances which need manual operations. • Actions by personnel on board, such as emergency response and onboard inspection. Taking them into account, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues is how to establish the emergency procedures to deal with conditions of leakage, spillage or

		procedures to ensure safety of cargoes in normal and emergency conditions, since there are a lot of provisions in the same themes or potential gaps in this chapter. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	fire involving cargoes, as well as the procedures for ensuring safety in normal conditions.
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) not amending them one by one, especially for the procedures to ensure safety of cargoes in normal and emergency conditions, since there are a lot of provisions in the same themes or potential gaps in this chapter. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified	Ditto.

		interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	

Instrument: IMSBC Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. On the other hand, another way could also be considered to amend the regulations or develop new instruments to introduce absolutely different emergency procedures in the case that there are no persons on board and the cargo does not include any harmful substances for the marine environment. In such a way, one of the future issues to be addressed is how to evaluate the reduction of risks owing to absence of persons on board and to what extent we could relax the regulations.	

		The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.

Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in SOLAS chapter VI, not amending them one by one, especially for the procedures to ensure safety of cargoes in normal and emergency conditions. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• The meanings of "master", etc. • Actions by personnel on board, such as emergency response, onboard inspection and security responsibilities. • Instructions for onboard procedures. Taking them into account, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues is how to establish the emergency procedures to deal with conditions of leakage, spillage or fire involving cargoes, as well as the procedures for ensuring safety in normal conditions.
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in SOLAS chapter VI, not	Ditto.

		amending them one by one, especially for the procedures to ensure safety of cargoes in normal and emergency conditions. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	

Instrument: CSS Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the	

		discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as "B" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.
Degree Three	**II and/or III**	Ditto.	Since "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.
Degree Four	**II and/or III**	Ditto.	Ditto.

Instrument: Grain Code Part A and B

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.

		these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard inspection with the similar issues in SOLAS chapter VI and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction.	• The meanings of "master", etc. • Actions by personnel on board, such as inspection of the lashing or strapping during voyages. Taking into account the above potential gaps and/or themes identified, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues to be considered is how to establish the procedures for ensuring safety of cargoes in normal conditions.

		Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard inspection with the similar issues in SOLAS chapter VI and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: SOLAS chapter VII

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.

		these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard inspection with the similar issues in SOLAS chapter VI and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction.	• The meanings of "master", etc. • Actions by personnel on board, such as inspection of the lashing during voyages. • Instructions for onboard procedures. Taking into account the above potential gaps and/or themes identified, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues to be considered is how to establish the procedures for ensuring safety of cargoes in normal conditions.

		Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other themes/ potential gaps, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard inspection with the similar issues in SOLAS chapter VI and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, the Volunteering Members determined "II and/or III" as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: IMDG Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the themes/potential gaps identified in the first step. On the other hand, another way could also be considered to amend the regulations or develop new instruments to introduce absolutely different emergency procedures in the case that there are no persons on board and the cargo does not include any harmful substances for the marine environment. In such a way, one of the future issues to be addressed is how to evaluate the reduction of risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the procedures to ensure safety of cargoes in normal and emergency conditions, with the similar issues in	• The meanings of "master", etc. • Actions by personnel on board, such as supervision or inspection of ro-ro cargo space and judgement by the master in the event of incidents. Taking them into account, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues is how to establish the emergency procedures to deal with conditions of leakage, spillage or fire involving cargoes, as well as the procedures for ensuring safety in normal conditions.

		SOLAS chapter VI and VII and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other themes/ potential gaps, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the procedures to ensure safety of cargoes in normal and emergency conditions, with the similar issues in SOLAS chapter VI and VII and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: IBC Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. On the other hand, another way could also be considered to amend the regulations or develop new instruments to introduce absolutely different emergency procedures in the case that there are no persons on board and the cargo does not include any harmful substances for the marine environment. In such a way, one of the future issues to be addressed is how to evaluate the reduction of risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. Regarding the other themes/potential gaps, the provisions regarding facilities such as alarms should be amended to safely introduce remote operations with seafarers on board. On the other hand, as mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • Provisions regarding facilities such as alarms should be amended so that remote operators can also be notified.
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely	• The meanings of "master", etc. • Systems and appliances which need manual operations. • Actions by personnel on board, such as training in emergency procedures and fire fighting.

		introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the procedures to ensure safety of cargoes in normal and emergency conditions, with the similar issues in SOLAS chapter VI and VII and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• Accommodations, spaces normally entered during cargo-handling operations and accessibility. • Facilities such as alarms. Taking into account the above potential gaps and/or themes identified, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues to be considered is how to establish the emergency procedures to deal with conditions of leakage, spillage or fire involving cargoes, as well as the procedures for ensuring safety in normal conditions.
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the procedures to ensure safety of cargoes in normal and emergency conditions, with the similar issues in SOLAS chapter VI and VII and the associated codes, not amending them one by one.	Ditto.

		As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	

Instrument: IGC Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		"Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. On the other hand, another way could also be considered to amend the regulations or develop new instruments to introduce absolutely different emergency procedures in the case that there are no persons on board and the cargo does not include any harmful substances for the marine environment. In such a way, one of the future issues to be	

		addressed is how to evaluate the reduction of risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. Regarding the potential gaps and/or themes, the provisions regarding facilities such as alarms should be amended to safely introduce remote operations with seafarers on board. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the	• Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • Provisions regarding facilities such as alarms should be amended so that remote operators can also be notified.

		discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard supervision with the similar issues in SOLAS chapter VI and VII and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	• The meanings of "master", etc. • Definitions of normally entered spaces, cargo control room and cargo control station. • Systems and appliances which need manual operations. • Actions by personnel on board, such as supervision and fire fighting. • Facilities such as alarms. • Accommodations. Taking into account the above potential gaps and/or themes identified, for the carriage of cargoes by ships without persons on board during sailing, one of the important issues to be considered is how to establish the emergency procedures to deal with conditions of leakage, spillage or fire involving cargoes, as well as the procedures for ensuring safety in normal conditions.

Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for the onboard supervision with the similar issues in SOLAS chapter VI and VII and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: INF Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the themes/potential gaps identified in the first step. On the other hand, it could also be considered to amend the regulations or develop new instruments to ensure fire safety based on another concept. In such a case, one of the future issues to be addressed is how to evaluate the reduction of fire risks owing to absence of persons on board and to what extent we could relax the regulations. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	

Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the clarification of the term "master" and its similar words, consistent measures (e.g. amending or developing definition) should be taken considering its importance. All IMO instruments are provided subject to the existence of the master on board even if there is no explicit reference. Changing this precondition would have huge impact on the instruments. Therefore, amendment or clarification of these terms should be done carefully in consistent manner. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Since there is the possibility that "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified.
Degree Three	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce remote operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for fire fighting with the similar issues in SOLAS chapter	• Since "master", "crew", "responsible person", etc. are not on board, the meanings of such personnel of the ship should be clarified. • Provisions regarding systems and appliances which need manual operations (fixed fire-extinguishing arrangements) should be amended. • Provisions regarding facilities such as notification and shipboard emergency plan should be amended.

		II-2 and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Four	**II and/or III**	Regarding clarifications of "master", etc., see the comments in degree Two. Regarding the other potential gaps and/or themes, one way is to amend the provisions to safely introduce autonomous operations without seafarers on board. Another way is to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) for fire fighting with the similar issues in SOLAS chapter II-2 and the associated codes, not amending them one by one. As mentioned in the general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. However, easy measures such as developing unified interpretation (UI) should be avoided to prevent creating confusion and contradiction. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: SOLAS chapter IX

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	For MASS operation at degree One: - still personnel with certified competencies on board; - master still on board; and - no changes to the continued technological development of ships. No changes to instrument needed.	
Degree Two	**IV**	For MASS operation at degree Two: - process control remote (off the ship); - still personnel with certified competencies on board; - still available personnel with certified competencies with the possibility to take over; and - themes and potential gaps are with other instruments. No changes to instrument needed as long as the relevant potential gaps and/or themes are addressed in a new separate instrument addressing the particulars of MASS operation (MASS Code).	1. role and placement of master and crew 2. remote control station 3. remote operator 4. connectivity 5. cybersecurity
Degree Three	**III**	For MASS operation at degree Three:	1. role and placement of master and crew 2. remote control station 3. remote operator

		- process control remote (off the ship) or automated on board with intervention possibility from a remote location; and - themes and potential gaps are common with other instruments. If potential gaps are addressed in a new separate instrument, in order of consistency the most appropriate way is III.	4. connectivity 5. cybersecurity 6. fundamental issue regarding reduction of risks owing to the absence of persons on board 7. implication of MASS on search and rescue
Degree Four	**III**	For MASS operation at degree Four: - themes and potential gaps are common with other instruments. If potential gaps are addressed in a new separate instrument, in order of consistency the most appropriate way is III.	1. role and placement of master and crew 2. cybersecurity 3. fundamental issue regarding reduction of risks owing to the absence of persons on board 4. implication of MASS on search and rescue

Instrument: ISM Code

Degree of autonomy	**The most appropriate way(s) of addressing MASS operations (I, II, III, IV)**	**Reason for selecting the most appropriate way(s) of addressing MASS operations**	**Potential gaps/themes that require addressing**
Degree One	**IV**	For MASS operation at degree One: - still personnel with certified competencies on board; - master still on board; and - no changes to the continued technological development of ships. No changes to instrument needed.	

Degree Two	**IV**	For MASS operation at degree Two: - process control remote (off the ship); - still personnel with certified competencies on board; - still available personnel with certified competencies with the possibility to take over; and - themes and potential gaps are common with other instruments. No changes to instrument needed as long as the relevant themes and potential gaps are addressed in a new separate instrument addressing the particulars of MASS operation (MASS Code).	1. role and placement of master and crew 2. remote control station 3. remote operator 4. connectivity 5. cybersecurity
Degree Three	**III**	For MASS operation at degree Three: - process control remote (off the ship) or automated on board with intervention possibility from a remote location; and - themes and potential gaps are common with other instruments. If potential gaps are addressed in a new separate instrument, in order of consistency the most appropriate way is III.	1. role and placement of master and crew 2. remote control station 3. remote operator 4. connectivity 5. cybersecurity 6. fundamental issue regarding reduction of risks owing to the absence of persons on board 7. implication of MASS on search and rescue
Degree Four	**III**	For MASS operation at degree Four: - themes and potential gaps are common with other instruments. If potential gaps are addressed in a new separate instrument, in order of consistency the most appropriate way is III.	1. role and placement of master and crew 2. cybersecurity 3. fundamental issue regarding reduction of risks owing to the absence of persons on board 4. implication of MASS on search and rescue

Instrument: SOLAS chapter XI-1

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	This chapter does not require any amendments for degree One.	
Degree Two	**III**	The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified.	
Degree Three	**I, III**	No actions are needed to address the issue of onboard certificates at this moment. The FAL Committee approved FAL.5/Circ.39/Rev.2 on the Guidelines for the use of electronic certificates. The Committee further endorsed that, for the time being, it would be better to keep the guidelines as a FAL circular, and not to convert it to an Assembly resolution or incorporate it into the IMO Compendium, and to continue gathering experience with respect to the implementation of electronic certificates. The distinctive objectives of the CSR document in case of a MASS needs to be taken into account. The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified. For unmanned vessels the possibility for having atmosphere testing instruments provided at the port instead of a carriage requirement would be recommended.	

Degree Four	**I, III**	No actions are needed to address the issue of onboard certificates at this moment. The FAL Committee approved FAL.5/Circ.39/Rev.2 on the Guidelines for the use of electronic certificates. The Committee further endorsed that, for the time being, it would be better to keep the guidelines as a FAL circular, and not to convert it to an Assembly resolution or incorporate it into the IMO Compendium, and to continue gathering experience with respect to the implementation of electronic certificates. The distinctive objectives of the CSR document in case of a MASS needs to be taken into account. The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified. For unmanned vessels the possibility for having atmosphere testing instruments provided at the port instead of a carriage requirement would be recommended.	

Instrument: ESP Code 2011

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	ESP Code concerns mainly surveys of ships and therefore requires no actions.	
Degree Two	**IV**	ESP Code concerns mainly surveys of ships and therefore requires no actions.	
Degree Three	**IV**	ESP Code concerns mainly surveys of ships and therefore requires no actions. However, the practical solution of having survey report file with all supporting documents on board might need to be considered.	
Degree Four	**IV**	ESP Code concerns mainly surveys of ships and therefore requires no actions. However, the practical solution of having survey report file with all supporting documents on board might need to be considered.	

Instrument: RO Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	RO Code concerns monitoring, auditing and management, cooperations and functions of the Recognized Organizations including flag State obligations and therefore has no application to MASS.	
Degree Two	**IV**	RO Code concerns monitoring, auditing and management, cooperations and functions of the Recognized Organizations including flag State obligations and therefore has no application to MASS.	
Degree Three	**IV**	RO Code concerns monitoring, auditing and management, cooperations and functions of the Recognized Organizations including flag State obligations and therefore has no application to MASS.	
Degree Four	**IV**	RO Code concerns monitoring, auditing and management, cooperations and functions of the Recognized Organizations including flag State obligations and therefore has no application to MASS.	

Instrument: Casualty Investigation Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		If a vessel of technical abilities to be of degree Three or Four would be manned with certified seafarers, this would have the consequence that the vessel concerned would cease to be of degree Three or Four, and would become 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). Seafarers are assumed to be able to take control of a fully autonomous system if seafarers are on board. This philosophy was applied to degrees Three and Four throughout the assessment.	
Degree One	**IV**	No provisions preventing MASS, in need to be amended or clarified were identified.	
Degree Two	**II**	The definition of a seafarer needs to be amended to include personnel engaged in remote operation of the vessel. It needs to be clarified if the location of a remote control centre causes the State in which it is located to be a substantially interested State to an accident, which is not located within its waters, territories and jurisdiction or does not involve any legal entities or citizens of that State.	

Degree Three	**II**	The definition of a seafarer needs to be amended to include personnel engaged in remote operation of the vessel. It needs to be clarified if the location of a remote control centre causes the State in which it is located to be a substantially interested State to an accident, which is not located within its waters, territories and jurisdiction or does not involve any legal entities or citizens of that State.	
Degree Four	**II**	It needs to be clarified if the location of a remote control centre causes the State in which it is located to be a substantially interested State to an accident, which is not located within its waters, territories and jurisdiction or does not involve any legal entities or citizens of that State.	

Instrument: SOLAS chapter XI-2

Degree of autonomy	**The most appropriate way(s) of addressing MASS operations (I, II, III, IV)**	**Reason for selecting the most appropriate way(s) of addressing MASS operations**	**Potential gaps/themes that require addressing**
Degree One	**I, II**	There is a need to add a definition concerning MASS to the definitions.	
Degree Two	**II, III**	There is a need to add a definition concerning MASS to the definitions. The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified.	

		The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations.	
Degree Three	**II, III**	There is a need to add a definition concerning MASS to the definitions. The exemption allowed under SOLAS XI-2/11 will require broadening of scope from short international voyage to all voyages. This would limit the need to amend the Code. The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified. The ship security alert systems activating point required to be placed on the bridge needs to be considered holistically in conjunction with remote control requirements to be developed. The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations.	

Degree Four	**II, III**	There is a need to add a definition concerning MASS to the definitions. The circumstances when the master of the vessel is performing his or her duties from a location not on board the vessel needs to be clarified. The ship security alert systems activating point required to be placed on the bridge needs to be considered holistically in conjunction with remote control requirements to be developed. The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations.	

Instrument: ISPS Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	No amendments required to ISPS Code pending necessary amendments done to SOLAS chapter XI-2.	

Degree Two	**IV**	No amendments required to ISPS Code pending necessary amendments done to SOLAS chapter XI-2.	
Degree Three	**IV**	No amendments required to ISPS Code pending necessary amendments done to SOLAS chapter XI-2.	
Degree Four	**IV**	No amendments required to ISPS Code pending necessary amendments done to SOLAS chapter XI-2.	

Instrument: SOLAS chapter XII

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step. The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis	

		shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**II and/or III**	Regarding the potential gap and/or themes in the right column, the provisions should be amended to safely introduce remote operations with seafarers on board. On the other hand, it can also be considered to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in the other chapters in SOLAS. As mentioned in general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Provisions regarding facilities such as alarms should be amended so that remote operators can also be notified.
Degree Three	**II and/or III**	Regarding the potential gaps and/or themes in the right column, the provisions should be amended to safely introduce remote operations without seafarers on board. On the other hand, it can also be considered to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in the other chapters in SOLAS.	• Provisions regarding facilities such as alarms should be amended. • Provisions requiring actions by personnel on board, such as onboard maintenance, should be amended. • Provisions regarding accessibility should be amended.

		As mentioned in general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	
Degree Four	**II and/or III**	Regarding the potential gaps and/or themes in the right column, the provisions should be amended to safely introduce autonomous operations without seafarers on board. On the other hand, it can also be considered to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in the other chapters in SOLAS. As mentioned in general comments, it seems difficult to determine the most appropriate way at this stage because it might only be found during the discussion on the actual amendments. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Ditto.

Instrument: Bulk carrier bulkhead and double bottom strength standards

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Three	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Four	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.

Instrument: Standards for owners' inspection and maintenance of bulk carrier hatch covers

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Appropriate alternative safety measures should be adopted to achieve the equivalent functionalities intended by the existing regulations and resolve the potential gaps and/or themes identified in the first step.	

		The choice of the most appropriate way(s) of doing so would be affected by several issues, such as the scale of amendments and time it takes to be agreed. Some of them would be identified during the discussion on the actual amendments, and thus it seems difficult to determine the most appropriate way at this stage. Therefore, the following analysis shows options to be considered as the most appropriate way(s).	
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Three	**II and/or III**	Regarding the potential gap/theme, the provisions should be amended to safely introduce remote operations without seafarers on board. On the other hand, it can also be considered to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make the code mandatory) with the similar issues in the SOLAS Convention. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	Provisions requiring actions by personnel on board, such as onboard maintenance, should be amended.
Degree Four	**II and/or III**	Regarding the potential gap/theme, the provisions should be amended to safely introduce autonomous operations without seafarers on board. On the other hand, it can also be considered to develop new instruments (new code for SOLAS-related issues and new chapter in SOLAS to make	Ditto.

		the code mandatory) with the similar issues in the SOLAS Convention. Therefore, "II and/or III" were determined as the most appropriate way(s) of addressing MASS operations.	

Instrument: Standards and criteria for side structures of bulk carriers of single-side skin construction

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Two	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Three	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.
Degree Four	**IV**	"MASS application" of all regulations were identified as ".B" and no action is required.	None.

Instrument: SOLAS chapter XIII

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Two	**IV**	MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Three	**IV**	MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.
Degree Four	**IV**	MASS application" of all regulations were identified as ".B" or ".D" and no action is required.	None.

Instrument: SOLAS chapter XIV

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	This chapter does not require any amendments.	
Degree Two	**IV**	This chapter does not require any amendments.	
Degree Three	**IV**	This chapter does not require any amendments.	
Degree Four	**IV**	This chapter does not require any amendments.	

Instrument: Polar Code

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	The Polar Code applies to MASS and requires no actions for degree One.	
Degree Two	**III**	The Polar Code is an add-on to the requirements of the SOLAS Convention, and the issue of remote operation of vessels from a remote control operational centre cannot be regulated by a sub-regulation to the Convention. The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations.	
Degree Three	**I, III**	*Electronic Certificates* No actions are needed to address the issue of onboard certificates at this moment. The FAL Committee approved FAL.5/Circ.39/Rev.2 on the Guidelines for the use of electronic certificates. The Committee further endorsed that, for the time being, it would be better to keep the guidelines as a FAL circular, and not to convert it to an Assembly	

		resolution or incorporate it into the IMO Compendium, and to continue gathering experience with respect to the implementation of electronic certificates. *Remote Control Centres* The Polar Code is an add-on to the requirements of the SOLAS Convention, and the issue of remote operation of vessels from a remote control operational centre cannot be regulated by a sub-regulation to the Convention. The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations. *Life-saving appliances* The requirement for life-saving appliances on degree Three might be in need of further consideration. However, this possible requirement needs to be addressed at a convention level. The requirements in the Polar Code regarding life-saving appliances are add-ons to the requirements specified in the SOLAS Convention, and therefore these requirements apply only if the equipment is fitted, and no amendments are required.	

Degree Four	**I, III**	*Electronic Certificates* No actions are needed to address the issue of onboard certificates at this moment. The FAL Committee approved FAL.5/Circ.39/Rev.2 on the Guidelines for the use of electronic certificates. The Committee further endorsed that, for the time being, it would be better to keep the guidelines as a FAL circular, and not to convert it to an Assembly resolution or incorporate it into the IMO Compendium, and to continue gathering experience with respect to the implementation of electronic certificates. *Remote Control Centres* The Polar Code is an add-on to the requirements of the SOLAS Convention, and the issue of remote operation of vessels from a remote control operational centre cannot be regulated by a sub-regulation to the Convention. The issue of remote control operational centres needs to be regulated at the instrument level where onboard command or manual operation is considered as a mandatory requirement. As the remote control operational centres will affect all instruments, it is deemed that the most appropriate way of addressing the issue is by a new instrument dedicated to the distinct features of MASS operations. *Life-saving appliances* The requirement for life-saving appliances on degree Three might be in need of further consideration. However, this possible requirement needs to be addressed at a convention level. The requirements in the Polar Code regarding life-saving appliances	

		are add-ons to the requirements specified in the SOLAS Convention, and therefore these requirements apply only if the equipment is fitted, and no amendments are required.	

Instrument: STCW Convention

Degree of Autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reasons for selecting the most appropriate way(s) of addressing MASS operations
Degree One	**I and/or II**	With seafarers serving on board, the Convention and Code in its entirety remains applicable to MASS. Some requirements may need to be amended based on the introduction of new technologies and/or automated processes. Changes can be made through the existing Convention processes and flexibilities – through authorized equivalencies or amendments to the codes or regulations.
Degree Two	**I and/or II**	**<u>Option 1</u>** – Determination that "remote operator is a seafarer" .1 Changes to the Convention and Code to establish definitions and provisions to include the "remote operator" can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the codes or regulations. .2 Some requirements applicable to seafarers may need to be amended to: 1) introduce new technologies and/or automated processes; and 2) address the relationship of the "remote operator" with other seafarers serving on board. These changes can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the codes or regulations.
	I and/or II and or III	**<u>Option 2</u>** – Determination that "remote operator is not a seafarer" .1 Provisions necessary to address the "remote operator" could be established through either: 1) existing instrument(s) other than the STCW Convention and Code; or 2) a new instrument.

		.2 Some requirements applicable to seafarers may need to be amended to: 1) introduce new technologies and/or automated processes; and 2) address the relationship between the "remote operator" and other seafarers serving on board. These changes can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the codes or regulations.
Degree Three	**I and/or II**	**Option 1** – Determination that "remote operator is a seafarer" .1 Changes to establish definitions and provisions to include the "remote operator" can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the codes or regulations. .2 There are no trained and qualified seafarers serving on board to perform the operational functions on board the vessel.
	III	**Option 2** – Determination that "remote operator is not a seafarer" .1 Consistent with the first step assumptions, new provisions necessary to address the "remote operator" will need to be established through either: 1) existing instrument(s) other than the STCW Convention and Code; or 2) a new instrument. The provisions will need to include the relationship between seafarers on board and the "remote operator". However, this relationship will also need to be established in the STCW Convention through the existing processes and other flexibilities – through authorized equivalencies or amendments to the codes or regulations. .2 There are no trained and qualified seafarers serving on board to perform the operational functions on board the vessel. Article 3 (Application) of the STCW Convention stipulates that the Convention applies only to "seafarers serving on board seagoing ships entitled to fly the flag of a Party…".
Degree Four	**IV**	There are no trained and qualified seafarers serving on board to perform the operational functions on board the vessel.

Instrument: STCW-F Convention

Degree of Autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reasons for selecting the most appropriate way(s) of addressing MASS operations
Degree One	**I and/or II**	With personnel serving on board fishing vessels, the Convention in its entirety remains applicable to MASS. Some requirements may need to be amended based on the introduction of new technologies and/or automated processes. Changes can be made through the existing Convention processes and flexibilities – through authorized equivalencies or amendments to the regulations.
Degree Two	**I and/or II**	**Option 1** – Determination that "remote operator is a personnel serving on board seagoing fishing vessel" 1 Changes to the Convention and Code to establish definitions and provisions to include the "remote operator" can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the regulations. 2 Some requirements applicable to personnel serving onboard seagoing fishing vessels may need to be amended to: .1 introduce new technologies and/or automated processes; and .2 address the relationship of the "remote operator" with other personnel serving on board. These changes can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the regulations.

	I and/or II and/or III	**<u>Option 2</u>** – Determination that "remote operator is not a personnel serving on board seagoing fishing vessel" 1 Consistent with the step 1 assumptions, provisions necessary to address the "remote operator" could be established through either: .1 existing instrument(s) other than the STCW-F Convention; or .2 a new instrument. 2 Some requirements applicable to seafarers may need to be amended to: .1 introduce new technologies and/or automated processes; and .2 address the relationship between the "remote operator" and other personnel serving on board fishing vessel. These changes can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the regulations.
Degree Three	**I and/or II**	**<u>Option 1</u>** – Determination that "remote operator is a personnel serving onboard seagoing fishing vessel" 1 Changes to establish definitions and provisions to include the "remote operator" can be made through the existing Convention processes and other flexibilities – through authorized equivalencies or amendments to the regulations. 2 There are no trained and qualified personnel serving onboard fishing vessel to perform the operational functions on board the vessel.
	III	**<u>Option 2</u>** – Determination that "remote operator is not a personnel serving onboard seagoing fishing vessel" 1 Consistent with the step 1 assumptions, provisions necessary to address, new provisions necessary to address the "remote operator" will need to be established through either: .1 existing instrument(s) other than the STCW-F Convention; or .2 a new instrument.

		The provisions will need to include the relationship between personnel on board and the "remote operator". However; this relationship will also need to be established in the STCW-F Convention through the existing processes and other flexibilities – through authorized equivalencies or amendments to the regulations. 2 There are no trained and qualified seafarers serving on board to perform the operational functions on board the vessel. Article 3 (Application) of the STCW-F Convention stipulates that the Convention applies only to "personnel serving onboard seagoing fishing vessels entitled to fly the flag of a Party".
Degree Four	**IV**	There are no trained and qualified personnel serving on board seagoing fishing vessels to perform the operational functions on board the vessel.

Instrument: COLREG 1972

Degree of Autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**I**	Some of the ways in which bridge watchkeeping and other operations on board will be carried out on MASS will result in distortion or a lack of clarity within COLREG. Degree One is expected to be the least disruptive and as a result the group feels equivalences as provided for by the instrument or developing interpretations will act as the best means to address this degree.	Terminology, lights, shapes and sound signals, role of master
Degree Two	**I and/or II**	Some of the ways in which bridge watchkeeping and other operations on board will be carried out on MASS will result in distortion or a lack of clarity within COLREG. Degree Two will serve as the intermediary point between degree One and degree Three and will result in control potentially being shifted to a remote location, as a result it is felt that either equivalences or interpretations as well as the amending of existing instruments will allow for the necessary distortion caused by this new approach to be addressed.	Terminology, lights, shapes and sound signals, role of master, responsibility of the remote operator
Degree Three	**I and/or II**	Degree Three represents the biggest shift in shipping and will require necessary amendments to COLREG in order to align itself with future autonomous shipping without seafarers on board and bringing about a significant reduction in the level of human interaction. It is agreed that COLREG in its current form is still the reference point and should retain as much of its current content as possible.	Terminology, lights, shapes and sound signals, role of master, responsibility of the remote operator, distress signals

Degree Four	**II**	Degree Four represents the most future concept in shipping and will require necessary amendments to COLREG in order to align itself with future autonomous shipping as a direct result of the lack of seafarers on board in any capacity. It is agreed that COLREG in its current form is still the reference point and should retain as much of its current content as possible.	Terminology, lights, shapes and sound signals, role of master, responsibility of the remote operator, distress signals

Instrument: CSC

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Themes/potential gaps that require addressing
Degree One	**IV**	"MASS application" of all articles of the Convention was ".B" or ".D" and no action is required.	None.
Degree Two	**IV**	"MASS application" of all articles of the Convention was ".B" or ".D" and no action is required.	None.
Degree Three	**IV**	"MASS application" of all articles of the Convention was ".B" or ".D" and no action is required. At the commenting stage, one member chose "II and/or III" with a comment that "Communication between ship and port should be considered involving remote control centre." However, CSC 1972 does not include any provision regarding communication between ship and port.	None.
Degree Four	**IV**	Ditto.	None.

Instrument: IMO Instruments Implementation Code (III Code)

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	All provisions of the code are applicable to degree One MASS.	None.
Degree Two	**II**	Some parts of the Code, such as obligations of flag, coastal and port States, may need revision to account for additional/alternate/equivalent responsibilities in relation to MASS operating in degree Two.	Additional/alternate/equivalent responsibilities arising out of amendments to instruments referred to, within the III Code.
Degree Three	**II**	Some parts of the Code, such as obligations of flag, coastal and port States, may need revision to account for additional/alternate/equivalent responsibilities in relation to MASS operating in degree Three.	Additional/alternate/equivalent responsibilities arising out of amendments to instruments referred to, within the III Code.
Degree Four	**II**	Some parts of the Code, such as obligations of flag, coastal and port States, may need revision to account for additional/alternate/equivalent responsibilities in relation to MASS operating in degree Four.	Additional/alternate/equivalent responsibilities arising out of amendments to instruments referred to, within the III Code.
General		The provisions of the III Code, are relevant to all degrees of MASS. Some parts of the Code, such as obligations of the flag, coastal and port States may need revision to account for additional/alternate/ equivalent responsibilities in relation to MASS operating in degrees Two, Three and Four. As the III Code deals with the implementation of IMO instruments in general, additional requirements arising out of amendments to IMO instruments may need to be accounted for.	

Instrument: International Code on Intact Stability, 2008 (2008 IS Code) – Part A

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	Part A of the IS Code remains relevant, as written to this category of MASS.	None.
Degree Two	**II**	With regard to regulations referring to "master", amendment may be required in order to clarify the equivalent responsible authority, in the remote operation mode.	Since, degree Two MASS operates in the remote operation mode, the term "master" needs to be clarified, whether it would include the "person in command" during remote operation mode.
Degree Three	**II**	With regard to regulations referring to "master", amendments may be required in order to clarify the equivalent responsible authority, in degree Three.	As a degree Three MASS is remotely operated, the term "master" needs to be clarified, whether it would include the "person in command" during remote operation mode.
Degree Four	**II**	With regard to regulations referring to "master", amendments may be required in order to clarify the equivalent responsible authority, in degree Four.	As a degree Four MASS is fully autonomous, the term "master" needs to be clarified to identify an equivalent responsible Authority.
General		In general, Part A of the IS code is considered relevant to all degrees of MASS. For MASS of degree Two, Three and Four, with regard to references to "master" used in sections of Part A, amendments may be required as identified for the respective categories of MASS.	

Instrument: Protocol of 1988 relating to LL 1966 (LL PROT 1988)

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	"MASS application" of all regulations were identified as ".B" in step 1 and no action is required.	None.
Degree Two	**IV**	"MASS application" of all regulations were identified as ".B" in step 1 and no action is required.	None.
Degree Three	**IV**	"MASS application" of all regulations were identified as ".B" in step 1 and no action is required.	None.
Degree Four	**IV**	"MASS application" of all regulations were identified as ".B" in step 1 and no action is required.	None.
General		LL PROT 1988 is considered to generally apply to all degrees of MASS with the understanding that they will be considered as New Ships, under the Convention.	

Instrument: International Convention on Load Lines, 1966 (LL 1966)

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing

Degree One	**II**	"MASS application" of most regulations were identified as ".B" in Step 1. Minor amendments may be required to generic sections such as application, definitions etc. to address the inclusion of this new category of Vessel (degree One MASS).	Minor amendments may be required to generic sections such as application, definitions etc. to address the inclusion of this new category of Vessel (degree One MASS).
Degree Two	**II**	With regard to regulations referring to "master", amendment may be required in order to clarify the equivalent responsible authority, in the remote operation mode.	Since the vessel operates in the remote operation mode, the term "master" needs to be clarified, whether it would include the "person in command" during remote operation mode.
Degree Three	**II**	With regard to regulations referring to "master", amendments may be required in order to clarify the equivalent responsible authority, in degree Three. Additionally, provisions which presume/require manual intervention for their application may need amendment owing to no seafarers being present on board. The LL 1966 contains several provisions for protection of the crew (i.e. guard rails elevated walkways etc.). For ships without seafarers on board (i.e. autonomy degrees Three and Four) these features are not necessary. However, whether protection arrangements should still be required, needs to be addressed.	As a degree Three vessel is remotely operated, the term "master" needs to be clarified, regarding whether it would include the "person in command" during remote operation mode. Provisions which presume/require manual intervention for their application may need amendments owing to the absence of seafarers on board.
Degree Four	**II**	With regard to regulations referring to "master", amendments may be required in order to clarify the equivalent responsible authority, in degree Four. Additionally, provisions which presume/ require manual intervention for their application may need adjustment owing to no seafarers being present on board. The LL 1966 contains several provisions for protection of the crew (i.e. guard rails elevated walkways, etc.). For ships without seafarers on board (i.e. autonomy degrees Three and Four) these features are not necessary. However, whether protection arrangements should still be required, needs to be addressed.	As a degree Four vessel is fully autonomous, the term "master" needs to be clarified to identify an equivalent responsible Authority. Provisions which presume/require manual intervention is a gap for this category of vessel, owing to absence of seafarers on board.

General		Articles of LL 1966, as amended by LL PROT 88: While most articles can be retained as they are, amendments may be required to address the following issues to cater for MASS. Potential gaps and/or themes that require addressing for specific gaps that have been identified for Articles: Article 2 – Definitions: Where new definitions may need to be added based on the amendments to other articles and annexes. Article 14 – Initial, Renewal and Annual Surveys: Where it may be clarified that the surveying of all listed items in para. 1(c) may not be applicable to MASS without seafarers on board. Article 21 – Control: Where it should be clarified as to how to implement control measures for MASS without seafarers on board. General: The concept of assigning freeboards and Load Line Marks remain relevant in the context of safety of all degrees of MASS, and hence most regulations remain applicable to all categories of MASS, with amendments being required for categories of MASS without crew on board (degrees Three and Four), in relation to activities requiring manual intervention/presence of crew on board. Further, there are explicit/implicit assumptions in the LL 1966 "General notes" that certain pre-departure functions will be accomplished by master and crew (safe loading, ballasting, stability, stowage, etc.). For MASS without seafarers on board, responsibility for these pre-departure functions needs to be addressed. With respect to the LL 1966 certificate and Record of Conditions of Assignment, consideration should be given to whether or not these need to include a notation regarding the vessel's autonomous status.	

Instrument: International Convention on Maritime Search and Rescue, 1979 (SAR Convention). France, Spain and Turkey

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree One	**IV**	Since no potential gaps have been identified none of the first three ways of addressing such MASS operation have been selected. Therefore, this degree would meet the provisions of the SAR Convention as it is.	None
Degree Two	**II**	Tacit acceptance procedure for amendments is not applicable to paragraphs 2.1.4, 2.1.5, 2.1.7, 2.1.10, 3.1.2, and 3.1.13. No gap has been identified in those paragraphs; therefore, any amendment to the Convention is likely to be feasible using tacit acceptance procedure. The SAR system, as it stands, is globally able to cope with the emergence of autonomous vessels. Mostly potential gaps need clarification which may be addressed most appropriately by amendments. The way the SAR Convention should be adapted taking into account the adaptation of the COLREG and SOLAS chapters IV and V.	Ability of MASS to perform as SAR facility, on-scene coordinator or alerting post. (2.1.1, 2.1.9, 2.2, 2.3, 2.5, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.4, 4.5 and 4.7) Reference to the master (3.1.9)
Degree Three	**II**	Tacit acceptance procedure for amendments is not applicable to paragraphs 2.1.4, 2.1.5, 2.1.7, 2.1.10, 3.1.2, and 3.1.13. No gap has been identified in those paragraphs; therefore, any amendment to the	Inconsistency between the concept of "rescue" and "distress" with regard to unmanned MASS being considered as "vessel and other craft".1.3.11, 1.3.12, 1.3.13, and potentially 1.3.7 and 1.3.9

		Convention is likely to be feasible using tacit acceptance procedure. The SAR system, as it stands, is globally able to cope with the emergence of autonomous vessels. Mostly potential gaps need clarification which may be addressed most appropriately by amendments. The way the SAR Convention should be adapted taking into account the adaptation of the COLREG and SOLAS chapters IV and V.	Ability of MASS to perform as SAR facility, on-scene coordinator or alerting post. (2.1.1, 2.1.9, 2.2, 2.3, 2.5, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.4, 4.5 and 4.7) Reference to the master (3.1.9)
Degree Four	**II**	Tacit acceptance procedure for amendments is not applicable to paragraphs 2.1.4, 2.1.5, 2.1.7, 2.1.10, 3.1.2, and 3.1.13. No gap has been identified in those paragraphs; therefore, any amendment to the Convention is likely to be feasible using tacit acceptance procedure. The SAR system, as it stands, is globally able to cope with the emergence of autonomous vessels. Mostly potential gaps need clarification, which may be addressed most appropriately by amendments. The way the SAR Convention should be adapted taking into account the adaptation of the COLREG and SOLAS chapters IV and V.	Inconsistency between the concept of "rescue" and "distress" with regard to unmanned MASS being considered as "vessel and other craft".1.3.11, 1.3.12, 1.3.13, and potentially 1.3.7 and 1.3.9 Ability of MASS to perform as SAR facility, on-scene coordinator or alerting post. (2.1.1, 2.1.9, 2.2, 2.3, 2.5, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.4, 4.5 and 4.7) Reference to the master (3.1.9)

Instrument: International Tonnage Convention on Tonnage Measurement of Ships, 1969

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
General		Generally, the TONNAGE 1969 Convention is equally applicable to MASS and non-MASS operations. However, for degrees of autonomy Two, Three and Four, article 2, regulation 2 and possibly also regulation 6 may require appropriate interpretations to provide clarifications and avoid ambiguities.	
Degree One	**IV**	At the RSE for the first step all articles and regulations were decided to be MASS application ".B", i.e. apply to MASS and do not prevent MASS operations and require no actions.	None.
Degree Two	**I**	At the RSE for the first step there was general consensus[1] that all articles and regulations were decided to be MASS application ".B" except for article 2 and regulation 2. Since both article 2 (Definitions) and regulation 2 (Definitions of terms used in the annexes) relates definitions it is expected these definition issues can be addressed through appropriate interpretation(s). Note 1: at the commenting stage at the first step United Kingdom disagreed with MASS application ".B" for regulation 6.	Definition of master, crew and passenger needs to be clarified in the context of MASS operation. This clarification could be addressed through developing interpretations. The calculation of volumes (Reg. 6) that are included in the calculation of gross and net tonnages may need to be further considered. Therefore, the reason for UK's disagreement with MASS application ".B" for Reg. 6 (Calculation of Volumes) needs to be identified to see if it can be addressed through interpretation(s).

Degree of autonomy	The most appropriate way(s) of addressing MASS operations (I, II, III, IV)	Reason for selecting the most appropriate way(s) of addressing MASS operations	Potential gaps/themes that require addressing
Degree Three	**I**	At the RSE for the first step there were general consensus[1] that all articles and regulations were decided to be MASS application ".B" except for article 2 and regulation 2. Since both article 2 (Definitions) and regulation 2 (Definitions of Terms used in the annexes) relates definitions it is expected these definition issues can be addressed through appropriate interpretation(s). Note 1: at the commenting stage at the first step United Kingdom disagreed with MASS application ".B" for regulation 6.	Definition of master, crew and passenger needs to be clarified in the context of MASS operation. This clarification could be addressed through developing interpretations. The calculation of volumes (Reg. 6) that are included in the calculation of gross and net tonnages may need to be further considered. Therefore, the reason for United Kingdom's disagreement with MASS application ".B" for Reg. 6 (Calculation of volumes) needs to be identified to see if it can be addressed through interpretation(s).
Degree Four	**I**	At the RSE for the first step there were general consensus[1] that all articles and regulations were decided to be MASS application ".B" except for article 2 and regulation 2. Since both article 2 (Definitions) and regulation 2 (Definitions of terms used in the annexes) relates definitions it is expected these definition issues can be addressed through appropriate interpretation(s). Note 1: at the commenting stage at the first step United Kingdom disagreed with MASS application ".B" for regulation 6.	Definition of master, crew and passenger needs to be clarified in the context of MASS operation. This clarification could be addressed through developing interpretations. The calculation of volumes (Reg. 6) that are included in the calculation of gross and net tonnages may need to be further considered. Therefore, the reason for United Kingdom's disagreement with MASS application ".B" for Reg. 6 (Calculation of volumes) needs to be identified to see if it can be addressed through interpretation(s).

Appendix 3

REFERENCES TO IMO DOCUMENTS PUBLISHED BEFORE AND DURING THE RSE

MSC documents

MSC 98/20/2	Denmark, Estonia, Finland, Japan, Netherlands, Norway, Republic of Korea, United Kingdom and United States	Maritime Autonomous Surface Ships Proposal for a regulatory scoping exercise
MSC 98/20/13	ITF	Comments on document MSC 98/20/2
MSC 98/23	Secretariat	Report of the Maritime Safety Committee on its ninety-eighth session
MSC 99/5	Secretariat	Comments on the regulatory scoping exercise
MSC 99/5/1	IFSMA and ITF	Comments and proposals on the way forward for the regulatory scoping exercise
MSC 99/5/2	ICS	Proposals for the development of a work plan
MSC 99/5/3	Finland, Liberia, Singapore, South Africa, Sweden	Recommendations on identification of potential amendments to existing IMO instruments
MSC 99/5/4	France	Considerations on and proposals for the methodology to use within the framework of the regulatory scoping exercise
MSC 99/5/5	Australia, Canada, Denmark, Estonia, Finland, Japan, Netherlands, Norway, Singapore, Sweden, United Kingdom, United States, IMarEST and IMCA	Plan of approach for the scoping exercise
MSC 99/5/6	Finland	Considerations on definitions for levels and concepts of autonomy
MSC 99/5/7	China and Finland	Proposal on the work plan of the regulatory scoping exercise for the use of MASS
MSC 99/5/8	China and Liberia	Recommendations on categorization and regulatory scoping exercise of MASS
MSC 99/5/9	Japan	Japan's perspective on regulatory scoping exercise for the use of MASS
MSC 99/5/10	ITF	General comments on a way forward
MSC 99/5/11	Turkey	Comments on documents MSC 99/5, MSC 99/5/2, MSC 99/5/5, MSC 99/5/8 and MSC 99/5/9
MSC 99/5/12	United States	Comments on document MSC 99/5/5
MSC 99/INF.3	Denmark	Final Report: Analysis of Regulatory Barriers to the use of Autonomous Ships
MSC 99/INF.5	IFSMA and ITF	Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)

MSC 99/INF.8	CMI	Work conducted by the CMI International Working Group on Unmanned ships
MSC 99/INF.13	Finland	Establishing international test area "Jaakonmeri" for autonomous vessels
MSC 99/INF.14	Japan	Studies conducted in Japan on mandatory regulations relating to Maritime Autonomous Surface Ships – SOLAS, STCW and COLREGs
MSC 99/INF.16	Norway	Presentation by Norway on 21 May 2018 on the "YARA Birkeland" development
MSC 99/WP.9	Secretariat	Report of the Working Group on Maritime Autonomous Surface Ships (MASS)
MSC 99/22	Secretariat	Report of the Maritime Safety Committee on its ninety-ninth session
MSC 100/5	Finland	Report of the Correspondence Group on MASS
MSC 100/5/1	ISO	Proposal for a classification scheme for degrees of autonomy
MSC 100/5/2	Norway and BIMCO	Interim guidelines for MASS trials
MSC 100/5/3	Republic of Korea	Proposals for the development of interim guidelines for Maritime Autonomous Surface Ships (MASS) trials
MSC 100/5/4	Secretariat	Comments on document MSC 100/5
MSC 100/5/5	Japan	Comments on document MSC 100/5
MSC 100/5/6	Australia, Denmark, Finland, France and Turkey	Comments on document MSC 100/5
MSC 100/5/7	China	Comments on document MSC 100/5
MSC 100/5/8	United States	Comments on document MSC 100/5
MSC 100/INF.3	Secretariat	Initial review of IMO instruments under the purview of MSC
MSC 100/INF.6	China	Preliminary analysis of the International Regulations for Preventing Collisions at Sea, 1972
MSC 100/INF.10	Republic of Korea	Results of technology assessment on Maritime Autonomous Surface Ships (MASS)
MSC 100/WP.8	Secretariat	Report of the Working Group on Maritime Autonomous Surface Ships (MASS)
MSC 100/20	Secretariat	Report of the Maritime Safety Committee on its 100th session
MSC 101/5	Secretariat	Status report – Progress of the regulatory scoping exercise
MSC 101/5/1	ITF	Comments and proposals for interim guidelines for MASS trials
MSC 101/5/2	China	The initial review of the mandatory IMO instruments related to maritime safety and security
MSC 101/5/3	China	Proposals on key aspects of the interim guidelines for MASS trials

MSC 101/5/4	Finland and France	Proposal for terms to be avoided, recommended terms and draft of glossary
MSC 101/5/5	Finland, Japan, Norway, Republic of Korea, Singapore, United Arab Emirates and BIMCO	Interim guidelines for MASS trials
MSC 101/5/6	Republic of Korea	Comments on documents MSC 101/5/5 and MSC 101/INF.17
MSC 101/INF.17	Finland, Japan, Norway and Republic of Korea	Draft interim guidelines for MASS trials
MSC 101/WP.8	Secretariat	Report of the Working Group on Maritime Autonomous Surface Ships (MASS)
MSC 101/24	Secretariat	Report of the Maritime Safety Committee on its 101st session
MSC 102/5	Secretariat	Status report – progress of the regulatory scoping exercise
MSC 102/5/1	Secretariat	Report of the Intersessional Working Group on Maritime Autonomous Surface Ships
MSC 102/5/2*	IFSMA	Comments on document MSC 102/5/1 – potential gaps and themes regarding the role of the shipmaster
MSC 102/5/3	Marshall Islands	Summary of results of the second step and conclusion of the RSE for the International Regulations for Preventing Collisions at Sea 1972 (COLREG)
MSC 102/5/4	Belgium, China, Netherlands	Summary of results of the second step of the RSE for SOLAS chapter III and the LSA Code
MSC 102/5/5	India	Summary of results of the second step of the RSE for LL 1966, LL PROT 1988, IS Code Part A and III Code
MSC 102/5/6	France	Summary of results of the second step of the RSE for SOLAS chapter II-1
MSC 102/5/7	Germany	List of common potential gaps/themes identified during the first step of RSE for STCW Convention and Code, STCW-F, SOLAS, ISM Code, TONNAGE 1969, LL 1966, LL PROT 1988, IS Code, III Code, COLREG and SAR 1979
MSC 102/5/8	Liberia	Summary of results of the RSE for the International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE 1969)
MSC 102/5/9	China	Summary of results of the second step of the RSE for SOLAS chapter V
MSC 102/5/10	Finland	Summary of results of the second step of the RSE for SOLAS chapter XI-1 and related codes
MSC 102/5/11	Finland	Summary of results of the second step of the RSE for SOLAS chapter XI-2 and the ISPS Code
MSC 102/5/12	Finland	Summary of results of the second step of the RSE for SOLAS chapter XIV and the Polar Code
MSC 102/5/13	France, Spain	Summary of results of the second step of the RSE for SAR 1979 Convention

MSC 102/5/14*	Russian Federation	Development of interim regulatory measures for operation of MASS in the Russian Federation
MSC 102/5/15	Turkey	Summary of the results of the second step of the RSE for SOLAS chapter IV
MSC 102/5/16*	CMI	Summary of results of analysis of IMO instruments under the purview of the Maritime Safety Committee
MSC 102/5/17	United States	Summary of results of the second step of the RSE for STCW Convention and Code
MSC 102/5/18	ISO	Proposed terminology for MASS
MSC 102/5/19	Japan	Summary of results of the second step of the RSE for SOLAS chapter II-2 and associated codes
MSC 102/5/20	Japan	Summary of results of the second step of the RSE for SOLAS chapter VI and associated codes
MSC 102/5/21	Japan	Summary of results of the second step of the RSE for SOLAS chapter VII and associated codes
MSC 102/5/22	Japan	Summary of the results of the second step of the RSE for SOLAS chapter XII and associated standards
MSC 102/5/23	Japan	Summary of the results of the second step of the RSE for SOLAS chapter XIII
MSC 102/5/24	Japan	Summary of the results of the second step of the RSE for CSC 1972
MSC 102/5/25	Norway	Summary of results of the second step of the RSE for SOLAS chapter IX and the ISM Code
MSC 102/5/26	Japan	Summary of the results of the second step of the RSE for the STCW-F Convention
MSC 102/5/27	Japan	Japan's perspective on further work after the completion of the RSE
MSC 102/5/28*	IMSO	Comments on document MSC 102/5/1 – potential gaps and themes regarding connectivity, cybersecurity and the implication of MASS on search and rescue
MSC 102/5/29	Russian Federation	Ongoing MASS trials in the Russian Federation
MSC 102/5/30	Republic of Korea	Comments on documents MSC 102/5/1, MSC 102/5/2 and MSC 102/5/7
MSC 102/5/31	Republic of Korea	Comments on document MSC 102/5/18
MSC 102/5/32	China	Comments on document MSC 102/5/1
MSC 102/INF.8	Japan	Report on MASS trials conducted in accordance with the Interim Guidelines for MASS trials
MSC 102/INF.17	Finland	Strategic themes in MASS perspective
MSC 103/5	IACS	Comments on documents MSC 102/5/1, MSC 102/5/7, MSC 102/5/27, MSC 102/5/32 and MSC 102/5/18
MSC 103/5/1	Republic of Korea	Comments on the potential gaps and themes identified by the results of the RSE
MSC 103/5/2	Islamic Republic of Iran	Comments on documents MSC 102/5/18, MSC 102/5/7 and MSC 103/5 and "common and goal-based understanding on these main issues, common potential gaps and themes identified during the RSE".

MSC 103/5/3	ISO	Comments on document MSC 102/5/18
MSC 103/5/4	Japan	Comments on documents MSC 102/5/9, MSC 102/5/11, MSC 102/5/15 and MSC 102/5/27
MSC 103/5/5	China	Comments on document MSC 102/5/3
MSC 103/5/6	China	Comments on document MSC 102/5/7
MSC 103/5/7*	Russian Federation	Comments on document MSC 102/5/14
MSC 103/5/8*	Russian Federation	Comments on document MSC 102/5/14
MSC 103/5/9	Russian Federation	Comments on document MSC 102/5/29
MSC 103/5/10*	Russian Federation	Comments on documents MSC 102/5/1, MSC 102/5/3 and MSC102/5/4
MSC 103/5/11	Russian Federation	Comments on documents MSC102/5/4, MSC 102/5/9, MSC 102/5/10, MSC 102/5/11, MSC 102/5/12, MSC102/5/16 and MSC 102/INF.17
MSC 103/5/12	Russian Federation	Comments on documents MSC102/5/4, MSC 102/5/9, MSC 102/5/10, MSC 102/5/11, MSC 102/5/12 and MSC 102/INF.17
MSC 103/WP.8	Secretariat	Report of the Working Group on Maritime Autonomous Surface Ships (MASS)
MSC 103/21	Secretariat	Report of the Maritime Safety Committee on its 103rd session

* *Following the decision of MSC 103, this document has been kept in abeyance for future consideration, as appropriate.*

ISWG documents

ISWG/MASS 1/1/Rev.1	Secretariat	Provisional agenda
ISWG/MASS 1/2	Norway	Results of the first step of the regulatory scoping exercise analysing possible gaps in SOLAS chapter IX and the ISM Code in relation to the safe operation of Maritime Autonomous Surface Ships (MASS)
ISWG/MASS 1/2/1	France	Summary of results of the first step of the RSE for SOLAS chapter II-1
ISWG/MASS 1/2/2	France and Spain	Summary of results of the first step of the RSE for International Convention on Maritime Search and Rescue, 1979
ISWG/MASS 1/2/3	Japan	Summary of results of the first step of the RSE for SOLAS chapter II-2 and associated codes
ISWG/MASS 1/2/4	Japan	Summary of results of the first step of the RSE for SOLAS chapter VI and associated codes
ISWG/MASS 1/2/5	Japan	Summary of results of the first step of the RSE for SOLAS chapter VII and associated codes
ISWG/MASS 1/2/6	Japan	Findings and common issues identified in the initial review of chapters II-2, VI and VII of the annex to SOLAS 1974 and the associated codes
ISWG/MASS 1/2/7	Japan	Summary of results of the first step of the RSE for SOLAS chapter XII and associated standards

ISWG/MASS 1/2/8	Japan	Summary of results of the first step of the RSE for SOLAS chapter XIII
ISWG/MASS 1/2/8	Japan	Summary of results of the first step of the RSE for SOLAS chapter XIII
ISWG/MASS 1/2/9	Japan	Summary of results of the first step of the RSE for CSC 1972
ISWG/MASS 1/2/10	Japan	Summary of results of the first step of the RSE for STCW-F 1995
ISWG/MASS 1/2/11	Belgium and Netherlands	Summary of results of the first step of the RSE for SOLAS chapter III and the LSA Code
ISWG/MASS 1/2/12	Finland	Summary of results of the first step of the RSE for SOLAS chapter XI-1 and related codes
ISWG/MASS 1/2/13	Finland	Summary of results of the first step of the RSE for SOLAS chapter XI-2 and the related ISPS Code
ISWG/MASS 1/2/14	Finland	Summary of results of the first step of the RSE for SOLAS chapter XIV and the related Polar Code
ISWG/MASS 1/2/15	Turkey	Summary of results of the first step of the RSE for SOLAS chapter IV
ISWG/MASS 1/2/16	China	Summary of results of the first step of the RSE for SOLAS chapter V
ISWG/MASS 1/2/16	China	Summary of results of the first step of the RSE for SOLAS chapter V
ISWG/MASS 1/2/17	Liberia	Summary of results of the first step of the RSE for International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE 1969)
ISWG/MASS 1/2/18	India	Summary of results of the first step of the RSE for LL 66, PROT 88, IS Code Part A and III Code
ISWG/MASS 1/2/19	Marshall Islands	Summary of results of the first step of the RSE for the International Regulations for Preventing Collisions at Sea 1972 (COLREGs)
ISWG/MASS 1/2/20	United States	Summary of results of the first step of the RSE for the STCW Convention and Code
ISWG/MASS 1/3	China	Proposals on the guidance for use in the second step
ISWG/MASS 1/3/1	China	Proposal on the second step of the regulatory scoping exercise of the International Regulations for Preventing Collisions at Sea, 1972
ISWG/MASS 1/3/2	Secretariat	Regulatory Scoping Exercise
ISWG/MASS 1/3/3	Japan	Comments on document ISWG/MASS 1/3/1
ISWG/MASS 1/6	Secretariat	Report of the Intersessional Working Group on Maritime Autonomous Surface Ships

MSC circulars

MSC.1/Circ.1604	Interim Guidelines for MASS trials
MSC.1/Circ.1638	Outcome of the regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)

IMO circular letters

Circular Letter No.3945	Intersessional Working Group on Maritime Autonomous Surface Ships (MASS) (2 to 6 September 2019)
Circular Letter No.3945/Add.1	Additional information on the Intersessional Working Group on Maritime Autonomous Surface Ships (MASS) (2 to 6 September 2019)
Circular Letter No.3956	New GISIS module for the regulatory scoping exercise on Maritime Autonomous Surface Ships (MASS)