

# **Considerations on the regulatory issues for realization of Maritime Autonomous Surface Ships**

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# 1. Introduction

## ■ 98<sup>th</sup> session of MSC\* (MSC 98, June 2017)

- **New agenda item** was agreed:

“Regulatory Scoping Exercise (RSE) for the use of Maritime Autonomous Surface Ships (MASS)”

## ■ 100<sup>th</sup> session of MSC (MSC 100, December 2018)

- **Framework for RSE** was approved.

- First step: review of IMO instruments\*\*

- Which provisions prevent MASS operations?
- Which provisions may need amendments or clarifications?

- Second step: analysis of IMO instruments

- Which is the most appropriate way of addressing MASS operations: developing clarifications, amendments, or new instruments ...?

\* MSC: Maritime Safety Committee of International Maritime Organization (IMO)

\*\* IMO instruments: conventions and codes under the purview of IMO

## ■ RSE procedure

### □ Level of review and analysis

- First step: review on **regulation** or **rule** level
- Second step: analysis on **instrument** level (**chapter** level for SOLAS)



## ■ Problem

It will **not be clearly indicated** which **parts of each regulation or rule** need to be amended or clarified during RSE .



## ■ Purposes

- Indicate **specific parts** of provisions which **need to be amended or clarified** with our **original categories**
- Give some **suggestions** for the amendments to the provisions in order to realize the use of MASS

## **2. Methodology and Procedure of RSE**

## □ Definition of MASS

A ship which, to a varying degree, can operate **independent of human interaction**.

## □ Definition of Degree of Autonomy (DoA)\*

DoA	Definition
1	<u>Ship with automated processes and decision support</u> : 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.
2	<u>Remotely controlled ship with seafarers on board</u> : 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.
3	<u>Remotely controlled ship without seafarers on board</u> : The ship is controlled and operated from another location. There are no seafarers on board.
4	<u>Fully autonomous ship</u> : The operating system of the ship is able to make decisions and determine actions by itself.

\* This table does not represent a hierarchic order as mentioned in the framework.

## □ First step (review): Scope of this study

Identify provisions in IMO instruments for each DoA which:

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

## □ Second step (analysis): Now on going

Analyze and determine the most appropriate way of addressing MASS operations for each DoA 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.

## □ First step: review of IMO instruments

- Initial review (Volunteering Member States)
- Comments on initial review (Other IMO Members)
- Finalize the results of first step (Volunteering Member States)



Confirmation by MSC Intersessional Working Group

## □ Second step: analysis of IMO instruments

- Initial analysis (Volunteering Member States)
- Comments on initial analysis (Other IMO Members)
- Finalize the results of second step (Volunteering Member States)

Authors: SOLAS chapters\* II-2, VI and VII and associated codes\*\*

\* SOLAS chapter N: chapter N of the annex to the International Convention for the Safety of Life at Sea

\*\* Associated codes: the codes which are made mandatory by these chapters



# **3. Scope and Assumptions**

The authors undertook **3 chapters of SOLAS** and **8 codes** and **1 subchapter of a code** made mandatory by these chapters:

- ❑ SOLAS chapter II-2 “Construction - Fire protection, fire detection and fire extinction”
  - **FSS** Code: International Code for Fire Safety Systems
  - **FTP** Code: International Code for Application of Fire Test Procedures, 2010
- ❑ SOLAS chapter VI “Carriage of cargoes and oil fuels”
  - **IMSBC** Code: International Maritime Solid Bulk Cargoes Code
  - **Grain** Code: International Code for the Safe Carriage of Grain in Bulk
  - Sub-chapter 1.9 of **CSS** Code: the Code of Safe Practice for Cargo Stowage and Securing
- ❑ SOLAS chapter VII “Carriage of dangerous goods”
  - **IMDG** Code: International Maritime Dangerous Goods Code
  - **IBC** Code: International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
  - **IGC** Code: International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
  - **INF** Code: International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships

- ❑ Degrees of autonomy (DoA) 1 and 2:  
Seafarers are assumed to be available on board to take control and to operate the shipboard systems and functions.
  
- ❑ DoA 3 and 4:  
It is assumed that persons may stay on board during berthing, cargo handling and anchoring.
  
- ❑ DoA 4:  
Even if the ships are fully autonomous, supervision by persons is assumed to be provided at a remote location.

## **4. Results of the initial review**

# Results of initial review

## □ First step (review):

Identify provisions in IMO instruments for each degree of autonomy (DoA) which:

**A:** apply to MASS and prevent MASS operations; or

**B:** apply to MASS and do not prevent MASS operations and require no actions; or

**C:** apply to MASS and do not prevent MASS operations but may need to be amended or clarified, and/or may contain gaps; or

**D:** have no application to MASS operations.

→ No action will be needed.

→ Actions will be needed to address MASS operations.

No provisions were identified as “A” in the scope of this article.



Only the provisions identified as “C” will be introduced.

□ DoA 2: Remotely controlled ship **with seafarers** on board

The following provisions **need clarifications or amendments.**

- ◆ Provisions containing the words “**master**”, “**crew**”, “**responsible person**”, etc. (II-2, VI, VII)
- ◆ **Definitions** (control stations and safety centre) (II-2)
- ◆ Provisions regarding **facilities which are effective only for seafarers on board** (alarms, indications and operational booklets) (II-2, VII)

\* The respective chapter number means the chapter and the associated codes with that chapter.

- ❑ DoA 3: Remotely controlled ship **without seafarers** on board
- ❑ DoA 4: Fully autonomous ship

The following provisions **need clarifications or amendments.**

- ◆ Provisions containing the words “**master**”, “**crew**”, “**responsible person**”, etc. (II-2, VI, VII)
- ◆ **Definitions** (manned spaces, control stations and safety centre) (II-2)
- ◆ Provisions regarding **facilities which are effective only for seafarers on board** (alarms, indications, notification and means of escape, operational booklets and shipboard emergency plan) (II-2, VII)
- ◆ Functional requirements for **fire detection and control** (II-2)
- ◆ Provisions regarding **systems and appliances** which need **manual operations** (II-2, VI, VII)
- ◆ Provisions requiring **actions by personnel** on board (II-2, VI, VII)
- ◆ Provisions regarding **accommodations** and **accessibility** (II-2, VII)

\* The respective chapter number means the chapter and the associated codes with that chapter.

# 5. Discussions



- Appropriate **alternative safety measures** to achieve the **equivalent functionalities** intended by the existing regulations



- ◆ One way is to amend the provisions to safely introduce
  - **remote operations with/without seafarers (DoA 2/3)**
  - **autonomous operations without seafarers (DoA 4)** on board.
- ◆ Another way is to **apply regulation 17 “Alternative design and arrangements”** to the provisions in regulations 4 to 23 other than 17 of SOLAS chapter **II-2**.

## Common important issues for DoA 3 & 4

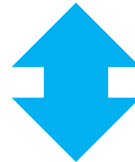
- ◆ Provisions regarding **systems and appliances** which need **manual operations** (II-2, VI, VII)
- ◆ Provisions requiring **actions by personnel** on board (II-2, VI, VII)  
e.g. fire fighting, emergency response and onboard inspection

Many of them are related to **emergency situations**.

- ◆ Systems and appliances for **fire extinguishing** (II-2)
- ◆ Actions for **firefighting** (II-2)
- ◆ Actions to deal with conditions of **leakage or spillage of cargoes** (VI, VII)

- Appropriate alternative safety measures, also for the common issues

- How to establish the emergency procedures to deal with fire, and leakage or spillage of cargoes.



- Absolutely different procedures, i.e. moderate the regulations or develop new exemption provisions for unmanned MASS

- For fire safety, how to evaluate, to what extent, the risks related to fire or toxicity will be reduced owing to absence of persons on board.

- For the carriage of cargoes, how to develop new exemption provisions for MASS when there are no persons on board and the cargo does not include any substances harmful to the marine environment.

# 6. Conclusions

- We conducted initial review and identified many provisions which need clarifications or amendments.
  - Meanings of master etc.
  - Definitions of control stations, etc.
  - Functional requirements
  - Systems and appliances which need manual operations
  - Actions by personnel on board
  - Accommodations and accessibilities
  - Facilities which are effective only when seafarers are on board
- Appropriate alternative safety measures should be adopted for these issues.
- Especially, it is important to establish emergency procedures to deal with fire, and leakage or spillage of cargoes, taking into account the reduction of risks related to fire and toxicity when there are no persons on board.

DoA 2,3,4

DoA 3,4

# Thank you for your attentions.

- ❑ Initial review of SOLAS chapter [II-2](#) was supported by [China](#) and [IACS](#).
- ❑ Initial review of SOLAS chapter [VI](#) and [VII](#) was supported by [China](#).
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