European Maritime Safety Agency

CMOROC Appendix D - Processes

Identification of Competences for MASS Operators in Remote Operation Centres

V 2.2

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EMSA

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Fundamentals About Processes

Processes

In this project is followed a process-oriented approach. The process descriptions are designed according to the general definition of a process.

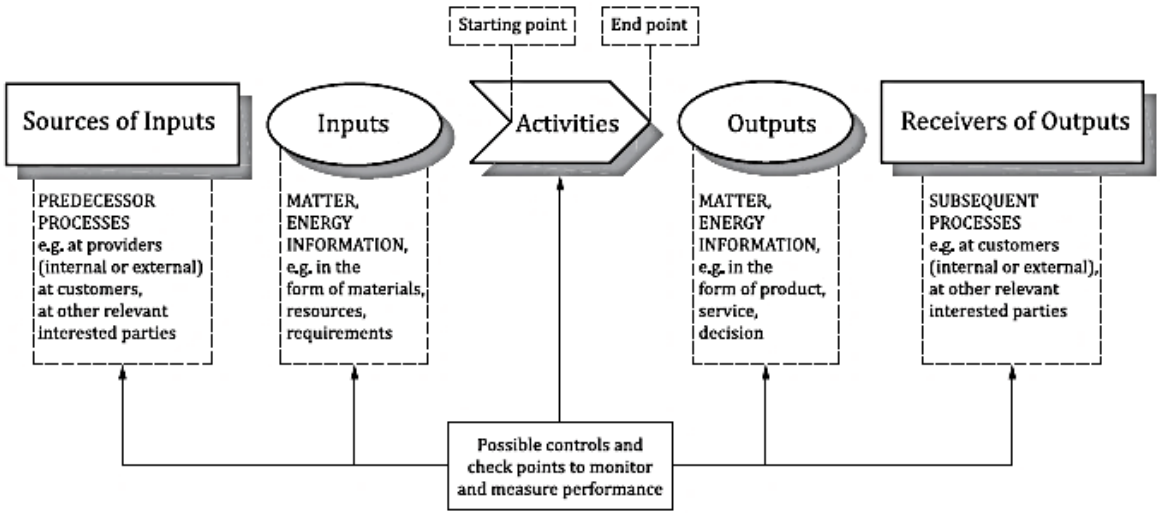

Figure 1: Scheme of elements of single processes (ISO 9001:2015)

Process Description Structure

The single processes are described in a systematic structure. They are in accordance with the requirements of ISO 9001:2015 (Clause 4.4.1).

Table 1: Content of process descriptions

Process nn	**<process name>**
Scope of application	In which areas is the process used? Differentiations are done for: > Ship type > "With crew on board" and "without crew on board".
Process objectives	What is to achieve by the process as a general objective?
Process operators	Operators who are involved in this process. Differentiated by "MASS operators in ROC" and "MASS operators on board". Assignment to operational or management level. Definition of the location and workstation where the process is mainly operated. Assumption of RACI for the different roles: R=Responsibility, A-Accountability, C-Consulted, I-Informed
Interfaces	Interfaces to other functions.
Event: input	Specific input to process, trigger to start, starting point.
Process description	Brief description of tasks, activities, and functionalities.
Resources needed	Needed resources to ensure availability of the process, such as equipment, systems, interfaces, HMI. Marked whether needed for … MASS: it is with crew on board ROC: it is with or without crew on board
Regulations	Major regulations to be considered in the process.
Event: output	Specific outcomes, results of the process, ending point
Required competences	Required competences, differentiated by the different roles: C/L = competence level STCW = related table MASS = additional competences needed by MASS operators (new table)
Additional comments	Only if required for further explanations.

Process Map

The purpose of the process map is to allow a general overview about all main processes related to the MASS system.

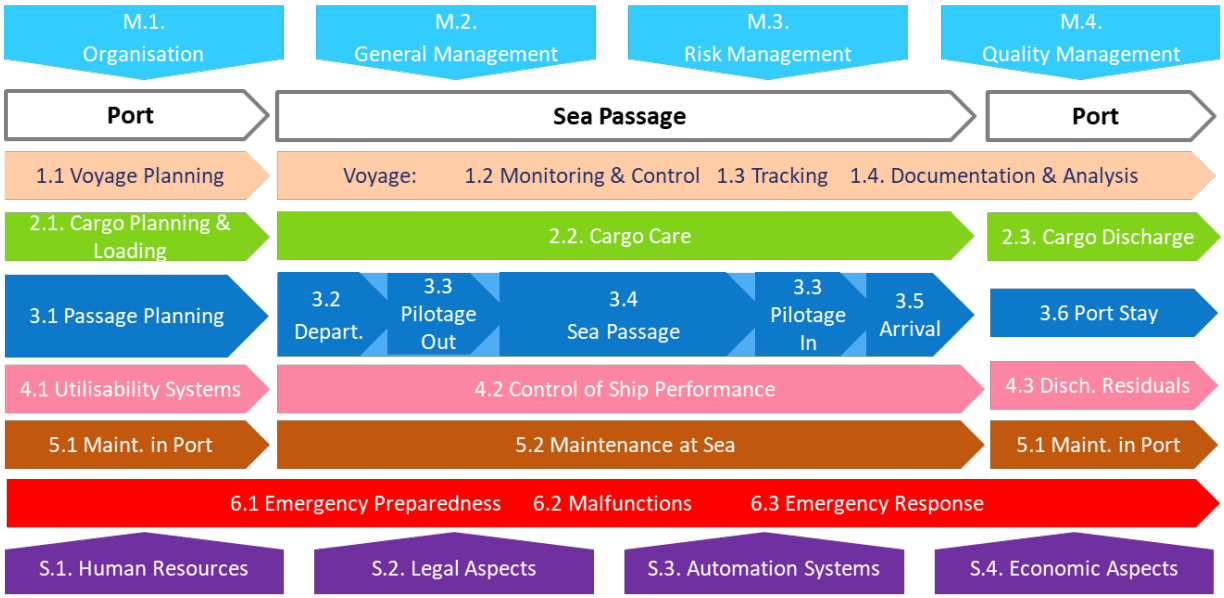

Figure 2: Process map for MASS operations

Management Processes

M.1 Organisation of MASS-ROC-Systems

Process M.1	**Organisation of MASS-ROC-Systems**				
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre				
Process objectives	To achieve smooth and safe operation of the entire MASS system				
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer	**Level** > Management > Management	**in ROC** > Planning station > Planning station	**RACI** R, A R	
Interfaces	> System Administrator > System Specialists (e.g. IT, automation, …) > Shipping Companies Management				
Event: input	Concept of Operations of a MASS system (organisational, technological, and human related perspectives)				
Process description	Manage all processes of MASS system: > Plan processes > Develop processes > Implement processes and improvements Determine and maintain the organisational structures: > Plan all functions of the MASS system with allocation of tasks and responsibilities > Determine required resources of humans and technologies Develop and manage the Human-Machine-Interfaces: > Work and rest time management > Ergonomic design of HMI				
Resources needed	Personnel > Manpower of operators, and specialists Equipment: > Commercial IT-system				
Regulations	MASS regulations International shipping law National regulatory framework, e.g. labour law				
Event: output	Implemented organisational structure and processes for the entire MASS system				
Required competences **MASS Senior Operators** Management Level	The **MASS Senior Operator (Navigator, Engineer) on management level** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to use organisation development tools … to implement communication brokers to achieve seamless internet access *regarding evaluating (C/L 5) and creating (C/L 6)* … to organize MASS systems, … to implement process management,			**C/L** 3 3 5 5	**STCW** MASS MASS MASS MASS

Process M.1	Organisation of MASS-ROC-Systems		
	... to develop, implement and supervise standard operational procedures, ... to develop and determine structural organisation, ... to allocate tasks and functions to operators, ... to implement and improve human-machine interfaces.	5 5 5 5	MASS MASS MASS MASS
Additional comments	./.		

M.2 General Management of MASS-ROC-Systems

Process M.2	General Management of MASS-ROC Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To manage the success factor “human resources” of a MASS-System by appropriate leadership and establishing an operational culture for the entire system			
Process operators	**MASS operators in ROC** > Senior Navigators > Navigators > Senior Engineers > Engineers > System Administrator	**Level** > Management > Operational > Management > Operational > Operational	**in ROC** > Planning station > Planning station	**RACI** R, A C R C C
Interfaces	> MASS System Specialists (e.g. IT, automation, …) > Shipping Company- Operations > Shipping Companies - Management			
Event: input	Organisation of MASS-System with all operators and technologies			
Process description	Leadership > Apply situational leadership > Support and improve teamwork > Allocate tasks and manage workloads > Improve decision making > Establish a just culture Situational awareness > Control workload to avoid fatigue > Improve the human-machine-interaction, especially for using sensors and trust in automation > Keep situational awareness in all situations, especially when using human-machine-interfaces MASS certification > Control of all required certificates to operate the MASS			
Resources needed	Personnel > Manpower of management, operators, and specialists			

Process M.2	General Management of MASS-ROC Systems		
	Equipment: > Navigational systems (ECDIS, radar, AIS, sounder, …) > Alarm and control systems (machinery, auxiliary and deck equipment, safety equipment) > Information systems (publications, MIS, forecasts, traffic information) > Computer systems > Sensor data (MASS status)		
Regulations	MASS regulations International shipping law National regulatory framework, e.g. labour law		
Event: output	Smooth and integrated operations		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to describe the system of sensors and how to use them to keep situational awareness *regarding using and applying (C/L 3) and analysing (C/L 4)* … to use knowledge about shipboard personnel management and training … to apply leadership and teamworking skills … to apply task and workload management … to apply effective resource management … to apply decision-making techniques … to operate the remote-control system with its specific interfaces … to maintain a safe remote watch … to maintain appropriate situational awareness when using the human-machine interfaces when monitoring or controlling remotely	**C/L** 2 3 3 3 3 3 3 3 3	**STCW** MASS A-II/1 A-II/1 A-II/1 A-II/1 A-II/1 MASS MASS MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to use leadership and managerial skills … to apply shipboard personnel management training … to apply task and workload management to apply effective resource management … to apply decision-making techniques … to apply a MASS-ROC-related resource management … to apply international and national regulatory framework for MASS and shipping … to apply national and international regulatory framework for the shore-based operators … to monitor and control compliance with legislative requirements and measures concerning MASS systems *regarding evaluating (C/L 5) and creating (C/L 6)* … to establish a safety culture in the entire MASS-ROC-system … to improve the human-machine interaction, especially to keep the situational awareness on a high level … to foster the teamwork and communication in the entire MASS team in ROC and at sea … to enable teams to work coordinated in different distributed locations	**C/L** 3 3 3 3 3 3 3 4 5 5 5	**STCW** A-II/2 A-II/2 A-II/2 A-II/2 MASS MASS MASS MASS MASS MASS

Process M.2	General Management of MASS-ROC Systems		
	... to identify behaviours of operators in distributed work locations	5	MASS
	... to identify the level of situational awareness in a team of operators and to improve in case of loss of sufficient S/A	5	MASS
	... to implement and improve systematic decision-making procedures in remote monitoring and control	5	MASS
	... to identify too high workloads in the operator and MASS team and to reduce stress levels by appropriate measures	5	MASS
	... to apply classification cycles for MASS systems and consider intervention scheme requirements	5	MASS
	... to manage MASS system related certificates	5	MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	... to use knowledge about shipboard personnel management and training	3	A-III/1
	... to apply leadership and teamworking skills	3	A-III/1
	... to apply task and workload management	3	A-III/1
	... to apply effective resource management	3	A-III/1
	... to apply decision-making techniques	3	A-III/1
	... to maintain a safe remote watch	3	MASS
	... to maintain appropriate situational awareness by using the human-machine interfaces and monitoring or controlling remotely	3	MASS
	... to operate the remote-control systems with its specific interfaces	3	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	... to use leadership and managerial skills	3	A-III/2
	... to apply shipboard personnel management training	3	A-III/2
	... to apply task and workload management	3	A-III/2
	... to apply effective resource management	3	A-III/2
	... to apply decision-making techniques	3	A-III/2
	... to apply a MASS-ROC-related resource management	3	MASS
	... to apply international and national regulatory framework for MASS and shipping	3	MASS
	... to apply national and international regulatory framework for the shore-based operators	3	MASS
	... to monitor and control compliance with legislative requirements and measures concerning MASS systems	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	... to improve the human-machine interaction, especially to keep the situational awareness on a high level	5	MASS
	... to apply classification cycles for MASS systems and consider intervention schemes requirements	5	MASS
	... to manage MASS system related certificates	5	MASS
Required competences **MASS System Administrator**	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	... to use knowledge about shipboard personnel management and training	3	A-III/6
	... to apply leadership and teamworking skills	3	A-III/6
	... to apply task and workload management	3	A-III/6

Process M.2	General Management of MASS-ROC Systems		
Operational Level	… to apply effective resource management	3	A-III/6
	… to apply decision-making techniques	3	A-III/6
	… to foster the teamwork and communication in the entire MASS team in ROC and at sea	5	MASS
	… to enable teams to work coordinated in different distributed locations	5	MASS
	… to identify behaviours of operators in distributed work locations	5	MASS
	… to identify the level of situational awareness in a team of operators and to improve in case of loss of sufficient S/A	5	MASS
	… to implement and improve systematic decision-making procedures in remote monitoring and control	5	MASS
	… to identify too high workloads in the operator and MASS team and to reduce stress levels by appropriate measures	5	MASS
Additional comments	./.		

M.3 Risk Management in MASS-ROC-Systems

Process M.3	Risk Management in MASS-ROC-Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Shipping company - operations **MASS without crew on board** > Remote Operation Centre			
Process objectives	To identify and assess risks in the entire MASS and remote-control system			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Senior Navigator	> Management	> Planning station	R, A
	> Senior Engineer	> Management	> Planning station	R
Interfaces	> MASS System Administrator > MASS System Specialists (e.g. IT, automation, …) > Shipping Companies - Operations > Shipping Companies - Management			
Event: input	Starting with hazard identification (HAZID) in all fields of operation			
Process description	> Hazard and risk identification in all fields of a MASS-system > Risk assessment > Definition of mitigating measures > Implementation of measures > Control of effectiveness of measures			
Resources needed	Personnel: > Manpower of operators and specialists Equipment: > n/a			
Regulations	According to the field of assessment			
Event: output	Identified risks and implemented mitigating measures			

Process M.3	Risk Management in MASS-ROC-Systems		
Required competences **Operators** Operational Level	The **MASS Operator (Navigator, Engineer) (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to use appropriate tools to identify and assess operational risks in the operation of MASS … to determine measures to mitigate operational risks and to implement them	**C/L** 4 4	**STCW** MASS MASS
Required competences **Senior Operators** Management Level	The **MASS Senior Operator (Navigator, Engineer) (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to identify hazards for the operations of a MASS system, covering all technical, organisational, and human-related aspects … to derive risks which may arise by operation of a remote-controlled MASS … to use appropriate tools to identify and assess operational risks in the operation of MASS … to determine measures to mitigate operational risks and to implement them *regarding evaluating (C/L 5) and creating (C/L 6)* … to identify and evaluate risk levels and to determine appropriate mitigation measures by applying systematic risk management tools … to set measures in place to reduce risk … to manage risk mitigating activities	**C/L** 4 4 4 4 5 5 5	**STCW** MASS MASS MASS MASS MASS MASS MASS
Additional comments	Risk management is required in all functionalities including navigation, engineering, communication, or integration of humans.		

M.4 Quality Management of MASS-ROC-Systems

Process M.4	Management of Quality of MASS-ROC-Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > In Remote Operation Centre **MASS without crew on board** > In Remote Operation Centre			
Process objectives	To determine the quality standards for safe operations with an available and reliable system, to implement and continuously improve them.			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Management > Operational > Operational	**in ROC** > Planning station > Planning station	**RACI** R, A C R C C
Interfaces	All relevant systems, equipment, persons			

Process M.4	Management of Quality of MASS-ROC-Systems		
Event: input	Determined quality standards and management reviews		
Process description	> Definition, implementation, and improvement of management systems, such as (but not limited to) … … Quality of the MASS and ROC system … Energy and climate aspects … Environmental protection … Safety and security systems … Occupational health		
Resources needed	Personnel: > Manpower of management, operators, and specialists > Stakeholder's requirements > Interested parties' expectations Equipment: > Inputs of all systems, equipment is needed		
Regulations	Entire regulatory framework		
Event: output	Transparency on all quality standards and a continuous improvement		
Required competences **MASS Senior Operators** Management Level	The **MASS Senior Operator (Navigator, Engineer) on management level** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to apply all relevant management systems … to determine objectives related to the required standards … to communicate the requirements with all stakeholders and interested parties *regarding evaluating (C/L 5) and creating (C/L 6)* … to determine the appropriate organisation and management of the named systems … to set-up processes for continuous improvement … to manage all relevant measures and activities to obtain the determined objectives … to conduct internal and external audits of MASS and ROC management systems	**C/L** 3 4 4 5 5 5 5	**STCW** MASS MASS MASS MASS MASS MASS MASS
Required competences **MASS Operators** Operational Level	The **MASS Operator (Navigator, Engineer, System Administrator) on operational level** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain management systems for quality, energy, environmental protection, safety, and security *regarding using and applying (C/L 3) and analysing (C/L 4)* … to set quality improving measures into place and to communicate them to all involved persons	**C/L** 2 3	**STCW** MASS MASS
Additional comments	The development and implementation of management systems is a task concerning the entire MASS and ROC system in wider sense. It shall contain all aspects as the operational system, environment, energy, safety, security, and human occupational health.		

Operational Core Processes

1 Voyage Planning & Control

1.1 Voyage Planning

Process 1.1	**Voyage Planning**			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre > On board of MASS **MASS without crew on board** > Remote Operation Centre			
Process objectives	To plan and prepare a voyage that a MASS can sail it by specific consideration of automation requirements			
Process operators	**MASS operators in ROC** > Senior Navigator	**Level** > Management	**in ROC** > Planning station	**RACI** R, A
	MASS operators on board > Senior Navigator	**Level** > Management	**On board** > Planning station	C
Interfaces	> Commercial office (booking cargo/pax), charterers > Port authorities > Port facility operators (terminals, tugs, stevedores, pilots, …) > Agencies			
Event: input	Cargo (type, amount) and port (POL, POD) Commercial data Automated Port Facilities Navigational Support Systems			
Process description	Plan the voyage Arrangement for navigational requirements > Getting passage permits > Getting data transmission slots > Ensuring of availability of navigational aid systems Arrangement of port and fairway facilities > Gathering all port and pilotage information > Arrangement for MASS-related AFS (automatic facility services) >			
Resources needed	Personnel > Operators Equipment: > MASS IT-system > Port and passage information		**Crew** X X X	**ROC** X X X
Regulations	MASS regulations International shipping law Local shipping law			
Event: output	> Voyage schedule > Passage permits and available navigational facilities > Available resources (to operate the MASS) in each port (berth, facilities,…)			
Required competences	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*		**C/L**	**STCW**

Process 1.1	Voyage Planning		
MASS Senior Navigator Management Level	… to apply international and national regulatory framework for MASS, ROC and shipping to plan and use automated facilities and services at sea and in ports	3	MASS
	… to apply national and international regulatory framework for the shore-based operators	3	MASS
	… to analyse the requirements for navigation and port operations	3	MASS
	… to identify all possible restrictions for MASS system on the specific planned voyage	4	MASS
	… to plan schedules for MASS voyages	5	MASS
Required competences	The **MASS Senior Engineer (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
MASS Senior Engineer Management Level	… to apply international and national regulatory framework for MASS, ROC, and shipping to plan, and use automated facilities and services at sea and in ports	3	MASS
	… to apply national and international regulatory framework for the shore-based operators	3	MASS
Additional comments	Commercial tasks will be done in the operations department of the shipping company. Expertise of navigators is required for specific technical coordination of interfaces for autonomous operation.		

1.2 Voyage Monitoring & Control

Process 1.2	Voyage Monitoring & Control			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre > On board of MASS **MASS without crew on board** > Remote Operation Centre			
Process objectives	To ensure correct functioning of the sensors and the automation and thus a safe operation of the MASS system			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Navigator	> Operational	> Monitoring station	R
	> Senior Navigator	> Management	> Direct control st.	R, A
	> Engineer	> Operational	> Monitoring station	R
	> Senior Engineer	> Management	> Direct control st.	R
	MASS operators on board	**Level**	**on board**	**RACI**
	> Senior Navigator	> Management	> Direct control st.	R, A
	> Navigator	> Operational	> Monitoring station	R
	> Engineer	> Operational	> Monitoring station	R
Interfaces	> MASS System Administrator > MASS System Specialists (e.g. IT, automation, …)			
Event: input	> All data (e.g. Sensor Data, Objectives, Decisions) of the automation system			

Process 1.2	Voyage Monitoring & Control		
Process description	Monitor the correct functioning of all systems of the MASS automation > Assess correct functioning of sensor system and MASS Situational awareness (MASS SA) > Assess correct functioning of automated navigation system and associated interpretation of SA Information and Decision Making unit > Assess correct functioning of automated control system > Assess correct functioning of autonomous communication system > Assess correct functioning of autonomous emergency response system Take over control if MASS automation reaches its limitations		
Resources needed	Personnel	**Crew**	**ROC**
	> Manpower of operators, and specialists	X	X
	Equipment:		
	> MASS automation system (including all systems, data & state of actuators)	X	X
Regulations	MASS flag state regulations MASS local coastal and port state regulations Radiocommunication regulations		
Event: output	> Correct functioning of the automation of the MASS is validated and ensured > In cases correct functioning cannot be ensured, control is taken over by the Navigator		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*	**C/L**	**STCW**
	… to understand the basics of automation and control techniques	2	MASS
	… to explain and consider the limitations and conditions of automation and control techniques	2	MASS
	… to discuss the objectives and systems of the automation	2	MASS
	… to discuss the basics of automation and control systems	2	MASS
	… to explain the limitations of automation, e.g. in challenging traffic situations or weather conditions	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor the automation and check whether the automation objectives are being met	4	MASS
	… to intervene if critical deviations and situations occur	4	MASS
	… to monitor and interpret the sensor data of the MASS (take a proper outlook)	4	MASS
	… to assess the reliability of sensor values	4	MASS
	… to interpret aggregated information of automation and control techniques appropriately	4	MASS
	… to assess interdependencies between different elements of information	4	MASS
	… to interpret errors and critical situations correctly (e.g. especially when dealing with subsequent errors)	4	MASS
	… to communicate as part of a MASS system with other stations by using standardised phrases	4	MASS
	… to monitor the communication of the MASS with ROC and automated navigational aids or systems	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (mgmt. level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to take over direct control of the MASS (get quickly into the loop and adapt quickly to the situation and the vessel involved)	**5**	MASS
	… to adjust and change parameters of the automation	**5**	MASS

Process 1.2	Voyage Monitoring & Control		
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … as Navigator *regarding using and applying (C/L 3) and analysing (C/L 4)* … as Navigator *regarding evaluating (C/L 5) and creating (C/L 6)* … as Navigator	**C/L** 	**STCW** MASS MASS MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to take over direct control of the MASS (get quickly into the loop and adapt quickly to the situation and the vessel involved) … to change parameters of the automation … to identify and evaluate consequences of changes in the voyage	**C/L** **5** **5** **5**	**STCW** MASS MASS MASS
Additional comments	./.		

1.3 Voyage Tracking

Process 1.3	Voyage Tracking			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre > On board of MASS **MASS without crew on board** > Remote Operation Centre			
Process objectives	To observe the voyage and to manage changes			
Process operators	**MASS operators in ROC** > Senior Navigator	**Level** > Management	**in ROC** > Planning station	**RACI** R, A
	MASS operators on board > Senior Navigator	**Level** > Management	**On board** > Planning station	 C
Interfaces	> Commercial office (booking cargo/pax), charterers > Port authorities > Port facility operators (terminals, tugs, stevedores, pilots, …) > Agencies			
Event: input	> Changes in voyage schedule > Changes in passage permits and available navigational facilities > Change in available resources in each port (berth, facilities,…)			
Process description	> Observe the status of MASS > Observe for deviations in voyage parameters > Manage changes of voyage parameters			
Resources needed	Personnel > Manpower of management, operators, and specialists Equipment: > Commercial IT-system > Navigational systems (ECDIS, radar, AIS, sounder, …)		**Crew** X X	**ROC** X X X

Process 1.3	Voyage Tracking		
	> Information systems (publications, MIS, forecasts, traffic information)	X	X
	> Sensor data (MASS status)	X	X
Regulations	International regulations MASS flag state regulations Local port regulations		
Event: output	> Revised voyage schedule with all changes of required capabilities and facilities		
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to apply the regulating framework for operations of MASS … to use automated facilities and services at sea and in ports … to analyse the requirements for navigation and port operations *regarding evaluating (C/L 5) and creating (C/L 6)* … to identify all possible restrictions for MASS system on the specific planned voyage … to plan schedules for MASS … to identify and evaluate consequences of changes in the voyage	**C/L** 3 3 4 5 5 5	**STCW** MASS MASS MASS MASS MASS MASS
Additional comments	In general, most of required competences are the same as in process 1.1 Voyage Planning		

1.4 Voyage Documentation and Analysis

Process 1.4	Voyage Documentation and Analysis			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre > On board of MASS **MASS without crew on board** > Remote Operation Centre			
Process objectives	To collect all relevant data and to analyse it for improvement of the MASS system			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer > System Administrator	**Level** > Management > Management > Operational	**in ROC** > Planning station > Planning station > System control st.	**RACI** R, A R R
	MASS operators on board > Senior Navigator	**Level** > Management	**on board** > Planning station	**RACI** R, C
Interfaces	> MASS systems			
Event: input	Data of all MASS systems			
Process description	> Continuous collecting and gathering of voyage related data and information > Checking data and information quality > Analysing data > Storage of data and information continuously			

Process 1.4	Voyage Documentation and Analysis		
Resources needed	Equipment in ROC and on board	**Crew**	**ROC**
	> Navigational systems (ECDIS, radar, AIS, sounder, …)	X	X
	> Information systems (publications, MIS, forecasts, traffic information)	X	X
	> Sensor data (MASS status)	X	X
	> IT storage and analysis systems		X
Regulations	International regulations MASS flag state regulations Local port regulations		
Event: output	Electronic logbooks with status and performance data for all operational issues, such as for example: > Navigation and deck > Propulsion and machinery > Safety and security > MASS status and performance		
Required competences **MASS Operators** Operational Level	The **MASS Operators (navigator and engineer on operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
	… to document and file operational data	3	MASS
	… to analyse data indicating performance, availability, and reliability of all MASS systems	4	MASS
	… to determine data being relevant for operation of a MASS, i.e. parameters reflecting operational states of all relevant systems on a MASS	4	MASS
	… to optimise data for evaluation purposes	4	MASS
	… to save all data and information of the MASS system	3	MASS
	… to prepare regular status reports from operational data	4	MASS
Required competences **MASS Senior Navigators** Management Level	The **MASS Senior Navigator (on management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
	… to determine relevant data for operation of a MASS, i.e. parameters reflecting operational states of all relevant systems on a MASS	4	MASS
	… to use software tools for data analysis	3	MASS
	… to use digital platforms	3	MASS
	… to determine and measure standards of performance of a MASS system	4	MASS
	… to map applications and hardware of automation systems to field level, control level, or supervisory level respectively (“Automation Pyramid”)	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to evaluate performance, reliability, and availability of all MASS and ROC subsystems	5	MASS
	… to structure and evaluate collected data and information	5	MASS
	… to derive baselines and thresholds for equipment from operating data that may be used for generating meaningful alarms and events	5	MASS
	… to derive information to analyse the MASS system	5	MASS
	… to control the performance of a MASS system	5	MASS
	… to evaluate the reliability of automation and control systems	**5**	MASS
	… to derive information to analyse the MASS system		

Process 1.4	Voyage Documentation and Analysis		
	… to optimise operations of MASS by using digital twins	**5**	MASS
		5	MASS
Required competences **MASS Senior Engineers** Management Level	The **MASS Senior Engineer (on management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to determine data being relevant for operation of a MASS, i.e. parameters reflecting operational states of all relevant systems on a MASS	4	MASS
	… to use software tools for data analysis	3	MASS
	… to use digital platforms	3	MASS
	… to analyse the automatic control systems by diagnostic applications	4	MASS
	… to analyse automatic control systems by using digital twins	4	MASS
	… to use robotic systems for inspections on MASS	3	MASS
	… to evaluate performance, reliability, and availability of all MASS and ROC subsystems	4	MASS
	… to map applications and hardware of automation systems to field level, control level, or supervisory level respectively (“Automation Pyramid”)	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to evaluate the performance of auxiliary and machinery automatic controlled systems	5	MASS
	… to evaluate the performance of propulsion automatic controlled systems	5	MASS
	… to evaluate the remote-control system for integrity and reliability	5	MASS
	… to determine and measure standards of performance of a MASS system	5	MASS
	… to structure and evaluate collected data and information	5	MASS
	… to derive baselines and thresholds for equipment from	4	MASS
	operating data that may be used for generating meaningful alarms and events	5	MASS
	… to derive information to analyse the MASS system	5	MASS
	… to control the performance of a MASS system	5	MASS
	… to evaluate the reliability of automation and control systems	5	MASS
	… to derive information to analyse the MASS system	5	MASS
	… to optimise operations of MASS by using digital twins	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to document and file operational data	3	MASS
	… to analyse data indicating performance, availability, and reliability of all MASS systems	4	MASS
	… to determine data being relevant for operation of a MASS, i.e. parameters reflecting operational states of all relevant systems on a MASS	4	MASS
	… to optimise data for evaluation purposes	4	MASS
	… to save all data and information of the MASS system	3	MASS
	… to prepare regular status reports from operational data	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to determine and measure standards of performance of a MASS system	5	MASS
		5	MASS

Process 1.4	Voyage Documentation and Analysis		
	... to evaluate performance, reliability and availability of all MASS and ROC subsystems ... to structure and evaluate collected data and information	5	MASS
Additional comments	./.		

2 Cargo Operations

2.1 Cargo & Persons Embarkation Planning and Preparation

Process 2.1	**Cargo & Persons Embarkation Planning and Preparation**			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	Ensure a safe loading of the MASS Ensure a safe embarkation of persons (passengers, maintenance and service crew, ship crew)			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Planning station > Planning station	**RACI** R, A C
Interfaces	> Shipping company - operations, charterer, ship planner > Terminal, stevedores, port facilities			
Event: input	Cargo to be loaded Persons to be embarked			
Process description A) Feeder C) Bulker	Cargo handling and stowage > Identification of cargoes, and planning of loading and stowage plans > Identification and planning of stowage and segregation of dangerous cargo > Identification and planning of loading of bulk cargoes > Planning of securing of cargoes and equipment Ship condition > Planning preparation of the ship for loading of cargo > Preparation of cargo holds and loading equipment Operation of ship > Planning of ship stability, trim and strength including ballasting			
Process description B) Ferry	Cargo handling and stowage > Identification of vehicles and planning of loading > Identification and planning of stowage and segregation of dangerous cargo > Planning of securing of vehicles Ship condition > Planning of preparation of the ship for loading of vehicles and persons embarkation Operation of ship and care for persons > Planning of persons boarding > Planning of ship stability and ballasting			
Resources needed	Personnel > Manpower of terminal Equipment: > MASS technical specifications (ship, holds, hatch covers, loading and discharging equipment, …) > Stability calculator > Loading and Stability Manual, > Cargo Securing Manual, > Cargo information, stowage plans			

Process 2.1	Cargo & Persons Embarkation Planning and Preparation		
	> Ship operational data (bunker, ballast, provisions)		
Regulations	International regulations (SOLAS, CSS, IMDG, IMSBC, …) MASS flag state regulations Local port regulations Occupational health and accident prevention regulations		
Event: output	Plan of loading and embarkation, Loading and boarding operations are prepared and can start.		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*	**C/L**	**STCW**
	… to explain the ship construction to maintain seaworthiness of the ship	2	A-II/1
	… to describe different types of MASS and their specific constructional differences	2	MASS
	… to explain the handling of cargo on a MASS, e.g. as container, break bulk, bulk, liquid, or Ro-Ro-cargo	2	MASS
	… to describe requirements of specific missions of MASS, e.g. as in research, offshore, or dredging operations	2	MASS
	… to explain the control of persons on board of a MASS	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to explain and apply stability issues to maintain seaworthiness of the ship	3	A-II/1
	… to control trim, stability, and stress by using tables, diagrams, and stress-calculating equipment	3	A-II/1
	… to use remote controlled or autonomous systems to control stability, trim, and stress	3	MASS
	… to use remotely controlled or autonomous pumping systems for liquids (ballast water, fuels, …) and to control remotely tank filling	3	MASS
	… to monitor remote the ship stability, trim, and stress	3	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*	**C/L**	**STCW**
	… explain tankers and tanker operations	2	A-II/2
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to consider compliance with legislative requirements ensuring safe cargo handling (as CSS-Code, IMDG-Code, IMSBC-Code, MARPOL, accident prevention)	4	A-II/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to plan a safe loading and stowage, taking all cargo properties into account	5	A-II/2
	… to plan a safe securing of cargoes	5	A-II/2
	… to plan trim, stability, and stress by using tables, diagrams, and automatic data-based equipment	5	A-II/2
	… to plan and set the parameters for stability conditions of a MASS passage	5	MASS
	… to control trim, stability, and stress in regard of fundamental principles of ship construction, theories, and affecting factors	5	A-II/2
	… to plan the carriage of dangerous cargo according to IMDG and IMSBC Codes	5	A-II/2
	… to plan and control automated cargo and mission operations	5	MASS
	… to evaluate the stability and reliability of the MASS	5	MASS
	… to evaluate the reliability of the remote stability control system	5	MASS

Process 2.1	Cargo & Persons Embarkation Planning and Preparation		
	... to plan procedures and control of passengers and other persons on board of a MASS to ensure a safe carriage	5	MASS
Additional comments	All three use cases of the study require the same competences. The task of cleaning the holds of a bulk carrier is not covered by this process and needs a riding crew unless technologies for cargo hold cleaning are available		

2.2 Cargo Loading & Persons Embarkation

Process 2.2	Cargo Loading & Persons Embarkation			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	Operate a safe loading of the MASS Operate a safe embarkation of persons (passengers, maintenance and service crew, ship crew)			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Cargo control st. > Cargo control st.	**RACI** R, A R
Interfaces	> Shipping company - operations, charterer, ship planner > Terminal operators, stevedores, port facilities > Auditors			
Event: input	Start of cargo loading or persons embarkation			
Process description A) Feeder B) Ferry C) Bulker	Cargo handling and stowage > Monitor and control loading operations > Monitor and control securing operations > Monitor for cargo damages and document if any Ship condition > Prepare loading systems (e.g. hatch covers, ramps, doors conveyors, …) > Prepare gangways and ship-shore-connections to MASS > Check MASS and equipment for defects and damages Operation of ship and care for persons > Ensuring security (ISPS) > Confirming cargo loaded in the documentation > Boarding and counting of crew and passengers > Ballasting when loading, control of stability, trim, and stress > Monitor ship-shore-connections			
Resources needed	Personnel > Manpower of terminal Equipment > MASS technical specifications (ship, holds, hatch covers, loading and discharging equipment, …) > Stability calculator, > Loading and Stability Manual, > Cargo Securing Manual, > Cargo information, > Ship operational data (bunker, ballast, provisions)			

Process 2.2	Cargo Loading & Persons Embarkation		
Regulations	International regulations (SOLAS, CSS, IMDG, IMSBC, …) MASS flag state regulations Local port regulations Occupational health and accident prevention regulations		
Event: output	End of loading and embarkation, all cargo without any damages and persons safely on board		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the ship construction to maintain seaworthiness of the ship	2	A-II/1
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to explain and apply stability issues to maintain seaworthiness of the ship	3	A-II/1
	… to monitor a safe loading and stowage	3	A-II/1
	… to monitor cargo securing	3	A-II/1
	… to inspect and report defects and damages to cargo spaces, hatch covers, and ballast tanks	3	A-II/1
	… to monitor compliance with legislative requirements	3	A-II/1
	… to monitor cargo or mission related equipment by remote control	3	MASS
	… to monitor the interfaces of the MASS to terminal and port operations	3	MASS
	… to support cargo or mission operations by providing all required information to other parties involved	3	MASS
	… to monitor persons (crew and passengers) on the MASS	3	MASS
	… to monitor and check specific MASS systems (automated berthing systems, ship-shore-connections, cargo operation remote monitoring systems)	3	MASS
	… to understand and monitor person identification and counting devices to control access to the MASS	3	MASS
	… to inspect a MASS for structural damages and report these when the MASS is in the port.	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to consider compliance with legislative requirements ensuring safe cargo handling (as CSS-Code, IMDG-Code, IMSBC-Code, MARPOL, IS-Code, accident prevention)	4	A-II/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to ensure and operate a safe loading and stowage, taking all cargo properties into account	5	A-II/2
	… to ensure a safe securing and handling of cargoes	5	A-II/2
	… to control trim, stability, and stress by using tables, diagrams, and automatic data-based equipment	5	A-II/2
	… to control trim, stability, and stress in regard of fundamental principles of ship construction, theories, and affecting factors	5	A-II/2
	… to assess reported defects and damage to cargo spaces, hatch covers, and ballast tanks and take appropriate action	5	A-II/2
	… to load dangerous cargo according to IMDG and IMSBC Codes	5	A-II/2
	… to evaluate the stability and reliability of the remote stability control system	5	MASS
	… to evaluate the stability and reliability of the MASS	5	MASS

Process 2.2	Cargo Loading & Persons Embarkation		
	... to evaluate the reliability of the remote stability control system	5	MASS
	... to handle luggage and personal effects safely	5	MASS
	... to perform remote inspections of the structure and deck equipment	3	MASS
	... to evaluate defects or damages of a MASS	5	MASS
	... to initiate corrective measures to ensure safe cargo and mission operations	5	MASS
	regarding communication and cooperation		
	... to establish effective communication and working relationship between ship and terminal personnel	5	A-II/2
	... to coordinate all activities to control stability, trim, and strength of a MASS	5	MASS
Additional comments	The required competences regarding to the loading and boarding processes are the same for each MASS use case. The differences are determined by the cargo provisions.		

2.3 Cargo Care & Persons Control at Sea

Process 2.3	Cargo Care & Persons Control at Sea			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	Safe carriage of cargo and persons on board			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Cargo control st. > Cargo control st.	**RACI** R, A R
Interfaces	> Shipping company, Fleet Operation Centre			
Event: input	Commence of voyage			
Process description A) Feeder C) Bulker	Cargo care > Monitoring of cargo, securing of containers > Monitoring of dangerous cargo > Monitoring of temperatures of bulk cargoes and reefer containers > Control of ventilation of cargo holds Control of persons on board > Monitoring of persons on board such as riding crew > Monitoring of ambient conditions in accommodations > Providing provisions, services, and accommodation			
Process description B) Ferry	Cargo care > Monitoring of cargo, securing of vehicles > Control of ventilation of cargo holds Control of persons on board > Monitoring of persons on board such as passengers, service crew, riding crew > Monitoring of ambient conditions in accommodations and public spaces			

Process 2.3	Cargo Care & Persons Control at Sea		
	> Providing of provisions and convenience services > Cleaning and hygienic services		
Resources needed	Personnel > Manpower of ratings and service crew Equipment > Cargo information > Ship operational data (bunker, ballast, provisions)		
Regulations	International regulations (SOLAS, CSS, IMDG, IMSBC, …) MASS flag state regulations Occupational health and accident prevention regulations		
Event: output	No damages of cargo and safely disembarked persons		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
	… to use remote controlled or autonomous systems to control stability, trim, and stress	3	MASS
	… to use remotely controlled or autonomous pumping systems for liquids (ballast water, fuels, …) and to remotely control tank filling	3	MASS
	… to monitor remote the ship stability, trim, and stress	3	MASS
	… to apply and monitor sensor-based cargo monitoring systems	3	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to ensure safe stowage, securing, and care during the voyage	5	A-II/2
	… to care about dangerous cargo according to IMDG and IMSBC Codes	5	A-II/2
	… to control trim, stability, and stress in regard of fundamental principles of ship construction, theories, and affecting factors	5	A-II/2
	… to take care of cargo and missions on a MASS when at sea and to initiate all required remote-controlled activities for a safe shipment or execution of tasks	5	MASS
	… to evaluate the stability and reliability of the remote stability control system	5	MASS
	… to evaluate the stability and reliability of the MASS	5	MASS
	… to evaluate remotely hazards to the MASS in the seaway, the cargo, and persons on board, and to establish appropriate measures	5	MASS
	… to evaluate remotely hazards to the cargo and persons on board, and to establish appropriate measures	5	MASS
	… to control persons and passengers, and monitor passengers on board remotely	5	MASS
	… to evaluate the behaviour of persons on board by remote observations	5	MASS
	… to establish a communication between ROC and MASS areas with persons on board	4	MASS
	… to organise the care for persons and passengers on board of the MASS	4	MASS
	… to monitor passenger and accommodation areas to ensure safety of persons	4	MASS
Additional comments	The care of persons on board of a ferry needs a service crew		

2.4 Cargo Discharging & Persons Disembarkation

Process 2.4	Cargo Discharging & Persons Disembarkation			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre (planning station)			
Process objectives	Operate a safe discharging of the MASS Operate a safe disembarkation of persons (passengers, maintenance and service crew, ship crew)			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Cargo control st. > Cargo control st.	**RACI** R, A R
Interfaces	> Shipping company - operations, charterer, ship planner > Terminal operators, stevedores, port facilities > Auditors			
Event: input	Start of cargo discharging or persons disembarkation			
Process description A) Feeder B) Ferry C) Bulker	Cargo handling > Monitor and control preparation of discharging > Monitor and control discharging operations Ship condition > Prepare loading systems (e.g. hatch covers, ramps, doors, conveyors, …) > Prepare gangways and ship-shore-connections to MASS > Check MASS and equipment for defects and damages Operation of ship and care for persons > Ensuring security (ISPS) > Disembarking and counting of leaving crew and passengers > Ballasting when loading, control of stability, trim, and stress > Monitor ship-shore-connections			
Resources needed	Personnel > Manpower of terminal Equipment > MASS technical specifications (ship, holds, hatch covers, loading and discharging equipment, …) > Stability calculator > Loading and Stability Manual, > Cargo Securing Manual, > Cargo information, > Ship operational data (bunker, ballast, provisions)			
Regulations	International regulations (SOLAS, CSS, IMDG, IMSBC, …) MASS flag state regulations Local port regulations Occupational health and accident prevention regulations			
Event: output	End of discharging and disembarking all cargo without any damages and persons safely from board			
Required competences **MASS Navigator**	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the ship construction to maintain seaworthiness of the ship		**C/L** 2	**STCW** A-II/1

Process 2.4	Cargo Discharging & Persons Disembarkation		
Operational Level	*regarding using and applying (C/L 3) and analyzing (C/L 4)*		
	… to explain and apply stability issues to maintain seaworthiness of the ship	3	A-II/1
	… to monitor a safe unloading	3	A-II/1
	… to monitor cargo un-securing	3	A-II/1
	… to inspect and report defects and damages to cargo spaces, hatch covers and ballast tanks	3 A-II/1	A-II/1
	… to monitor compliance with legislative requirements	3	A-II/1
	… to monitor cargo or mission related equipment by remote control	3	MASS
	… to monitor the interfaces of the MASS to terminal and port operations	3	MASS
	… to support cargo or mission operations by providing all required information to other parties involved	3	MASS
	… to monitor persons (crew and passengers) on the MASS	3	MASS
	… to monitor and check specific MASS systems (automated berthing systems, ship-shore-connections, cargo operation remote monitoring systems)	3	MASS
	… to use remote controlled or autonomous systems to control stability, trim, and stress	3	MASS
	… to use remotely controlled or autonomous pumping systems for liquids (ballast water, fuels, …), and to control remotely tank filling	3	MASS
	… to monitor remote the ship stability, trim, and stress	3	MASS
	… to inspect a MASS for structural damages and report these when the MASS is in the port.	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to consider compliance with legislative requirements ensuring safe cargo handling (as CSS-Code, IMDG-Code, IMSBC-Code, MARPOL, IS-Code, accident prevention)	4	A-II/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to ensure and operate a safe discharging, taking all cargo properties into account	5	A-II/2
	… to ensure a safe un-securing and handling of cargoes	5	A-II/2
	… to control trim, stability, and stress by using tables, diagrams and automatic data-based equipment	5	A-II/2
	… to control trim, stability, and stress in regard of fundamental principles of ship construction, theories, and affecting factors	5	A-II/2
	… to evaluate the stability and reliability of the MASS	5	MASS
	… to evaluate the reliability of the remote stability control system	5	MASS
	… to assess reported defects and damage to cargo spaces, hatch covers, and ballast tanks, and take appropriate action	5	A-II/2
	… to discharge dangerous cargo according to IMDG and IMSBC Codes	5	A-II/2
	… to evaluate the stability and reliability of the remote stability control system	5	MASS
	… to handle luggage and personal effects safely	5	MASS
	regarding communication and cooperation		
	… to establish effective communication and working relationship between ship and terminal personnel	5	A-II/2

Process 2.4	Cargo Discharging & Persons Disembarkation		
	... to coordinate all activities o control stability, trim and strength of a MASS	5	MASS
Additional comments	The required competences regarding the loading and boarding process are the same for each MASS use case. The differences are determined by the cargo provisions.		

3 Navigation

3.1 Navigation when Leaving Port

3.1.1 Passage Planning

Process 3.1.1	**Navigation when Leaving Port - Passage Planning**			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To prepare a passage plan from berth to berth			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator > Senior Engineer	**Level** > Management > Operational > Management	**in ROC** > Planning station > Planning station > Planning station	**RACI** R, A C R
Interfaces	> Shipping company - operations, charterer, ship planner > Navigational data provider (weather forecasts, electronic charts, …)			
Event: input	Order to sail from the port of departure to the port of destination			
Process description	Plan the passage : > Prepare the passage plan (waypoints, courses, speed) > Determine and plan specific manoeuvres > Consider environmental conditions, water depth, obstructions, etc. > Determine communication requirements with VTS, ports, pilots, etc. > Update all navigational data as electronic navigational charts, nautical publications, MSI, … > Check availability of navigational systems and plan probable required maintenance > Confirmation and release of passage plan by MASS Master or Supervisor			
Resources needed	Equipment: > Navigational systems, e.g., ECDIS > Publications Information and Data: > Voyage schedule > Navigational data, MIS, weather forecasts > Data for updating of navigational systems (charts, publications) > MASS status (navigational, propulsion, persons on board, draught, …)			
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations			
Event: output	Prepared and approved passage plan			
Required competences **MASS Navigator**	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to understand radar and ARPA regarding performance, use, types and limitations		**C/L** *2*	**STCW** A-II/1

Process 3.1.1	Navigation when Leaving Port - Passage Planning		
Operational Level	… to understand ECDIS regarding capabilities and limitations *regarding using and applying (C/L 3) and analysing (C/L 4)*	2	A-II/1
	… to plan a passage by applying terrestrial and coastal navigation	3	A-II/1
	… to plan a passage by using electronic systems	3	A-II/1
	… to plan a passage by using and interpreting meteorological information	4	A-II/1
	… to prepare a passage plan	3	A-II/1
	… to use radar and ARPA to maintain safety of navigation	3	A-II/1
	… to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	… to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	… to plan a passage with consideration of MASS relevant communication and data transfer demands	4	MASS
	… to plan a passage with consideration of MASS relevant navigational aids	4	MASS
	… to prepare all navigational and communication systems of a MASS for operation, as updates and settings	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to plan a passage for all conditions by using all acceptable methods of plotting ocean tracks	5	A-II/2
	… to determine positions and assess accuracy of the resultant position fix by terrestrial observations	5	A-II/2
	… to determine positions and assess accuracy of the resultant position fix by modern electronic navigational aids	5	A-II/2
	… to establish watchkeeping arrangements and procedures	5	A-II/2
	… to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	… to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	… to forecast weather and oceanographic conditions	5	A-II/2
	… to evaluate and release a passage plan for a MASS	5	MASS
	… to evaluate provided navigational data and information with respect to the demands of a MASS	5	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to plan a passage of a MASS with specific evaluation and consideration of energy consumption	5	MASS
	… to plan a passage of a MASS with specific evaluation and consideration of availability of propulsion and auxiliary systems	5	MASS
Additional comments	./.		

3.1.2 Departure / De-Berthing

Process 3.1.2	**Navigation when Leaving Port - Departure / De-Berthing**					
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre (direct control)					
Process objectives	To leave the berth safely and to start pilotage					
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Direct control st. > Direct control st.	**RACI** R, A C		
Interfaces	> Navigational data provider (weather forecasts, electronic charts, …) > Port control > Local port AFS, Local port facilities > Local pilot (remote or on board)					
Event: input	Order for departure					
Process description	Prepare leaving berth -> ‘ready to go’ > Check systems and maintain status of ship systems and controls for integrity and availability for de-berthing > Get port clearance > Ensure watertight integrity > Check for all people from board and all PAX and service crew on board > Change to autonomous operations > Disconnect all in autonomous or manual mode (power, water, fuel, gangway,…) Leaving > Monitor the MASS manoeuvres in autonomous mode. > Change to direct control if required by system or situation or environmental conditions > Let-go all (release MASS, start passage) > Incorporate pilot (on board or by remote advice) > Manoeuvre MASS to fairway					
Resources needed	Equipment on board > Navigational systems (ECDIS, radar, AIS, sounder, specific positioning system,…) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)					
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations					
Event: output	MASS is de-berthed and is in position to start pilotage					
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to understand radar and ARPA regarding performance, use, types, and limitations … to understand ECDIS regarding capabilities and limitations … to explain the manoeuvring and handling of a ship			**C/L** *2* 2 2	**STCW** A-II/1 A-II/1 A-II/1	

Process 3.1.2	Navigation when Leaving Port - Departure / De-Berthing		
	... to discuss the application of MASS-specific systems and their use for autonomous ships	2	MASS
	... to explain the handling of a MASS regarding the mooring equipment and the use of automated port facilities	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	... to conduct a passage and determine a position by using electronic systems	3	A-II/1
	... to conduct a passage and determine a position by using echo-sounders	3	A-II/1
	... to conduct a passage and determine a position by using magnetic and gyro compasses	3	A-II/1
	... to conduct a passage by using and adjusting steering control systems	3	A-II/1
	... to conduct a passage by using and interpreting meteorological information	4	A-II/1
	... to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	... to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	... to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	... to use radar and ARPA to maintain safety of navigation	4	A-II/1
	... to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	... to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	... to operate the navigational and communication system of a MASS	3	MASS
	... to explain the handling of a MASS regarding the mooring equipment and the use of automated port facilities	2	MASS
	... to use specific navigational aids for MASS	3	MASS
	... to use remotely all navigational tools to verify and assess the MASS position, course, and speed	4	MASS
	... to interpret remotely the environmental conditions and to verify and assess the status of the MASS in the sea	4	MASS
	... to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	... to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	... to monitor the automated functionalities of a MASS	4	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	... to take over the manual control from automated systems in all situations	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding evaluating (C/L 5) and creating (C/L 6)		
	... to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	... to determine positions and assess accuracy of the resultant position fix by modern electronic navigational aids	5	A-II/2

Process 3.1.2	Navigation when Leaving Port - Departure / De-Berthing		
	... to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	... to establish watchkeeping arrangements and procedures		
	... to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5 5	A-II/2 A-II/2
	... to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	... to forecast weather and oceanographic conditions	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially when unberthing or undocking and when using tugs	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially manoeuvring in restricted and shallow waters	5	A-II/2
	... to take over the command by changing from automated to manual mode of a MASS	5	MASS
	... to communicate remotely with port services when berthing or unberthing	4	MASS
	... to berth and unberth a MASS based on sensor data	5	MASS
	... to handle a MASS safely in all manoeuvres as berthing, anchoring, fairway and sea passages	5	MASS
	... to handle a MASS according to environmental influences	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	./.		

3.2 Navigation on Pilotage - Outbound

Process 3.2	Navigation on Pilotage - Outbound			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Control Centre **MASS without crew on board** > Remote Control Centre (direct control)			
Process objectives	To navigate the MASS safely through restricted waters in pilotage conditions			
Process operators	**MASS operators in RCC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in RCC** > Direct control st. > Direct control st.	**RACI** R, A R
Interfaces	> Navigational data provider (weather forecasts, electronic charts, navigational aids, …) > Port control			

Process 3.2	Navigation on Pilotage - Outbound		
	> Local port AFS, Local port facilities > Local pilot (remote or on board) > Other ships, VTS		
Event: input	Commence of pilotage		
Process description	Navigate the MASS through restricted waters: > Change to autonomous mode and monitor the MASS conditions > Monitor position of MASS and water depth > Monitor the traffic situation > Monitor the movement of the MASS and identify influences such as by currents, wind impact squat, interactions, etc > Change to direct control if required by system, situation, or environmental conditions > Incorporate the pilot (on board or remotely) and take pilots advice, coordinate with MASS system		
Resources needed	Equipment on board > Navigational systems (ECDIS, radar, AIS, sounder, local positioning systems, …) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)		
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations		
Event: output	End of pilotage outbound, commence of sea passage		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to understand radar and ARPA regarding performance, use, types, and limitations	*2*	A-II/1
	… to understand ECDIS regarding capabilities and limitations	2	A-II/1
	… to explain the manoeuvring and handling of a ship	2	A-II/1
	… to explain the navigational and communication system of a MASS	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to conduct a passage and determine a position by applying terrestrial and coastal navigation	2	MASS
	… to conduct a passage and determine a position by using electronic systems	3	A-II/1
	… to conduct a passage and determine a position by using echo-sounders	3	A-II/1
	… to conduct a passage and determine a position by using magnetic and gyro compasses	3	A-II/1
	… to conduct a passage by using and adjusting steering control systems	3	A-II/1
	… to conduct a passage by using and interpreting meteorological information	3	A-II/1
	… to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	… to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	4	A-II/1

Process 3.2	Navigation on Pilotage - Outbound		
	... to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	... to use radar and ARPA to maintain safety of navigation	3	A-II/1
	... to operate radar navigation by interpreting and analysing radar and ARPA information	3	A-II/1
	... to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	... to apply collision-avoidance regulations for a MASS	4	MASS
	... to use specific navigational aids for MASS	3	MASS
	... to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	... to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	... to initiate manoeuvres of the MASS to avoid collisions	4	MASS
	... to control the speed and course remotely according to the manoeuvring parameters of the MASS	4	MASS
	... To take-over control according to levels of alarm	4	MASS
	... to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	... to monitor cellular and satellite communication networks	4	MASS
	... to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	... to monitor the automated functionalities of a MASS	4	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	... to take control from automated systems according to alarm levels	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	... to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	... to determine positions and assess accuracy of resultant position fix by modern electronic navigational aids	5	A-II/2
	... to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	... to establish watchkeeping arrangements and procedures	5	A-II/2
	... to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	... to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	... to forecast weather and oceanographic conditions	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially when unberthing or undocking, and when using tugs	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially manoeuvring in restricted and shallow waters	5	A-II/2
	... to take over command by changing from automated to manual mode of a MASS	5	MASS
	... to manoeuvre a MASS based on sensor data	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS

Process 3.2	Navigation on Pilotage - Outbound		
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	./.		

3.3 Navigation on Sea Passage

Process 3.3	Navigation on Sea Passage			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Control Centre **MASS without crew on board** > Remote Control Centre (monitoring station)			
Process objectives	To navigate the MASS safely on the sea passage in monitoring conditions			
Process operators	**MASS operators in RCC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in RCC** > Monitoring station > Monitoring station	**RACI** R, A R
Interfaces	> Navigational data provider (weather forecasts, electronic charts, navigational aids, …) > Other ships, VTS			
Event: input	Commence of sea passage			
Process description	Navigate the MASS through open sea: > Navigate in autonomous mode and monitor the MASS conditions > Monitor the state of the MASS fleet and the single MASS, change to single MASS if required (alarms, conditions, checks) > Monitor the state of all sensors and operate checks of critical systems > Monitor that the MASS system keeps within set limitations > Change parameters and settings of the MASS system as appropriate to keep the MASS in required operational conditions > Change to direct communication with other stations if required by navigational situations > Change to a direct control station if required by system or situation or environmental conditions > Identify malfunctions and arising emergency situations and alert direct control stations and experts to take over			
Resources needed	Equipment on board > Navigational systems (ECDIS, radar, AIS, sounder, local positioning systems, …) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)			

Process 3.3	Navigation on Sea Passage		
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local coastal state traffic regulations		
Event: output	End of sea passage, change to pilotage inbound		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to understand radar and ARPA regarding performance, use, types, and limitations	*2*	A-II/1
	… to understand ECDIS regarding capabilities and limitations	2	A-II/1
	… to explain the manoeuvring and handling of a ship	2	A-II/1
	… to explain the navigational and communication system of a MASS	2	MASS
	… to explain the handling of a MASS regarding the mooring equipment and the use of automated port facilities	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to conduct a passage and determine a position by applying terrestrial and coastal navigation	3	A-II/1
	… to conduct a passage and determine a position by using electronic systems	3	A-II/1
	… to conduct a passage and determine a position by using echo-sounders	3	A-II/1
	… to conduct a passage and determine a position by using magnetic and gyro compasses	3	A-II/1
	… to conduct a passage by using and adjusting steering control systems	3	A-II/1
	… to conduct a passage by using and interpreting meteorological information	4	A-II/1
	… to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	… to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	… to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	… to use radar and ARPA to maintain safety of navigation	3	A-II/1
	… to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	… to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	… to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	… to apply collision-avoidance regulations for a MASS	4	MASS
	… to use specific navigational aids for MASS	4	MASS
	… to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	… to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	… to use specific navigational aids for MASS	3	MASS
	… to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS

Process 3.3	Navigation on Sea Passage		
	... to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	... to monitor cellular and satellite communication networks	4	MASS
	... to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	... to monitor the automated functionalities of a MASS	4	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	... to take over control from automated systems according to alarm levels	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	... to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	... to determine positions and assess accuracy of resultant position fix by modern electronic navigational aids	5	A-II/2
	... to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	... to establish watchkeeping arrangements and procedures	5	A-II/2
	... to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	... to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	... to forecast weather and oceanographic conditions	5	A-II/2
	... to manoeuvre and handle a ship in all conditions	5	A-II/2
	... to take over the command by changing from automated to manual mode of a MASS	5	MASS
	... to manoeuvre a MASS based on sensor data	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	./.		

3.4 Navigation on Pilotage - Inbound

Process 3.4	Navigation on Pilotage - Inbound
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Control Centre **MASS without crew on board** > Remote Control Centre (direct control)

Process 3.4	Navigation on Pilotage - Inbound					
Process objectives	To navigate the MASS safely through restricted waters in pilotage conditions					
Process operators	**MASS operators in RCC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in RCC** > Direct control st. > Direct control st.	**RACI** R, A C		
Interfaces	> Navigational data provider (weather forecasts, electronic charts, navigational aids, …) > Port control > Local port AFS, Local port facilities > Local pilot (remote or on board) > Other ships, VTS					
Event: input	Commence of pilotage					
Process description	Navigate the MASS through restricted waters: > Monitor position of MASS and water depth > Monitor the traffic situation > Monitor the movement of the MASS and identify influences as by currents, wind impact squat, interactions > Change to direct control if required by system or situation or environmental conditions > Incorporate the pilot (on board or remotely) and take pilots advice, coordinate with MASS system					
Resources needed	Equipment on board > Navigational systems (ECDIS, radar, AIS, sounder, local positioning systems, …) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)					
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations					
Event: output	Arrival at berth, start of mooring manoeuvre					
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to understand radar and ARPA regarding performance, use, types, and limitations … to understand ECDIS regarding capabilities and limitations … to explain the manoeuvring and handling of a ship … to explain the navigational and communication system of a MASS *regarding using and applying (C/L 3) and analysing (C/L 4)* … to conduct a passage and determine a position by applying terrestrial and coastal navigation … to conduct a passage and determine a position by using electronic systems … to conduct a passage and determine a position by using echo-sounders … to conduct a passage and determine a position by using magnetic and gyro compasses … to conduct a passage by using and adjusting steering control systems … to conduct a passage by using and interpreting meteorological information				**C/L** *2* 2 2 2 3 3 3 3 3 4	**STCW** A-II/1 A-II/1 A-II/1 MASS A-II/1 A-II/1 A-II/1 A-II/1 A-II/1 A-II/1

Process 3.4	Navigation on Pilotage - Inbound		
	… to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	… to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	… to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	… to use radar and ARPA to maintain safety of navigation	3	A-II/1
	… to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	… to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	… to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	… to apply collision-avoidance regulations for a MASS	4	MASS
	… to use specific navigational aids for MASS	4	MASS
	… to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	… to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	… to use specific navigational aids for MASS	3	MASS
	… to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	… to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	… to monitor cellular and satellite communication networks	4	MASS
	… to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	… to monitor the automated functionalities of a MASS	4	MASS
	… to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	… to take over the control from automated systems according to alarm levels	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	… to determine positions and assess accuracy of resultant position fix by modern electronic navigational aids	5	A-II/2
	… to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	… to establish watchkeeping arrangements and procedures	5	A-II/2
	… to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	… to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	… to forecast weather and oceanographic conditions	5	A-II/2
	… to manoeuvre and handle a ship in all conditions, especially when un-berthing or un-docking and when using tugs	5	A-II/2

Process 3.4	Navigation on Pilotage - Inbound		
	... to manoeuvre and handle a ship in all conditions, especially manoeuvring in restricted and shallow waters	5	A-II/2
	... to take over command by changing from automated to manual mode of a MASS	5	MASS
	... to manoeuvre a MASS based on sensor data	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	./.		

3.5 Navigation when Entering the Port

3.5.1 Anchoring

Process 3.5.1	Navigation when Entering the Port - Anchoring			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre (direct control)			
Process objectives	To anchor the MASS in waiting position			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in ROC** > Direct control st. > Direct control st.	**RACI** R, A C
Interfaces	> Navigational data provider (weather forecasts, electronic charts, …) > VTS, port control > Local pilot (remote or on board)			
Event: input	Order for anchoring			
Process description	Prepare anchoring and drop anchor: > Check and maintain status of ship systems and controls for integrity and availability for mooring operations > Change to direct control and monitor automated manoeuvre > Incorporate pilot if required (on board or by remote advice) > Prepare anchoring system, anchors ready to drop > Drop anchor and check the holding Anchor watch > Monitor anchor position and surrounding traffic > Monitor communication with VTS, pilots, and other ships > Change to direct control if required by system or situation or environmental conditions			

Process 3.5.1	Navigation when Entering the Port - Anchoring		
	Heaving anchor and proceeding > Prepare anchoring system for heaving anchor > Monitor the manoeuvre in direct control condition > Secure anchors when manoeuvre is finished > Change to appropriate control mode to continue with the passage		
Resources needed	Equipment > Navigational systems (ECDIS, radar, AIS, sounder, specific positioning system, …) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)		
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations		
Event: output	Anchors up and passage can be continued		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the handling of a MASS regarding the anchoring equipment	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to conduct a passage and determine a position by using electronic systems	3	A-II/1
	… to conduct a passage and determine a position by using echo-sounders	3	A-II/1
	… to conduct a passage and determine a position by using magnetic and gyro compasses	3	A-II/1
	… to conduct a passage by using and adjusting steering control systems	3	A-II/1
	… to conduct a passage by using and interpreting meteorological information	4	A-II/1
	… to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	… to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	… to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	… to use radar and ARPA to maintain safety of navigation	4	A-II/1
	… to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	… to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	… to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	… to use specific navigational aids for MASS	3	MASS
	… to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	… to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	… to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	… to monitor the automated functionalities of a MASS	4	MASS

Process 3.5.1	Navigation when Entering the Port - Anchoring		
	... to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	... to take over control from automated systems according to alarm levels	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	... to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	... to determine positions and assess accuracy of resultant position fix by modern electronic navigational aids	5	A-II/2
	... to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	... to establish watchkeeping arrangements and procedures	5	A-II/2
	... to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	... to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	... to forecast weather and oceanographic conditions	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially when anchoring	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially manoeuvring in restricted and shallow waters	5	A-II/2
	... to take over command by changing from automated to manual mode of a MASS	5	MASS
	... to anchor a MASS based on sensor data	5	MASS
	... to handle a MASS safely in all manoeuvres as berthing, anchoring, fairway and sea passages	5	MASS
	... to handle a MASS according to environmental influences	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	This process can also be applied in other circumstances such as anchoring in shelter positions or in case of malfunctions		

3.5.2 Arrival / Berthing

Process 3.5.2	Navigation when Entering the Port - Arrival / Berthing
Scope of application	**All types of MASS** D) Dry Cargo – Container Feeder – short sea E) Ferry – RoPax – one hour passage F) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Control Centre **MASS without crew on board** > Remote Control Centre (direct control)

Process 3.5.2	**Navigation when Entering the Port - Arrival / Berthing**					
Process objectives	To berth the MASS safely in the planned position					
Process operators	**MASS operators in RCC** > Senior Navigator > Navigator	**Level** > Management > Operational	**in RCC** > Direct control st. > Direct control st.	**RACI** R, A C		
Interfaces	> Navigational data provider (weather forecasts, electronic charts, …) > Port control > Local port AFS, Local port facilities > Local pilot (remote or on board)					
Event: input	MASS in position to start mooring manoeuvre					
Process description	Prepare mooring operations: > Check and maintain status of ship systems and controls for integrity and availability for mooring operations > Incorporate pilot (on board or by remote advice) Mooring > Monitor the manoeuvring of the MASS to the berth > Change to direct control if required by system or situation or environmental conditions > Check for all vessel fixing connections (lines or other devices) > Connect all (power, water, fuel, gangway, …) Arrival > Check for all PAX and service crew from board > Switch automation systems to port conditions					
Resources needed	Equipment > Navigational systems (ECDIS, radar, AIS, sounder, specific positioning system, …) > Information systems (publications, MIS, forecasts, traffic information) > Sensor data (MASS status)					
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations					
Event: output	MASS is moored, port operations can start					
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to understand radar and ARPA regarding performance, use, types, and limitations … to understand ECDIS regarding capabilities and limitations … to explain the manoeuvring and handling of a ship … to explain the navigational and communication system of a MASS … to explain the handling of a MASS regarding the mooring equipment and the use of automated port facilities *regarding using and applying (C/L 3) and analysing (C/L 4)* … to conduct a passage and determine a position by using electronic systems … to conduct a passage and determine a position by using echo-sounders … to conduct a passage and determine a position by using magnetic and gyro compasses				**C/L** *2* 2 2 2 2 3 3 3	**STCW** A-II/1 A-II/1 A-II/1 MASS MASS A-II/1 A-II/1 A-II/1

Process 3.5.2	Navigation when Entering the Port - Arrival / Berthing		
	... to conduct a passage by using and adjusting steering control systems	3	A-II/1
	... to conduct a passage by using and interpreting meteorological information	4	A-II/1
	... to maintain a safe navigational watch by analysing traffic situations and applying the international Regulations for Preventing Collisions at Sea	4	A-II/1
	... to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	... to maintain a safe navigational watch by applying bridge resource management principles	3	A-II/1
	... to use radar and ARPA to maintain safety of navigation	4	A-II/1
	... to operate radar navigation by interpreting and analysing radar and ARPA information	4	A-II/1
	... to operate ECDIS by interpreting and analysing of information obtained from ECDIS	4	A-II/1
	... to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	... to use specific navigational aids for MASS	3	MASS
	... to use all navigational tools remotely to verify and assess the MASS position, course and speed	4	MASS
	... to interpret the environmental conditions remotely and to verify and assess the status of the MASS in the sea	4	MASS
	... to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	... to monitor the automated functionalities of a MASS	4	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	4	MASS
	... to take over the control from automated systems	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	... to determine positions and assess accuracy of resultant position fix by terrestrial observations	5	A-II/2
	... to determine positions and assess accuracy of resultant position fix by modern electronic navigational aids	5	A-II/2
	... to determine and allow for compass errors (magnetic and gyro)	5	A-II/2
	... to establish watchkeeping arrangements and procedures	5	A-II/2
	... to maintain safe navigation through the use of information from navigation equipment and systems to assist command decision making	5	A-II/2
	... to maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making	5	A-II/2
	... to forecast weather and oceanographic conditions	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially when berthing or docking, and when using tugs	5	A-II/2
	... to manoeuvre and handle a ship in all conditions, especially manoeuvring in restricted and shallow waters	5	A-II/2
	... to take over command by changing from automated to manual mode of a MASS	5	MASS

Process 3.5.2	Navigation when Entering the Port - Arrival / Berthing		
	... to communicate remotely with port services when berthing or unberthing	4	MASS
	... to handle a MASS safely in all manoeuvres such as berthing, anchoring, fairway, and sea passages	5	MASS
	... to handle a MASS according to environmental influences	5	MASS
	... to berth and unberth a MASS based on sensor data	5	MASS
	... to evaluate and ensure the data and information exchange between MASS and all relevant stations	5	MASS
	... to evaluate the reliability of data and information provided by sensor systems	5	MASS
	... to coordinate and adjust the different automated functionalities of a MASS	5	MASS
	... to analyse and adjust automated systems in terms of navigational parameters	5	MASS
Additional comments	./.		

3.6 Port stay

Process 3.6	Port Stay			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Control Centre **MASS without crew on board** > Remote Control Centre			
Process objectives	To stay safely in the port with focus on the MASS safety			
Process operators	**MASS operators in RCC** > Navigator	**Level** > Operational	**in RCC** > Monitoring station	**RACI** R, A
Interfaces	> Port control > Local port AFS and port facilities > Terminal			
Event: input	Moored MASS, commence of port operations			
Process description	Maintaining a port watch with focus to safe condition of the MASS > Monitoring all MASS-shore connections > Monitoring environmental conditions to identify hazardous situations > Monitoring of availability of all MASS systems required in the port > Operating of remote-controlled equipment			
Resources needed	Equipment > MASS status information > Sensor data (MASS status)			
Regulations	International regulations MASS flag state traffic regulations Local port state and coastal state traffic regulations			
Event: output	MASS in safe and operational conditions			

Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the navigational and communication system of a MASS	2	MASS
	… to explain the handling of a MASS regarding the mooring equipment and the use of automated port facilities	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to observe meteorological information	4	A-II/1
	… to maintain a safe navigational watch by using all equipment, provisions, information, regulations, principles, techniques, and procedures for watchkeeping	3	A-II/1
	… to monitor and operate all connections of the MASS with the shore	4	MASS
	… to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	… to monitor and operate sensor systems by interpretation and analysing reliability of provided information	4	MASS
	… to monitor the automated functionalities of a MASS	4	MASS
	… to analyse and adjust automated systems in terms of operational parameters	4	MASS
	… to take over control from automated systems according to alarm levels	4	MASS
Additional comments	./.		

4 Engineering Operations

4.1 Utilisable Condition of MASS System

4.1.1 Bunker and Supply

Process 4.1.1	**Utilisable Condition of MASS System - Bunker and Supply**			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To provide the MASS with all fuel, power, provisions, consumables for the passage			
Process operators	**MASS operators in ROC** > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Operational	**in ROC** > Planning station > Monitoring station > Monitoring station	**RACI** R, A R C
Interfaces	> Terminal and port facilities > Service providers > Shipping company - operations			
Event: input	Status of products and material on board, battery charging status			
Process description	> Connect all automated supply lines > Monitor supply operations > Initiate securing of the area and avoiding environmental impact > Load spare parts			
Resources needed	Equipment > Bunkering and charging systems > Ballast and tank system			
Regulations	International regulations MASS flag state traffic regulations Local port state regulations			
Event: output	MASS is able to sail the planned voyage			
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the provisions and requirements of non-fossil fuels *regarding using and applying (C/L 3) and analysing (C/L 4)* … to ensure compliance with pollution-prevention requirements … to maintain seaworthiness of the ship, especially ship stability, trim, stress, and watertight integrity … to maintain seaworthiness of the ship and to take fundamental action in the event of partial loss of intact stability … to operate and control automated bunker systems with monitoring and control functions		**C/L** 2 3 3 3	**STCW** MASS A-III/1 A-III/1 A-III/1 MASS

	… to operate and monitor automated battery charging system with monitoring and control functions	3	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to plan and schedule operations by consideration of physical and chemical properties of fuels and lubricants … to manage fuel, lubrication, and ballast operations including the operation of machinery such as pumps and piping systems … to manage automated and remote-controlled bunkering systems … to manage automated and remote-controlled battery charging systems	**C/L** 5 5 5 5	**STCW** A-III/2 A-III/2 MASS MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able… *regarding using and applying (C/L 3) and analysing (C/L 4)* … to ensure compliance with pollution-prevention requirements … to operate and monitor automated battery charging systems	**C/L** 3 3	**STCW** A-III/6 MASS
Additional comments	./.		

4.1.2 System Checks

Process 4.1.2	**Utilisable Condition of MASS system - Systems Checks**			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To ensure that the MASS is fully utilisable and available with all functionalities necessary to sail a safe voyage			
Process operators	**MASS operators in ROC** > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R, A R C
Interfaces	> All MASS and ROC systems			
Event: input	Voyage order with operational parameters			
Process description	> Check and prepare of propulsion systems (according to type of ship and propulsion system) > Check and prepare all auxiliary systems (according to ship type) > Check and prepare automation and communication systems > Operate plausibility checks for system integrity and reliability > Confirm “ready to go” status			
Resources needed	Equipment > All MASS systems			

Process 4.1.2	Utilisable Condition of MASS system - Systems Checks		
Regulations	International regulations MASS flag state traffic regulations Local port state regulations		
Event: output	MASS with all systems is “ready to go”		
Required competences **MASS Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate remote controls of propulsion plant and engineering systems and services	**C/L** 4	**STCW** A-II/2
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the ship construction … to explain the entire automation system with interfaces and control parameters … to explain the digital twin of the MASS *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate system checks of automated systems by using operational scenarios	**C/L** 2 2 2 3	**STCW** A-III/1 MASS MASS MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to apply the IMO regulations about control trim, stability, and stress *regarding evaluating (C/L 5) and creating (C/L 6)* … to plan and schedule operations by consideration of technology of materials and ship construction … to operate, observe, assess performance and maintain safety of propulsion plant and auxiliary machinery … to manage operation of electrical and electronic control equipment … to control trim, stability, and stress and take measures to preserve trim and stability … to evaluate system checks based on operational scenarios and to manage corrective measures … to evaluate systems integrity and reliability by applying plausibility checks and using digital twins … to evaluate the reliability of data and information provided by sensor systems … to coordinate and adjust the different automated functionalities of a MASS	**C/L** 3 5 5 5 5 5 5 5	**STCW** A-III/2 A-III/2 A-III/2 A-III/2 MASS MASS MASS MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to monitor the operation of electrical, electronic, and control systems … to monitor the operation of automatic control systems of propulsion and auxiliary machinery … to operate generators and distribution systems … to operate and maintain power systems in excess of 1,000 volts … to operate computers and computer networks on ships	**C/L** 4 4 3 4 3	**STCW** A-III/6 A-III/6 A-III/6 A-III/6 A-III/6

Process 4.1.2	Utilisable Condition of MASS system - Systems Checks		
	... to use internal communication systems	3	A-III/6
	... to operate system checks of automated systems by using operational scenarios	3	MASS
Additional comments	./.		

4.2 Control of MASS Performance

4.2.1 Auxiliary and Machinery Systems

Process 4.2.1	Control of MASS Performance - Auxiliary and Machinery Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To keep all auxiliary and machinery systems available and operate them on required performance levels			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Senior Engineer	> Management	> Monitoring station	R, A
	> Engineer	> Operational	> Monitoring station	R
	> System Administrator	> Operational	> Monitoring station	C
Interfaces	> All MASS auxiliary and machinery systems			
Event: input	MASS is in operations			
Process description	> Control of automated auxiliary and machinery systems, in engine, deck and accommodation departments > Control of automated power management and availability of systems			
Resources needed	Equipment > All auxiliary and machinery systems			
Regulations	International regulations MASS flag state traffic regulations Local port state regulations			
Event: output	All auxiliary and machinery systems are operating as required			
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*		**C/L**	**STCW**
	... to explain the fundamentals of process data processing		2	MASS
	... to explain fundamentals of mathematics and statistics in terms of operation engineering		2	MASS
	... to explain the sensor technologies used in automated systems		2	MASS
	... to explain robotic technologies and how to use them in MASS operation engineering		2	MASS
	... to discuss MASS-specific propulsion and auxiliary systems and their use for autonomous ships		2	MASS
	... to explain the limitations of automation, e.g., in challenging environmental conditions		2	MASS

Process 4.2.1	Control of MASS Performance - Auxiliary and Machinery Systems		
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to maintain a safe engineering watch, keeping the watch with all duties	3	A-III/1
	… to use internal communication systems	3	A-III/1
	… to operate main and auxiliary machinery and associated control systems	3	A-III/1
	… to operate fuel, lubrication, ballast, and other pumping systems and associated control systems	3	A-III/1
	… to operate electrical, electronic, and control systems	3	A-III/1
	… to monitor cellular and satellite communication networks	4	MASS
	… to take over manual control from automated systems in all situations	4	MASS
	… to monitor and operate the data and information exchange between MASS and all relevant stations	4	MASS
	… to monitor and operate sensor systems by interpreting and analysing reliability of provided information	4	MASS
	… to monitor the automated functionalities of a MASS	4	MASS
	… to analyse and adjust automated systems in terms of engineering parameters	4	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to analyse the automatic control systems by diagnostic applications	4	MASS
	… to analyse automatic control systems by using digital twins	4	MASS
	… to use robotic systems for inspections on MASS	3	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to plan and schedule operations by consideration of physical fundamentals	5	A-III/2
	… to plan and schedule operations for refrigeration systems	5	A-III/2
	… to perform operations, surveillance, performance assessment, and maintain safety of auxiliary machinery	5	A-III/2
	… to manage operation of electrical and electronic control equipment	5	A-III/2
	… to manage troubleshooting, and restoration of electrical and electronic control equipment to operating condition	5	A-III/2
	… to evaluate the performance of auxiliary and machinery automatic controlled systems	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the fundamentals of process data processing	2	MASS
	… to explain fundamentals of mathematics and statistics in terms of operation engineering	2	MASS
	… to explain the sensor technologies used in automated systems	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor the operation of electrical, electronic and control systems	4	A-III/6
	… to monitor the operation of automatic control systems of propulsion and auxiliary machinery	4	A-III/6
	… to operate generators and distribution systems	3	A-III/6
	… to operate and maintain power systems in excess of 1,000 volts	4	A-III/6
	… to operate computers and computer networks on ships	3	A-III/6

Process 4.2.1	Control of MASS Performance - Auxiliary and Machinery Systems		
	… to use internal communication systems	3	A-III/6
	… to monitor cellular and satellite communication networks	4	MASS
Additional comments	./.		

4.2.2 Propulsion Systems

Process 4.2.2	Control of MASS Performance - Propulsion Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To keep all propulsion systems available and operate them on required performance levels			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Senior Engineer	> Management	> Monitoring station	R, A
	> Engineer	> Operational	> Monitoring station	R
	> System Administrator	> Operational	> Monitoring station	C
Interfaces	> All MASS propulsion systems			
Event: input	MASS is in operations			
Process description	> Control of automated propulsion systems			
Resources needed	Equipment > All propulsion systems (as main engine, wind systems, electric motors and generators, steering gear, rudder, propellers, thrusters, azimuth drives)			
Regulations	International regulations MASS flag state traffic regulations Local port state regulations			
Event: output	All propulsion systems are operating as required			
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*		**C/L**	**STCW**
	… to explain the fundamentals of process data processing		2	MASS
	… to explain fundamentals of mathematics and statistics in terms of operation engineering		2	MASS
	… to explain the sensor technologies used in automated systems		2	MASS
	… to explain robotic technologies and how to use them in MASS operation engineering		2	MASS
	… to discuss MASS-specific propulsion and auxiliary systems and their use for autonomous ships		2	MASS
	… to explain the limitations of automation, e.g., in challenging environmental conditions		2	MASS

Process 4.2.2	Control of MASS Performance - Propulsion Systems		
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to maintain a safe engineering watch, keeping the watch with all duties	3	A-III/1
	… to use internal communication systems	3	A-III/1
	… to operate main and auxiliary machinery and associated control systems	3	A-III/1
	… to operate fuel, lubrication, ballast, and other pumping systems and associated control systems	3	A-III/1
	… to operate electrical, electronic, and control systems	3	A-III/1
	… to operate wind propulsion systems (as Flettner rotors, rigid sails)	3	MASS
	… to operate fuel cells	3	MASS
	… to operate power generation by solar cells and wind turbines	3	MASS
	… to monitor cellular and satellite communication networks	4	MASS
	… to take over manual control from automated systems in all situations	4	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to operate remote controls of propulsion plant	4	A-II/2
	… to analyse the automatic control systems by diagnostic applications	4	MASS
	… to analyse automatic control systems by using digital twins	4	MASS
	… to use robotic systems for inspections on MASS	3	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to plan and schedule operations by consideration of physical fundamentals	5	A-III/2
	… to plan and schedule operations for refrigeration systems	5	A-III/2
	… to perform operations, surveillance, performance assessment, and maintain safety of auxiliary machinery	5	A-III/2
	… to manage operation of electrical and electronic control equipment	5	A-III/2
	… to manage troubleshooting, and restoration of electrical and electronic control equipment to operating condition	5	A-III/2
	… to evaluate the performance of propulsion automatic controlled systems	5	MASS
	… to evaluate the operability of new propulsion systems as wind systems, fuel cells, electric systems	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the fundamentals of process data processing	2	MASS
	… to explain fundamentals of mathematics and statistics in terms of operation engineering	2	MASS
	… to explain the sensor technologies used in automated systems	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor the operation of electrical, electronic, and control systems	4	A-III/6

Process 4.2.2	Control of MASS Performance - Propulsion Systems		
	... to monitor the operation of automatic control systems of propulsion and auxiliary machinery	4	A-III/6
	... to operate generators and distribution systems	3	A-III/6
	... to operate and maintain power systems in excess of 1,000 volts	4	A-III/6
	... to operate computers and computer networks on ships	3	A-III/6
	... to use internal communication systems	3	A-III/6
	... to monitor cellular and satellite communication networks	4	MASS
Additional comments	./.		

4.2.3 Performance Monitoring

Process 4.2.3	Control of MASS Performance - Performance Monitoring			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To control the MASS to stay within the planned performance parameters			
Process operators	**MASS operators in ROC** > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R, A R C
Interfaces	> All MASS systems > Shipping company - operations			
Event: input	MASS is in operations			
Process description	> Monitoring the technical MASS systems ... Monitoring of propulsion system ... Monitoring of auxiliary and machinery systems ... Monitoring of hotelling systems ... Identification of deviations ... Change of settings when appropriate ... Managing of alarms ... Taking actions to stabilise the MASS systems if required ... Calling experts when malfunctions occur ... Pass the MASS to direct control stations in cases of failure search and direct control activities			
Resources needed	Equipment > All technical automatic controlled systems > Sensor data (MASS status)			
Regulations	International regulations MASS flag state traffic regulations Local port state regulations			

Process 4.2.3	Control of MASS Performance - Performance Monitoring		
Event: output	The MASS is operating within the planned performance parameters		
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain hydrodynamic parameters, provisions of coatings, and air lubrication systems influencing hull performance	2	MASS
	… to explain physical parameters influencing MASS performance	2	MASS
	… to describe the system of sensors and how to use them to keep situational awareness	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to maintain a safe engineering watch, keeping the watch with all duties	3	A-III/1
	… to use internal communication systems	3	A-III/1
	… to operate main and auxiliary machinery and associated control systems	3	A-III/1
	… to operate fuel, lubrication, ballast, and other pumping systems and associated control systems	3	A-III/1
	… to operate electrical, electronic, and control systems	3	A-III/1
	… to operate the remote-control systems with its specific interfaces	3	MASS
	… to monitor cellular and satellite communication networks	4	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to plan and schedule operations by consideration of physical fundamentals	5	A-III/2
	… to plan and schedule operations for propulsion and auxiliary systems	5	A-III/2
	… to perform operations, surveillance, performance assessment, and maintaining safety of propulsion plant and auxiliary machinery	5	A-III/2
	… to manage operation of electrical and electronic control equipment	5	A-III/2
	… to evaluate the remote-control system for integrity and reliability	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to analyse the performance of automation control and data processing systems	4	MASS
	… to monitor cellular and satellite communication networks	4	MASS
Additional comments	./.		

4.2.4 Hotelling

Process 4.2.4	**Control of MASS Performance - Hotelling**				
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre				
Process objectives	To keep all hotelling systems available and operate them on required performance levels				
Process operators	**MASS operators in ROC** > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R, A R C	
Interfaces	> All MASS hotelling systems				
Event: input	MASS is in operations, persons on board				
Process description	> Control of automated hotelling systems				
Resources needed	Equipment > All propulsion systems (such as fresh water supply and sewage, ventilation and air condition, convenience systems)				
Regulations	International regulations MASS flag state traffic regulations Local port state regulations				
Event: output	All hotelling systems are operating as required				
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the fundamentals of process data processing … to explain fundamentals of mathematics and statistics in terms of operation engineering … to explain the sensor technologies used in automated systems … to explain robotic technologies and how to use them in MASS operation engineering *regarding using and applying (C/L 3) and analysing (C/L 4)* … to maintain a safe engineering watch, keeping the watch with all duties … to use internal communication systems … to operate main and auxiliary machinery and associated control systems … to operate fuel, lubrication, ballast and other pumping systems, and associated control systems … to operate electrical, electronic, and control systems			**C/L** 2 2 2 2 3 3 3 3 3	**STCW** MASS MASS MASS MASS A-III/1 A-III/1 A-III/1 A-III/1 A-III/1

Process 4.2.4	Control of MASS Performance - Hotelling		
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to analyse the automatic control systems by diagnostic applications	4	MASS
	… to analyse automatic control systems by using digital twins	4	MASS
	… to use robotic systems for inspections on MASS	3	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to plan and schedule operations by consideration of physical fundamentals	5	A-III/2
	… to plan and schedule operations for refrigeration systems	5	A-III/2
	… to perform operations, surveillance, performance assessment, and maintain safety of auxiliary machinery	5	A-III/2
	… to manage operation of electrical and electronic control equipment	5	A-III/2
	… to manage troubleshooting, and restoration of electrical and electronic control equipment to operating condition	5	A-III/2
	… to evaluate the performance of automatic controlled auxiliary systems	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the fundamentals of process data processing	2	MASS
	… to explain fundamentals of mathematics and statistics in terms of operation engineering	2	MASS
	… to explain the sensor technologies used in automated systems	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor the operation of electrical, electronic, and control systems	4	A-III/6
	… to monitor the operation of automatic control systems of propulsion and auxiliary machinery	4	A-III/6
	… to operate generators and distribution systems	3	A-III/6
	… to operate and maintain power systems in excess of 1,000 volts	4	A-III/6
	… to operate computers and computer networks on ships	3	A-III/6
	… to use internal communication systems	3	A-III/6
Additional comments	./.		

4.3 Discharging residues

Process 4.3	Discharging residues
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre

Process 4.3	Discharging residues			
Process objectives	To discharge all residues by avoiding any environmental impact			
Process operators	**MASS operators in ROC** > Senior Engineer > Engineer > System Administrator	**Level** > Management > Operational > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R, A R C
Interfaces	> Terminal > Port AFS			
Event: input	MASS is alongside and ready for port operations			
Process description	> Discharge of garbage and sewage > Discharge of residues of noxious liquid and solid harmful substances > Discharge of oily residues, sludge			
Resources needed	Equipment > Discharging system with sensors			
Regulations	International regulations MASS flag state traffic regulations Local port state regulations			
Event: output	All residues discharged without environmental impact			
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain automatic port facilities *regarding using and applying (C/L 3) and analysing (C/L 4)* … to keep the MASS in position for discharging operations		**C/L** 2 3	**STCW** MASS MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain automatic port facilities *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate fuel, lubrication, ballast and other pumping systems, and associated control systems … to ensure compliance with pollution-prevention requirements … to operate automatic port facilities for bunkering and discharge		**C/L** 2 3 3 3	**STCW** MASS A-III/1 A-III/1 MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to consider all regulations for bunkering and discharge by using automated port facilities		**C/L** 5	**STCW** MASS
Additional comments	./.			

5 Maintenance

5.1 Maintenance in Port

5.1.1 Maintenance Planning

Process 5.1.1	**Maintenance in Port – Maintenance Planning**				
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre				
Process objectives	To plan the preventive and curative maintenance of all MASS (bridge, deck, engine) and ROC (workstations) systems.				
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer > System Administrator	**Level** > Management > Management > Operational	**in ROC** > Planning station > Planning station > Planning station	**RACI** R, A R R	
Interfaces	> Shipping company - operations > Service provider > Manufacturer				
Event: input	Periodical revision of systems status and maintenance requirements				
Process description	> Inspections of all systems > Condition monitoring of all systems > Inspection of MASS structures > Planning of preventive maintenance (time-based, condition-based) > Planning curative maintenance (repairs, overhauls) > Planning of class works and inspections				
Resources needed	Equipment > All systems and equipment on board > All systems and equipment in ROC				
Regulations	International regulations MASS flag state and class regulations Local port state and coastal state traffic regulations				
Event: output	Maintenance tasks and job orders are planned				
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to apply maintenance strategies as predictive, condition-based, or risk-based maintenance for a MASS *regarding evaluating (C/L 5) and creating (C/L 6)* … to perform remote analysis of system parameters and communication protocols to identify the root cause of failures … to derive maintenance requirements from operating data and to plan the tasks and jobs for a MASS … to determine maintenance equipment for remote use and control … to derive maintenance requirements from operating data (“predictive maintenance”)			**C/L** 3 4 5 4 5	**STCW** MASS MASS MASS MASS MASS

Process 5.1.1	Maintenance in Port – Maintenance Planning		
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to ensure safe working practices	3	A-III/2
	… to manage safe and effective maintenance and repair procedures by application of knowledge of marine engineering practice	3	A-III/2
	… to apply maintenance strategies as predictive, condition-based, or risk-based maintenance for a MASS	3	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to manage safe and effective maintenance and repair procedures	5	A-III/2
	… to detect and identify the cause of machinery malfunctions and correct faults	5	A-III/2
	… to perform remote analysis of system parameters and communication protocols to identify the root cause of failures	4	MASS
	… to derive maintenance requirements from operating data and to plan the tasks and jobs for a MASS	5	MASS
	… to determine maintenance equipment for remote use and control	4	MASS
	… to derive maintenance requirements from operating data (“predictive maintenance”)	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to apply maintenance and repair of electrical and electronic equipment	3	A-III/6
	… to apply maintenance and repair of automation and control systems of main propulsion and auxiliary machinery	3	A-III/6
	… to apply maintenance and repair of bridge navigation equipment and ship communication systems	3	A-III/6
	… to apply maintenance and repair of electrical, electronic, and control systems of deck machinery and cargo-handling equipment	3	A-III/6
	… to apply maintenance and repair of control and safety systems of hotel equipment	3	A-III/6
	… to use risk-based and predictive maintenance tools for inspection and maintenance	3	MASS
	… to perform remote analysis of system parameters and communication protocols to identify the root cause of failures	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to derive maintenance requirements from operational data and to plan the tasks and jobs for a MASS	5	MASS
Additional comments	./.		

5.1.2 Overhaul and Repair

Process 5.1.2	**Maintenance in Port – Overhaul and Repair**				
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre				
Process objectives	To operate all corrective maintenance tasks				
Process operators	**MASS operators in ROC** > Navigator > Engineer > System Administrator	**Level** > Operational > Operational > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R R R	
Interfaces	> Shipping company - operations > Service provider > Manufacturer				
Event: input	Planned and unplanned corrective repairs and overhauls				
Process description	> Control of corrective repairs > Control of planned overhauls > Control of all jobs on the MASS from a remote station > Update of systems and software				
Resources needed	Equipment > All systems and equipment on board > All systems and equipment in ROC				
Regulations	International regulations MASS flag state and class regulations Local port state and coastal state traffic regulations				
Event: output	All MASS systems are in working order again				
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate remote system updates of navigational and communication systems … to apply remotely all settings of the navigational and communication equipment … to analyse malfunction alarms and to identify need for corrections … to operate maintenance and repairs of MASS systems			**C/L** 4 3 4 3	**STCW** MASS MASS MASS MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate maintenance and repair of electrical and electronic equipment … to operate an appropriate use of hand tools, machine tools, and measuring instruments for fabrication and repair on board … to operate maintenance and repair of shipboard machinery and equipment … to operate maintenance and repairs of MASS systems … to integrate machinery and equipment after repairs into the remote-control system again and to operate tests accordingly			**C/L** 3 3 3 3 3	**STCW** A-III/1 A-III/1 A-III/1 MASS MASS

Process 5.1.2	Maintenance in Port – Overhaul and Repair		
	… to perform remote analysis of system parameters and communication protocols to identify the root cause of failures	4	MASS
	… to use risk-based and predictive maintenance tools for inspection and maintenance	4	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
	… to apply maintenance and repair of electrical and electronic equipment	3	A-III/6
	… to apply maintenance and repair of automation and control systems of main propulsion and auxiliary machinery	3	A-III/6
	… to apply maintenance and repair of bridge navigation equipment and ship communication systems	3	A-III/6
	… to apply maintenance and repair of electrical, electronic, and control systems of deck machinery and cargo-handling equipment	3	A-III/6
	… to apply maintenance and repair of control systems of hotel equipment	3	MASS
	… to integrate machinery and equipment after repairs into the remote-control system again and to operate tests accordingly	3	MASS
Additional comments	Most maintenance tasks are to be expected in port. Maintenance jobs are expected to be done by shore-based persons.		

5.1.3 Spare Part Control

Process 5.1.3	Maintenance in Port – Spare Part Control			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To get all demanded spare parts on time to the MASS by avoiding too much stock			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer	**Level** > Management > Management	**in ROC** > Planning station > Planning station	**RACI** R, A R
Interfaces	> Shipping company - operations > Service provider > Manufacturer			
Event: input	Demand for spare parts based on preventive maintenance and by unplanned events.			
Process description	> Evaluation of demand of spare parts that MASS keeps to be able to sail > Planning of specifications, amounts, availability, stocks, delivery > Placing purchase orders to the shipping company administration > Control of incoming spare parts > Management of stocks on MASS or warehouses or ROC			

Process 5.1.3	Maintenance in Port – Spare Part Control		
Resources needed	Equipment > All systems and equipment on board > All systems and equipment in ROC		
Regulations	International regulations MASS flag state and class regulations Local port state and coastal state traffic regulations		
Event: output	All demanded spare parts on time in required specification and amount available		
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to evaluate spare part demands and to manage availability to ensure safe operation of MASS	**C/L** 5	**STCW** MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to evaluate spare part demands and to manage availability to ensure safe operation of MASS … to use a digital twin for evaluating the spare part demands	**C/L** 5 5	**STCW** MASS MASS
Additional comments	./.		

5.2 Maintenance at Sea

Process 5.2	Maintenance at Sea			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To operate preventive maintenance at sea			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer > System Administrator	**Level** > Management > Management > Operational	**in ROC** > Monitoring station > Monitoring station > Monitoring station	**RACI** R, A R R
Interfaces	> Shipping company - operations > Service provider > Manufacturer > Riding crew > Service crew (Ferry only)			
Event: input	Planned maintenance tasks			
Process description	> Inspection of all propulsion systems > Inspection of all machinery and auxiliary equipment			

Process 5.2	Maintenance at Sea		
	> Inspection of all safety equipment > Inspection of all navigational and communication equipment > Inspection of all ROC systems > Updates of software in all systems > Minor repairs in all systems		
Resources needed	Equipment > All systems and equipment on board > All systems and equipment in ROC		
Regulations	International regulations MASS flag state and class regulations Local port state and coastal state traffic regulations		
Event: output	All systems in good working order		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate remote-controlled maintenance tasks on a MASS … to operate remote system updates of navigational and communication systems … to apply all settings of the navigational and communication equipment remotely … to analyse malfunction alarms and to identify need for corrections … to operate maintenance and repairs of MASS systems	**C/L** 4 4 3 4 3	**STCW** MASS MASS MASS MASS MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to manage maintenance, inspection, and repairs of MASS systems *regarding evaluating (C/L 5) and creating (C/L 6)* … to evaluate the options for a remote maintenance of navigational and communication equipment … to evaluate the options for a remote maintenance of MASS structure and deck equipment … to manage remote maintenance with or without riding crews on board … to guide personnel on board to support maintenance and repair tasks … to report incidents to IT service providers and to track incident/problem management … to interoperate with IT service providers and to comply to respective service processes … to report incidents to IT service providers and to track incident/problem management	**C/L** 3 5 5 5 4 4 4 4	**STCW** MASS MASS MASS MASS MASS MASS MASS MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* … to operate maintenance and repair of electrical and electronic equipment … to operate an appropriate use of hand tools, machine tools, and measuring instruments for fabrication and repair on board … to operate maintenance and repair of shipboard machinery and equipment … to operate remote-controlled maintenance tasks on a MASS … to apply all settings of the operational engineering equipment remotely	C/L 3 3 3 3 4	STCW A-III/1 A-III/1 A-III/1 MASS MASS

Process 5.2	Maintenance at Sea		
	… to analyse malfunction alarms and to identify a need for corrections	4	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to ensure safe working practices	3	A-III/2
	… to manage safe and effective maintenance and repair procedures by application of knowledge of marine engineering practice	3	A-III/2
	… to manage maintenance, inspection and repairs of MASS systems	3	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to manage safe and effective maintenance and repair procedures	5	A-III/2
	… to detect and identify the cause of machinery malfunctions and correct faults	5	A-III/2
	… to evaluate the options for a remote maintenance	5	MASS
	… to evaluate the options for a remote maintenance of MASS structure and deck equipment	5	MASS
	… to manage remote maintenance with or without riding crews on board	5	MASS
	… to guide personnel on board to support maintenance and repair tasks	4	MASS
	… to report incidents to IT service providers and to track incident/problem management	4	MASS
	… to interoperate with IT service providers and to comply to respective service processes	4	MASS
	… to report incidents to IT service providers and to track incident/problem management	4	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to apply maintenance and repair of electrical and electronic equipment	3	A-III/6
	… to apply maintenance and repair of automation and control systems of main propulsion and auxiliary machinery	3	A-III/6
	… to apply maintenance and repair of bridge navigation equipment and ship communication systems	3	A-III/6
	… to apply maintenance and repair of electrical, electronic, and control systems of deck machinery and cargo-handling equipment	3	A-III/6
	… to apply maintenance and repair of control systems of hotel equipment	3	MASS
	… to restore system function from backups in case of data loss	4	MASS
	… to guide personnel on board to support maintenance and repair tasks	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to evaluate the options for a remote maintenance	5	MASS
	… to manage remote maintenance with or without riding crews on board	5	MASS
Additional comments	It is expected that at sea, only preventive maintenance is possible on a MASS. All corrective measures as repairs must be done in port, except of minor repairs. Riding crews are to be expected on board.		

6 Malfunctions & Emergencies

6.1 Emergency Preparedness

Process 6.1	**Emergency Preparedness**			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	Contingency plans are available, and the crew on board and the team in the ROC are trained on malfunction and emergency response			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer > System Administrator	**Level** > Management > Management > Operational	**in ROC** > Planning station > Planning station > Planning station	**RACI** R, A R C
Interfaces	> Shipping company - operations > ROC > Authorities			
Event: input	Risk assessments and regulations			
Process description	> Evaluate risk assessment mitigating measures and develop MASS specific contingency plans > Prepare muster lists, role, and further supporting instructions and checklists > Get approval from shipping company and authorities as far as requested > Set-up trainings for MASS operators and service crews on board > Set up trainings for MASS operators in ROC > Plan and operate drills in regular sequence on the different emergency and malfunction scenarios > Check of availability of all safety equipment on board > Check of all safety equipment in the ROC			
Resources needed	Equipment > Safety systems and equipment			
Regulations	International safety regulations (SOLAS, Codes, …) MASS flag state and class regulations			
Event: output	The operators are prepared for malfunction and emergency response, the MASS and the ROC are well equipped with safety and security equipment			
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the content of IAMSAR Manual concerning search and rescue … to explain the specific emergency operations for a MASS with and without crew on board *regarding using and applying (C/L 3) and analysing (C/L 4)* … to ensure compliance with pollution-prevention requirements by precautions, procedures, equipment, and measures … prevent, control, and fight fires on board, including advanced fire-fighting (**STCW A-VI/3**)		**C/L** 2 2 3 3	**STCW** A-II/1 MASS A-II/1 A-II/1 **A-VI/3**

Process 6.1	Emergency Preparedness		
	… operate life-saving appliances, including survival craft and rescue boats (**STCW A-VI/2**) -> only if crew is on board	3	A-II/1 **A-VI/2**
	… apply medical first aid on board ships, including elementary first aid (**STCW A-VI/4**) -> only if crew is on board	3	A-II/1 **A-VI/4**
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to maintain safety and security of the ship's crew and passengers and the operational condition of life-saving, fire-fighting, and other safety systems	5	A-II/2
	… to develop emergency and damage control plans	5	A-II/2
	… to assess cyber risks and to identify cyber attacks	5	MASS
	… to evaluate the MASS and ROC security-related situation, and to initiate appropriate measures, including **STCW A-VI/5**	5	MASS **A-VI/5**
	… to implement and apply a MASS and ROC security plan	5	MASS
	… to implement concepts of cyber security on board and ashore	5	MASS
	… to manage that all remote-controlled safety equipment is in operational availability	5	MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*	**C/L**	**STCW**
	… to explain the specific emergency operations for a MASS with and without crew on board	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to prevent, control, and fight fires on board, including advanced fire-fighting (**STCW A-VI/3**)	3	A-III/1 **A-VI/3**
	… to operate life-saving appliances, including survival craft and rescue boats (**STCW A-VI/2**) -> only if crew is on board	3	A-III/1 **A-VI/2**
	… to apply medical first aid on board ship, including elementary first aid (**STCW A-VI/4**) -> only if crew is on board	3	A-III/1 **A-VI/4**
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to control trim, stability, and stress and to take countermeasures in event of damage to, and consequent flooding of a compartment	5	A-III/2
	… to maintain safety and security of the ship's crew and passengers and the operational condition of lifesaving, fire-fighting and other safety systems	5	A-III/2
	… to develop emergency and damage control plans and handle emergency situations	5	A-III/2
	… to manage that all remote-controlled safety equipment is in operational availability	5	MASS
	… to assess cyber risks and to identify cyber attacks	5	MASS
	… to evaluate the MASS and ROC security-related situation and to initiate appropriate measures	5	MASS
	… to implement and to apply a MASS and ROC security plan	5	MASS
	… to implement concepts of cyber security on board and ashore	5	MASS
Required competences **MASS System Administrator**	The **MASS System Administrator (operational level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)*	**C/L**	**STCW**
	… to explain the specific emergency operations for a MASS with and without crew on board	2	MASS
	… to prevent, control, and fight fires on board	3	A-III/6
	… to operate life-saving appliances	3	A-III/6

Process 6.1	Emergency Preparedness		
Operational Level	... to apply medical first aid on board ship	3	A-III/6
Additional comments	Emergency preparedness includes all malfunctions and emergencies according to the risk assessments. Cyber security is also part of emergency preparedness.		

6.2 Malfunction Response

Process 6.2	Malfunction Response			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To respond to malfunctions efficiently, and to keep the MASS in operational conditions in case of a malfunction			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Senior Navigator	> Management	> Direct control st.	R, A
	> Navigator	> Operational	> Direct control st.	C
	> Senior Engineer	> Management	> Direct control st.	R
	> Engineer	> Operational	> Direct control st.	C
	> System Administrator	> Operational	> Direct control st.	C
Interfaces	> Shipping Company - Operations > Traffic Services > Service providers			
Event: input	Malfunctions of the MASS or ROC occur			
Process description	> use of contingency plan > set-up of a response organisation > initiating measures to get the MASS back under control ... black out ... steering gear failure, emergency steering ... loss of engine ... loss of propulsion ... extreme list, shifted cargo or equipment ... spills (SOPEP) ... failures of sensors and automation devices ... loss of data connectivity ... failure of remote-control system ... extreme weather and environmental conditions			
Resources needed	Equipment > Contingency plans > Safety equipment on board > All equipment related to the malfunction			
Regulations	International regulations and codes MASS flag state regulations Local coastal state regulations			
Event: output	MASS is under control			

Process 6.2	Malfunction Response		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain critical equipment of a MASS and its possible malfunctions	2	MASS
	… to explain how to get critical equipment of a MASS back under control	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to respond to emergencies by applying emergency procedures	3	A-II/1
	… to identify malfunctions and to initiate an immediate remote response	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to take actions to protect and safeguard all persons on board	4	A-II/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to respond to navigational emergencies	5	A-II/2
	… to handle emergency situations	5	A-II/2
	… to take actions to limit damage and salve the ship following fire, explosion, collision, or grounding	5	A-II/2
	… to evaluate malfunctions and emergency situations and to initiate appropriate measures	5	MASS
	… to organize, control, and operate emergency response activities in the ROC and on a MASS	5	MASS
	… to set-up measures to get the MASS system back under control after malfunctions or emergencies	5	MASS
	… to manage entering of a MASS not under control (NUC)	5	MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain critical equipment of a MASS and its possible malfunctions	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to perform a take-over in manual control to get the MASS system back under control after malfunctions or emergencies occur	3	MASS
	… to apply safety precautions and take action in the event of fire, with particular reference to oil systems	3	A-III/1
	… to identify malfunctions and initiate an immediate remote response	4	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to take actions to protect and safeguard all persons on board	4	A-III/2
	regarding to evaluating (C/L 5) and creating (C/L 6)		
	… to handle emergency situations	5	A-III/2
	… to take actions to limit damage and salve the ship following fire, explosion, collision, or grounding	5	A-III/2
	… to evaluate malfunctions and emergency situations and to initiate appropriate measures	5	MASS
	… to organize, control, and operate emergency response activities in the ROC and on a MASS	5	MASS
	… to set-up measures to get the MASS system back under control after malfunctions or emergencies	5	MASS

Process 6.2	Malfunction Response		
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain critical automation equipment of a MASS and its possible malfunctions	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to perform a take-over in manual control to get the MASS system back under control after malfunctions or emergencies occurred	3	MASS
	… to identify malfunctions and to initiate an immediate remote response	4	MASS
	… to get automation of critical equipment of a MASS back under control	4	MASS
Additional comments	The competences to respond to malfunctions and to emergencies are quite equal		

6.3 Emergency Response

Process 6.3	Emergency Response			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To response to emergencies efficiently, and to keep the MASS in operational conditions in case of an emergency.			
Process operators	**MASS operators in ROC**	**Level**	**in ROC**	**RACI**
	> Senior Navigator	> Management	> Direct control st.	R, A
	> Navigator	> Operational	> Direct control st.	C
	> Senior Engineer	> Management	> Direct control st.	R
	> Engineer	> Operational	> Direct control st.	C
	> System Administrator	> Operational	> Direct control st.	C
Interfaces	> MROC > Shipping company - operations > Traffic Services, other vessels > Rescue forces, salvage forces			
Event: input	Emergency of the MASS or ROC occur			
Process description	> use of contingency plan > set-up of a response organisation > initiating measures to get the MASS back under control … structural damage … water ingress / flooding … fire in holds, engine rooms, auxiliary rooms, accommodation … medical emergencies … cyber attack … emergency towing			

Process 6.3	Emergency Response		
	... evacuation PAX / service crew / crew ... person over-board ... helicopter operations in emergencies ... SAR support		
Resources needed	Equipment > Contingency plans > Safety equipment on board > All equipment related to the emergency		
Regulations	International regulations and codes MASS flag state regulations Local coastal state regulations		
Event: output	MASS is under control, no persons in danger, no environmental impact		
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* ... to explain emergency situations of a MASS and its possible impacts to the MASS *regarding using and applying (C/L 3) and analyzing (C/L 4)* ... to respond to emergencies by applying emergency procedures ... respond to distress signals at sea ... to perform a take-over in manual control to get the MASS system back under control after malfunctions or emergencies occurred ... to identify emergency situations and to initiate immediate response ... to ensure security procedures for the MASS at sea and in port ... to explain and apply the applicable and relevant cyber security measures to protect the MASS system	**C/L** 2 3 3 3 4 3 3	**STCW** MASS A-II/1 A-II/1 MASS MASS MASS MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding using and applying (C/L 3) and analysing (C/L 4)* ... to take actions to protect and safeguard all persons on board *regarding evaluating (C/L 5) and creating (C/L 6)* ... to coordinate search and rescue operations according to IAMSAR ... to perform duties and assess the ship as a ship security officer ... to respond to navigational emergencies ... to manoeuvre and handle a ship in all conditions, especially when launching rescue boats or picking-up survivors ... to handle emergency situations ... to take actions to limit damage and salve the ship following fire, explosion, collision, or grounding ... to set-up measures to get the MASS back under control	**C/L** 4 5 5 5 5 5 5 5	**STCW** A-II/2 A-II/2 A-VI/5 A-II/2 A-II/2 A-II/2 A-II/2 MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* ... to explain the specific emergency operations for a MASS with and without crew on board ... to explain critical equipment of a MASS and its possible malfunctions	**C/L** 2 2	**STCW** MASS MASS

Process 6.3	Emergency Response		
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to perform a take-over in manual control to get the MASS system back under control after malfunctions or emergencies occurred	3	MASS
	… to apply safety precautions and take action in event of fire, with particular reference to oil systems	3	A-III/1
	… to identify malfunctions and to an initiate immediate remote response	4	MASS
	… to ensure security procedures for the MASS at sea and in port	3	MASS
	… to explain and apply the applicable and relevant cyber security measures to protect the MASS system	3	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to take actions to protect and safeguard all persons on board	4	A-III/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to handle emergency situations	5	A-III/2
	… to take actions to limit damage and salve the ship following fire, explosion, collision, or grounding	5	A-III/2
	… to set-up measures to get the MASS back under control	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain critical automation equipment of a MASS and its possible malfunctions	2	MASS
	… to explain the specific emergency operations for a MASS with and without crew on board	2	MASS
	regarding using and applying (C/L 3) and analysng (C/L 4)		
	… to perform a take-over in manual control to get the MASS system back under control after malfunctions or emergencies occur	3	MASS
	… to ensure security procedures for the MASS at sea and in port	3	MASS
	… to explain and apply the cyber security measures to protect the MASS system	3	MASS
	… to identify emergency situations and to initiate an immediate remote response	4	MASS
	… to get automation of critical equipment of a MASS back under control	4	MASS
	… to implement concepts of cyber security on board and ashore	5	MASS
Additional comments	The competences to respond to malfunctions and to emergencies are quite equal		

Support Processes

S.1 Human Resources – Providing and Developing

Process S.1	**Providing and Developing Human Resources**			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To enable persons to work as MASS operator			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer	**Level** > Management > Management	**in ROC** > Office > Office	**RACI** R, A R
Interfaces	> All processes			
Event: input	Persons who intend to work as MASS operator			
Process description	> Ensure the basic competences in maritime safety and security issues ... Survival at sea ... Firefighting ... Personal safety and social responsibility ... Security matters ... Safety equipment on MASS > Ensure the basic competences in working with maritime automated and autonomous systems ... Challenges of automation systems ... Situational awareness by using sensors ... Fast decision making on machine information ... Workload management ... Stress management > Ensure communication skills ... English for MASS systems, including standard communication phrases ... Communication in MASS systems ... Communication between MASS systems and other stations as conventional ships and VTS			
Resources needed	n/a			
Regulations	International regulations MASS flag state traffic regulations Occupational health regulations			
Event: output	MASS operators with basic skills			
Required competences **MASS Navigator**	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* ... to explain the challenges for humans involved in highly automated systems		**C/L** 2	**STCW** MASS

Operational Level	*regarding using and applying (C/L 3) and analysing (C/L 4)* … to use SMCP and English in written and oral form … to transmit and receive information by visual signalling (not really necessary) … to take part in GMDSS radio communication, including **STCW A-IV/2** as radio operator … to contribute to the safety of personnel and ship by applying personal survival techniques, including **STCW A-VI/1-1** -> only if crew is on board … to contribute to the safety of personnel and ship by explaining fire prevention and applying firefighting, including **STCW A-VI/1-2** … to contribute to the safety of personnel and ship by demonstrating personal safety and social responsibility, including **STCW A-VI/1-4** … to explain and to take part in security-related emergency and contingency procedures, including **STCW A-VI/6-1 and 6-2** … to apply MASS specific safety equipment … to apply behavioural techniques to keep situational awareness and to make decisions when using information by sensors and machines … to organize workload and minimise stress when working with automated systems … to communicate as part of a MASS system with other stations by using standardised phrases	 3 3 3 3 3 3 3 3 3 3	 A-II/1 A-II/1 **A-IV/2** A-II/1 **A-VI/1** A-II/1 **A-VI/1** A-II/1 **A-VI/1** A-II/1 **A-VI/6** MASS MASS MASS MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)* … to organise and manage the provision of medical care on board … to evaluate the MASS and ROC security-related situation and to initiate appropriate measures, including **STCW A-VI/5** … to implement and to apply a MASS and ROC security plan	**C/L** 5 5	**STCW** A-II/2 MASS **A-VI/5**
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the challenges for humans of highly automated systems *regarding using and applying (C/L 3) and analysing (C/L 4)* … to use English in written and oral form … to contribute to the safety of personnel and ship by applying personal survival techniques, including **STCW A-VI/1-1** -> only if crew is on board … to contribute to the safety of personnel and ship by explaining fire prevention and applying fire-fighting, including **STCW A-VI/1-2** … to contribute to the safety of personnel and ship by demonstrating personal safety and social responsibility, including **STCW A-VI/1-4** … to explain and to take part in security-related emergency and contingency procedures, including **STCW A-VI/6** … to apply MASS specific safety equipment	**C/L** 2 3 3 3 3 3 3	**STCW** MASS A-III/1 A-III/1 **A-VI/1** A-III/1 **A-VI/1** A-III/1 **A-VI/1** A-III/1 **A-VI/6** MASS

	… to apply behavioural techniques to keep situational awareness and to make decisions when using information by sensors and machines	3	MASS
	… to organise workload and minimise stress when working with automated systems	3	MASS
	… to communicate as part of a MASS system with other stations by using standardised phrases	3	MASS
	… to apply international communication standards for MASS operations	3	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able … *regarding evaluating (C/L 5) and creating (C/L 6)*	**C/L**	**STCW**
	… to implement and to apply a MASS and ROC security plan	5	MASS
Required competences **MASS Administrator** Operational Level	The **MASS Administrator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)*	**C/L**	**STCW**
	… to explain the challenges for humans of highly automated systems	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to use English in written and oral form	3	A-III/6
	… to contribute to the safety of personnel and ship by applying personal survival techniques, including **STCW A-VI/1-1** -> only if crew is on board	3	A-III/6 **A-VI/1**
	… to contribute to the safety of personnel and ship by explaining fire prevention and applying fire-fighting, including **STCW A-VI/1-2**	3	A-III/6 **A-VI/1**
	… to contribute to the safety of personnel and ship by demonstrating personal safety and social responsibility, including **STCW A-VI/1-4**	3	A-III/6 **A-VI/1**
	… to explain and to take part in security-related emergency and contingency procedures, including **STCW A-VI/6**	3	A-III/6 **A-VI/6**
	… to apply MASS specific safety equipment	3	MASS
	… to apply behavioural techniques to keep situational awareness and to make decisions when using information by sensors and machines	3	MASS
	… to operate workload and minimise stress when working with automated systems	3	MASS
	… to communicate as part of a MASS system with other stations by using standardised phrases	3	MASS
Additional comments	Personal and social capabilities to be integrated and to coordinate with process M.2 General Management		

S.2 Legal Aspects

Process S.2	Legal Aspects			
Scope of application	**All types of MASS** > Dry Cargo – Container Feeder – short sea > Ferry – RoPax – one hour passage > Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To ensure compliance with all relevant legislation and regulations			
Process operators	**MASS operators in ROC** > Senior Navigator > Navigator > Senior Engineer > Engineer	**Level** > Management > Operational > Management > Operational	**in ROC** > Office > Office > Office > Office	**RACI** R, A C R C
Interfaces	> All processes			
Event: input	Operations of MASS system			
Process description	> Ensure the application of all relevant legislation and regulations, such as … ... certificates and documents required by international conventions ... Load Line Convention ... SOLAS ... MARPOL ... International health regulations ... International instruments affecting safety of ship passengers, crew, and cargo ... National legislation for implementing international agreements and conventions > Ensure the application of all relevant legislation and regulations concerning MASS systems, e.g. as ... MASS flag state regulations ... ROC state regulations ... Coastal and port state regulations ... International agreements on passages of MASS			
Resources needed	> All relevant laws and regulations			
Regulations	International regulations (COLREG, …) MASS flag state traffic regulations Local port state and coastal state traffic regulations			
Event: output	Compliance with all legislation and regulations			
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* ... to explain international maritime conventions and recommendations ... to explain national legislation ... to explain international and national MASS legislation and regulation *regarding using and applying (C/L 3) and analysing (C/L 4)* ... to monitor compliance with legislative requirements		**C/L** 2 2 2 3	**STCW** A-II/1 A-II/1 MASS A-II/1

Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and the protection of the marine environment	4	A-II/2
	… to apply international and national regulatory framework for MASS and shipping	3	MASS
	… to apply national and international regulatory framework for the shore-based operators	3	MASS
	… to monitor and control compliance with legislative requirements and measures concerning MASS systems	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to apply classification cycles for MASS systems and consider intervention schemes requirements	5	MASS
	… to manage MASS system related certificates	5	MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain international and national MASS legislation and regulation	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to monitor compliance with legislative requirements	3	A-III/1
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to apply international and national regulatory framework for MASS and shipping	3	A-III/2
	… to apply national and international regulatory framework for the shore-based operators	3	MASS
	… to monitor and control compliance with legislative requirements and measures concerning MASS systems	4	MASS
	… to monitor and control compliance with legislative requirements and measures to ensure safety of life at sea, security and the protection of the marine environment	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to apply classification cycles for MASS systems and consider intervention schemes requirements	5	MASS
	… to manage MASS system related certificates	5	MASS
Required competences **MASS Administrator** Operational Level	The **MASS Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain international and national MASS legislation and regulation	2	MASS
Additional comments	./.		

S.3 Automation Systems

Process S.3	Automation Systems			
Scope of application	**All types of MASS** A) Dry Cargo – Container Feeder – short sea B) Ferry – RoPax – one hour passage C) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To provide and operate the MASS and ROC system with an available and reliable infrastructure for all control and communication systems			
Process operators	**MASS operators in ROC** > Senior Navigator > System Administrator	**Level** > Management > Operational	**in ROC** > Planning station > Planning station	**RACI** R, A R
Interfaces	> The entire control and communication system > Experts on IT and communication systems > Service providers (cloud systems, communication, …)			
Event: input	Commence of operation of the control and communication system			
Process description	Operate the entire system > keep the entire system running > checks and tests > maintain hardware configuration > keep software updated > check of data interfaces for reliability, consistency, integrity > securing of data			
Resources needed	Equipment > All systems and equipment on board > All systems and equipment in ROC			
Regulations	n/a			
Event: output	All systems (hardware and software) can be operated in reliable mode			
Required competences **MASS Navigator** Operational Level	The **MASS Navigator (operational level)** is able … *regarding knowledge (C/L 1) and understanding (C/L 2)* … to explain the technical design of a MASS and to name the differences to a conventional ship … to explain the operational design of a remote-control centre for a MASS … to explain the operational design and components of the workstations with its equipment to control a MASS … to explain digital platforms … to explain the design, use, and limitations of satellite and cellular networks available to MASS systems … to explain the design and use of remote automation control networks … to explain the different degrees of autonomy of the navigational and communication systems *regarding using and applying (C/L 3) and analysing (C/L 4)* … to apply procedures to operate a MASS in different remote-control modes by using the work stations		**C/L** 2 2 2 2 2 2 2 3	**STCW** MASS MASS MASS MASS MASS MASS MASS MASS

	… to maintain situational awareness with limited sensor availability	3	MASS
	… to operate all navigational and communication controls in the ROC and on the MASS	3	MASS
	… to map applications and hardware of automation systems to field level, control level, or supervisory level respectively (“Automation Pyramid”)	4	MASS
	… to name examples of interfaces and protocols being used on each level of automation	4	MASS
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to take actions to protect and safeguard all persons on board	4	A-II/2
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to coordinate search and rescue operations according to IAMSAR	5	A-II/2
	… to perform duties and assess the ship as ship security officer	5	A-VI/5
	… to respond to navigational emergencies	5	A-II/2
	… to manoeuvre and handle a ship in all conditions, especially when launching rescue boats or picking-up survivors	5	A-II/2
	… to handle emergency situations	5	A-II/2
	… to take actions to limit damage and salve the ship following fire, explosion, collision or grounding	5	A-II/2
	… to set-up measures to get the MASS back under control	5	MASS
Required competences **MASS Engineer** Operational Level	The **MASS Engineer (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the technical design of a MASS and to name the differences to a conventional ship	2	MASS
	… to explain the operational design of a remote-control centre for a MASS	2	MASS
	… to explain the operational design and components of the work stations with their equipment to control a MASS	2	MASS
	… to explain digital platforms	2	MASS
	… to implement communication brokers to achieve seamless internet access	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to apply procedures to operate a MASS in different remote-control modes by using the work stations	3	MASS
	… to establish operational platforms for information processing, also in cooperation with data service providers	3	MASS
	… to operate all engineering controls in the ROC and on the MASS	3	MASS
	… to maintain situational awareness with limited sensor availability	3	MASS
	… to operate the control systems and communication systems for a MASS	3	MASS
	… to maintain availability and reliability of the control and communication systems for a MASS	3	MASS
	… to map applications and hardware of automation systems to field level, control level, or supervisory level respectively (“Automation Pyramid”)	4	MASS
	… to name examples of interfaces and protocols being used on each level of automation	4	MASS

	… to interoperate with IT service providers and to comply to respective service processes	4	MASS
	… to involve IT service providers and to track related incident/problem management	4	MASS
	… to apply tests and checks and to evaluate the quality of the MASS system performance	5	MASS
	… to decide on appropriate measures to stabilize a MASS control and communication system and to keep it available	5	MASS
Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to evaluate and ensure the entire control and communication system for operating a MASS	5	MASS
	… to give advice to keep data availability, consistency, and reliability	5	MASS
	… to manage the control systems and communication systems for a MASS	5	MASS
Required competences **MASS System Administrator** Operational Level	The **MASS System Administrator (operational level)** is able …	**C/L**	**STCW**
	regarding knowledge (C/L 1) and understanding (C/L 2)		
	… to explain the technical design of a MASS and to name the differences to a conventional ship	2	MASS
	… to explain the operational design of a remote-control centre for a MASS	2	MASS
	… to explain the operational design and components of the work stations with their equipment to control a MASS	2	MASS
	… to explain digital platforms	2	MASS
	… to explain the features of fieldbus standards and their network-based equivalents	2	MASS
	… to discuss the function of analogue and digital interfaces between MASS control systems and on-board hardware	2	MASS
	… to explain the design and use of satellite and cellular networks available to MASS systems	2	MASS
	… to explain the design and use of navigation and communication networks	2	MASS
	… to implement communication brokers to achieve seamless internet access	2	MASS
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to apply procedures to operate a MASS in different remote-control modes by using the work stations	3	MASS
	… to operate all engineering controls in the ROC and on the MASS	3	MASS
	… to map applications and hardware of automation systems to field level, control level, or supervisory level respectively (“Automation Pyramid”)	4	MASS
	… to name examples of interfaces and protocols being used on each level of automation	4	MASS
	… to operate the control and communication system for a MASS	3	MASS
	… to maintain availability and reliability of the control and communication system for a MASS	3	MASS
	… to save all data and information	3	MASS
	… to establish operational platforms for information processing, also in cooperation with data service providers	3	MASS
	… to interoperate with IT service providers and to comply to respective service processes	4	MASS

	… to involve IT service providers and to track related incident/problem management	4	MASS
	… to operate backup facilities to maintain data protection and availability	4	MASS
	… to operate on-board facilities for monitoring and troubleshooting	4	MASS
	… to improve human-machine interfaces to demands of MASS control	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to apply tests and checks and to evaluate the quality of the MASS system performance	5	MASS
	… decide on appropriate measures to stabilise a MASS control and communication system and to keep it available	5	MASS
Additional comments	./.		

S.4 Economic Aspects

Process S.4	**Economic Aspects**			
Scope of application	**All types of MASS** D) Dry Cargo – Container Feeder – short sea E) Ferry – RoPax – one hour passage F) Dry Cargo – Bulk Carrier – long distances **MASS with crew on board** > Remote Operation Centre **MASS without crew on board** > Remote Operation Centre			
Process objectives	To take economic aspects in the operations of a MASS system into account			
Process operators	**MASS operators in ROC** > Senior Navigator > Senior Engineer	**Level** > Management > Management	**in ROC** > Planning station > Planning station	**RACI** R, A R
Interfaces	> Shipping company - operations			
Event: input	Decisions on technical and operational improvements			
Process description	> Calculations of costs and investments > Evaluation of operational benefits > Evaluation of impacts on safety of the MASS system			
Resources needed	n/a			
Regulations	> n/a			
Event: output	Decisions on technical and operational improvement affecting safety of the MASS system			
Required competences **MASS Senior Navigator** Management Level	The **MASS Senior Navigator (management level)** is able …		**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)			
	… to use remote-controlled resources and infrastructure cost-effectively and economically		3	MASS
	… to determine technical and operational benefits		4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)			
	… to evaluate economic effects of optimisation measures		5	MASS

Required competences **MASS Senior Engineer** Management Level	The **MASS Senior Engineer (management level)** is able …	**C/L**	**STCW**
	regarding using and applying (C/L 3) and analysing (C/L 4)		
	… to use remote-controlled resources and infrastructure cost-effectively and economically	3	MASS
	… to determine technical and operational benefits	4	MASS
	regarding evaluating (C/L 5) and creating (C/L 6)		
	… to evaluate economic effects of optimisation measures	5	MASS
Additional comments	./.		

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