INTERNATIONAL MARITIME ORGANIZATION

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MARITIME SAFETY COMMITTEE
108th session
Agenda item 4

MSC 108/INF.16
12 March 2024
ENGLISH ONLY
Pre-session public release: ☒

DEVELOPMENT OF A GOAL-BASED INSTRUMENT FOR MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

Ongoing MASS projects in Norway

Submitted by Norway

SUMMARY

Executive summary:	This document provides information on ongoing MASS projects in Norway.
Strategic direction, if applicable:	2
Output	2.23
Action to be taken:	Paragraph 4
Related documents:	MSC 107/20 and MSC 107/WP.9

Background

1 At MSC 107, the MASS Correspondence Group, established at MSC 105, was instructed to continue the work of developing the goal-based non-mandatory MASS instrument (MASS Code), based on annex 1 of document MSC 107/WP.9.

2 Norway would like to provide information on the ongoing domestic MASS projects, some of which are the first of their kind in different ways. The purpose of the document is to share this information to further facilitate the discussions on the MASS Code as it is considered beneficial for the further development and eventual finalization of the Code.

3 The projects that are being presented in the annex are the YARA BIRKELAND, the ASKO sea drones, the Reach Remote USV and the Deepocean Ocean Challenger, while reference is also made to a domestic ferry project. Yara and ASKO are both cargo owners, i.e. fertilizer producer and goods supplier, while Reach Subsea and Deep Ocean are offshore support companies.

Action requested of the Committee

4 The Committee is invited to note the information, including the annex.

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ANNEX

In the following sections there is a brief description of ongoing MASS projects operating domestically in Norway.

The main characteristics of these vessels are:

Name	Ship type	Length (m)	Beam (m)	Capacity	Status
Yara Birkeland	Container feeder	80	15	120 TEU	In operation/ testing
ASKO seadrones	Ro-ro cargo	67	15	16 trailers	In operation/ testing
Deepocean – Ocean Challenger	ROV support vessel	24	7.5		Final design approval phase/ under construction
Reach Remote	ROV support vessel	23.9	8		Final design approval phase/ under construction

Yara Birkeland

Basic description

Yara Birkeland is a fully electrical and autonomous container feeder designed for daily transport of up to 120 containers from Yara's production plant in Porsgrunn to the regional export port in Brevik. Containers are loaded and discharged using a remotely operated gantry crane at Porsgrunn and a manned crane at Brevik.

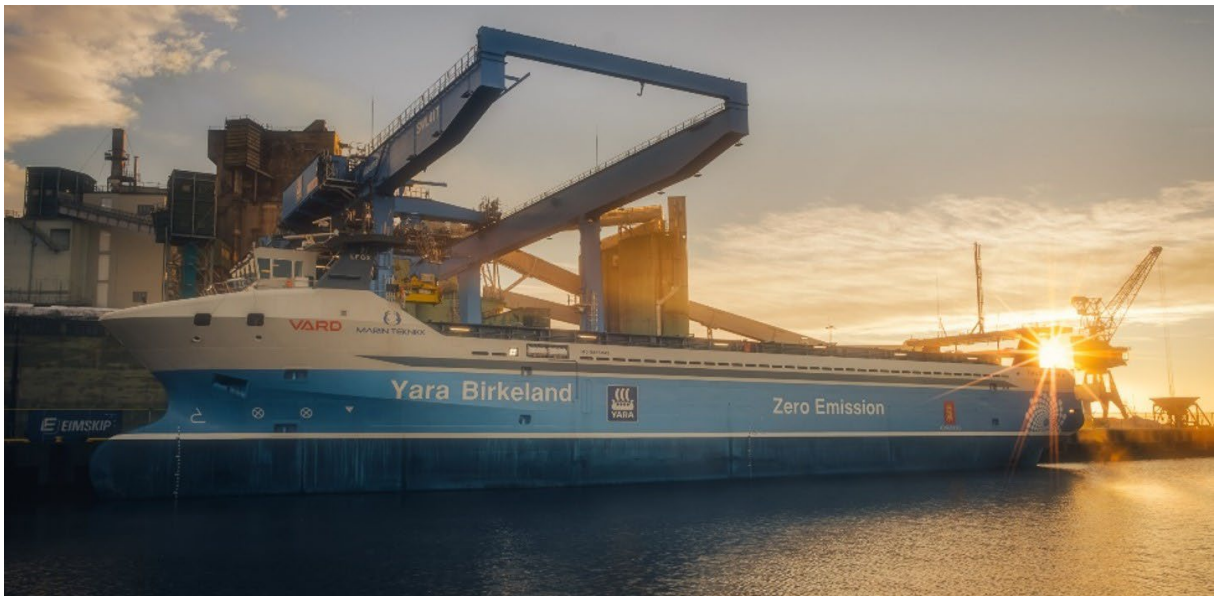
The vessel is designed according to a zero-emission strategy using fixed ballasting systems and electric propulsion powered by batteries on board. There shall be no discharge to either air or sea. With this vessel Yara will remove 40,000 diesel-powered truck journeys every year, and reduce NOx and CO_2 emissions.

Permanent charging facilities for the vessel at Yara's production plant will be available. Kongsberg Maritime is responsible for the development and delivery of all essential technologies, such as technologies enabling uncrewed operation supervised from a Remote Operation Centre, electrical propulsion, battery and control systems.

Operational area

The vessel operates inside the Grenland harbour district between Grenland harbour and Brevik harbour, which is on the western part of the outer Oslo fjord (sailing distance appr. 8 nm).
The operational area of the vessel is under VTS control and traffic consists of both commercial and leisure craft. The vessel needs to pass narrow passages with significant current.

1 Yara Birkeland sailing along the Brevik passing.



2 Yara Birkeland at the quay in Porsgrunn

3 Route (nais.kystverket.no showing Yara Birkeland under voyage from Herøya to Brevik)

Fallback states

The fallback state will be dependent on the situation that forces the vessel out of normal operation and is chosen between the available options after a thorough operational analysis.

There are two possibilities for entering a fallback state:

1) For situations that the system on board is capable of detecting automatically, the system may be programmed to enter a fallback state.

2) The responsible person in the ROC commands the vessel to enter a fallback state.

A set of fallback states will be implemented. Fallback states are defined for a combination of location along the route (mission phase) and type of malfunction or failure (e.g. different fallback states are applicable close to the port and within the narrow passage). For each mission phase two fallback states and a last resort are defined.

Crewing

After the final design approval, the vessel will operate uncrewed from berth to berth supervised from an ROC.

ROC

Kongsberg Maritime and Wilhelmsen have established a joint corporation, Massterly, which is set up to operate vessels such as the Yara Birkeland, Asko AutoBarge, Reach Remote and others from a Remote Operations Centre (ROC).

The ROC is located in Horten monitoring and supervising the vessels' operation. The ROC is equipped with several working stations and is built in a way that enables it to monitor and control several vessels for several owners at the same time.

4 Picture shows the current installation at Massterly's Remote Operation Centre with two Navigation Operation Work Stations and one Engineer Operation Work Stations.

Other relevant information

The vessel is connected to the ROC via a set of communication technologies. Bandwidth, latency, security and relevant costs are important elements when assessing and choosing communication and connectivity technologies. Significant evolution occurs within this domain and it is likely that changes will be introduced within the timespan of the project.

Status

The Yara Birkeland is on a gradual transition towards uncrewed sailing. The vessel has several voyages per week. Today the vessel is operated by a reduced crew (three persons on board). The vessel has currently implemented automated docking/undocking and automated crossing. The vessel is monitored from the ROC.

The system manufacturer works constantly on improvements and implementation of more remote and autonomous functions and improvement of the control system. The functions and capabilities will gradually be implemented on board and in the ROC and the number of crew

on board the vessel will be adjusted accordingly. Before new functions are implemented on board the vessel, they are thoroughly tested and evaluated. The Yara and Asko projects have a tight collaboration, including the provision of systems and services, to the same ROC (Massterly).

Administration involvement

The Norwegian Administration has been actively involved since the beginning of the project. Close cooperation between the Norwegian Maritime Authority (NMA), DNV (as a third party), Massterly and Kongsberg Maritime has enabled the vessel to sail since 2022. Prior to the introduction of new functions/systems on board the vessel or in the ROC, the NMA was involved from an early phase in the different approval steps to provide its final approval.

Testing phase

The next milestone for the vessel will be to move one seafarer on board (Electrical Technical Operator) to the Massterly ROC in Horten. Concurrently, Kongsberg Maritime is also planning the implementation of functions such as Collision Avoidance Advisory systems as the first step to introduce automation within the navigation domain.

ASKO sea drones

Basic description

ASKO is a wholesaler and major distributor of groceries to restaurants and supermarkets in Norway. With a distribution hub on each side of the Oslo fjord, the company runs a significant logistics operation where trucks and road transport, including ferries crossing the fjord, is the main means of transport.

Asko currently operates two sea drones: Marit and Therese. Each has a capacity of 16 trailers and the vessel type is Ro-Ro. The trailers are loaded/discharged with terminal tractors. The ports are fully automated (mooring and DC-charging) and synchronized with the vessels automated docking process. Similar to the Yara Birkeland, the implementation of an uncrewed operation is planned in several steps.

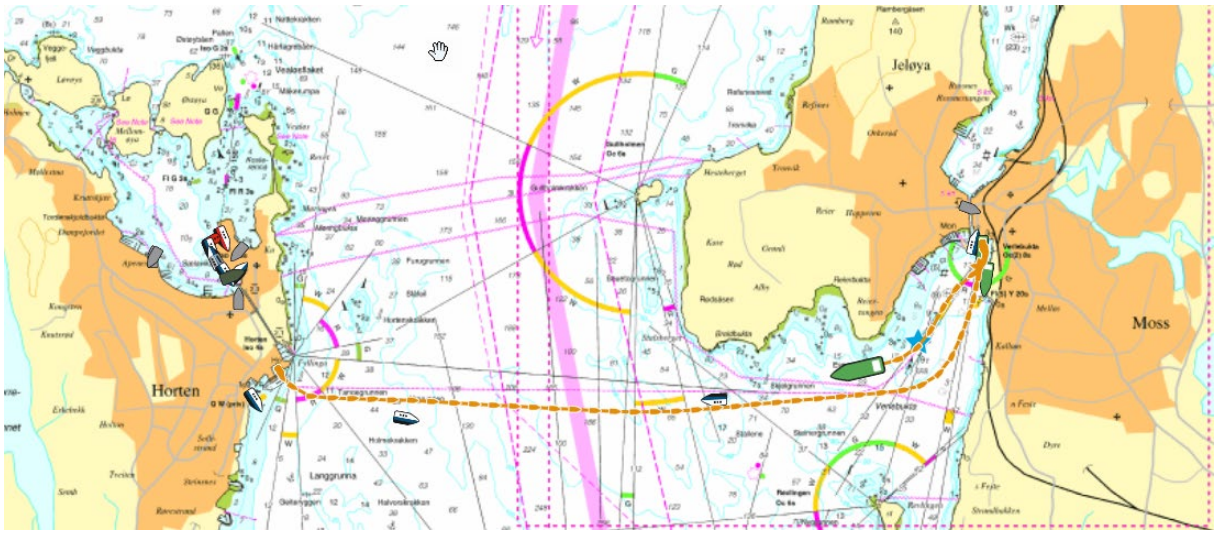
Operational area

The ASKO sea drones navigate across the Oslo fjord between Moss and Horten. The sailing distance is approximately 6 nm.

Many vessels operating in the area are scheduled connections, for example the passenger ferry between Moss and Horten and cruise ferries to/from Oslo. The operational area is under VTS control and has commercial traffic and also significant leisure traffic during some parts of the year. The sea drones are part of a coordinated sea/land logistics operation. Departure/arrival times, destinations, and number of trailers on each crossing will be determined based on the logistics plan most efficient for the cargo owner.

5 Therese under voyage from Moss to Horten

6 Therese approaching the dedicated dock in Horten



7 Route (NAIS|NAIS - BarentsWatch (kystverket.no) showing Therese under voyage from Moss to Horten)

Fallback states

For the sea drones, similar preliminary fallback states have been defined as for Yara Birkeland.

Crewing

After the final design approval, the vessel will operate uncrewed from berth to berth supervised from an ROC.

ROC

Same as the Yara Birkeland project.

Other relevant information

Same as the Yara Birkeland project.

Current status

The ASKO sea drones are on a gradual transition towards uncrewed sailing. Both ASKO sea drones are sailing on a daily basis.

As of January 2024, the ASKO sea drones are operated with a crew of three (3) persons on board. When the automated DC charging is fully operational, the intention is to reduce to a crew of two (captain and navigator). The vessels have currently implemented automated docking/undocking, automated crossing and automated mooring. A collision avoidance advisory system is implemented and the NMA is evaluating the application to start testing this system. The system includes situational awareness (including intelligent sensor fusion), a collision avoidance computer (detection of collision risk and provision of collision avoidance) and dedicated user interface, including augmented reality. Automated DC charging is in its final approval steps. The vessels can be monitored from the ROC.

The Asko and Yara projects have a tight collaboration including the provision of systems and services to the Massterly ROC.

Administration involvement

Same as the Yara Birkeland project.

Testing phase

Same as the Yara Birkeland project.

Deepocean – Ocean Challenger

Basic description

USV AS is a joint venture company, established by DeepOcean, Solstad Offshore and Østensjø, whose main purpose is to invest and own Unmanned Surface Vehicles (USV). The Ocean Challenger is 24 meters long and 7.5 meters wide. The Ocean Challenger will be equipped with a hybrid diesel-electric propulsion system and a battery package which allows the unmanned vessel to operate offshore for up to 30 days without charging or refueling.

The Ocean Challenger will be remotely controlled from shore and will have some autonomous features to ensure safety in all normal operations, such as in severe weather conditions. During operations, both the Ocean Challenger vessel crew and Remotely Operated Vehicle (ROV) operators will be located in the same remote operations centre. The Ocean Challenger will be equipped with a work ROV that is capable of operating in up to 1,500 meters water depth. The Ocean Challenger will then be capable of servicing subsea inspection work and subsea intervention tasks. It is also equipped with a newly-developed launch and recovery system which allows for work class ROVs to be operated from USVs.

8 The Ocean Challenger concept

Operational area

The vessel will operate within the Norwegian Continental Shelf.

Fallback states

The following fallback states were developed according to NMA guidelines.

1. Station keeping
2. Towing
3. Anchoring

At least 2 of these fallback states are available during normal operations.

Crewing

When uncrewed, the vessel will be remotely operated from the ROC. One USV operator will be responsible for maneuvering, steering and navigation, watchkeeping, radio watch, engineering watch and other vessel functions.

ROC

The remote operations centre is in Haugesund and the remote service is delivered by Remota AS, a sister company of USV AS. The charterer of the vessel, DeepOcean, will be responsible for manning ROV pilots with appropriate qualifications while the USV operators will be hired via USV AS. ROV pilots and USV operators will control operations from the same room. The USV operators will only be responsible for a single USV.

Current status

Astilleros Gondán has been contracted to build the Ocean Challenger on behalf of USV AS and the construction is ongoing. The delivery of the vessel is expected by the end of 2024. Following a testing period, the Ocean Challenger should be ready for operations in 2025.

Administration involvement

The NMA has been involved from the start of the project. The initial contact between the NMA and DeepOcean was in 2021, to cooperate regarding the philosophy documents required, and, when the preliminary documents and building notice was submitted, a project team was set up. The NMA attended pre-Hazid and Risk Based Assessment Tool (RBAT) workshops.

Reach Remote

Basic description

The Reach Remote concept consists of initially two uncrewed, remote operated USVs and a remote operations centre.

The USV is equipped with a full-size working ROV that is remotely operated from its own remote operations centre. The USV will be able to perform survey operations using various hull-mounted survey equipment. The ROV will be able to perform survey operations and subsea inspection and maintenance jobs.

9 The Reach Remote concept

Operational area

The USVs are planned to operate in the North Sea, as well as in other parts of the world, as permitted by flag and coastal Administrations. Typical operations will be on existing or planned oilfields and windfarms, as well as general seabed survey. The USV will be capable of 30 days continuous operation.

Fallback states

There are five defined fallback states.

.1 Limp home with degraded system functionality

.2 Abort current operation and standby
   a. When sailing: stop and standby
   b. When in ROV operation: Recover ROV and standby

.3 Move to a set safe location [e.g. move out of safety zone]

.4 Controlled drifting

.5 Anchoring

The criteria for entering, and to recover from, the fallback states vary.

Each mission or project may have its own definition of safe location. This means that what is a safe location in one mission or project may not be a safe location in another mission or project.

Crewing

The USV will be uncrewed. There are no crew facilities on board.

ROC

The ROC will be in the same physical location that also handles the Yara Birkeland and the ASKO sea drones.

An additional, full service, containerized ROC could be made available, if required.

The ROC for Reach Remote will be manned by personnel holding the qualifications required and approved by the Administration. There will be one ROC vessel manager, one ROC operator and one ROC technician.

The ROC operator will cover the operational Master role while the ROC technician will cover the operational technical aspect.

Current status

The two USVs are set to be delivered from the yard during spring 2024. Sea trials and testing of remote operations will be performed immediately after delivery. Testing of remote operations will be performed mainly in the Horten area in the eastern part of Norway. Final operational testing including ROV operations will be performed in the Haugesund area on the west coast of Norway.

10 The Reach Remote 1 in the yard

Testing of remote operations to be finalized Q2/Q3 of 2024, with a goal of commercial remote operations in Q3/Q4 of 2024.

Administration involvement

The NMA has been involved since the pre-approval stage of the project. The approval of the remote operations is ongoing.

Fjord1 / Lavik-Oppedal ferry

Basic description

A domestic ro-pax ferry is currently in the phase of preliminary approval with several automatic ship functions. As the current approval step, only limited information can be shared.

The ferry project is a result of a tender from the Norwegian Public Roads Administration for the crossing between Lavik and Oppedal, requesting more automation, both with regard to ship functions and traffic handling, as well as loading and unloading. A number of ship owners and operators competed for the tender, where Fjord 1 ended up with the winning concept.

During the preliminary assessment of the concepts, the handling and safety of passengers, both in normal and abnormal situations had the highest priority. Due to the tasks related to passenger handling, none of the proposed concepts aimed for uncrewed operation, and neither did Fjord 1.

Current status

The status of the Fjord 1 concept is that the yard contract is signed. The ferry will be built in accordance with Norwegian passenger ship regulations, taking into consideration alternative design principles and the possibility of equivalents. Fjord 1 will have a regular passenger ship certificate at first, before gradually introducing more automation and eventually crew reduction.

Administration involvement

The NMA did a preliminary assessment of all of the concepts from the different ship owners in the Tender. This was done due to a requirement from the Norwegian Public Roads Administration that the tender bids should have an assessment from the NMA. Currently the ship is between the preliminary approval and building phase and the NMA has been kept informed during the development of the concept from Fjord 1, which is taking further steps in the risk-based process, based on IMO MSC.1/Circ.1455.