CONCEPT OF MULTIFUNCTIONAL SMALL CLEANUP SHIP

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Abstract

The Baltic Sea belongs to a global system of protected area and has a status of Particularly Sensitive Sea Area (PSSA) which results in a mechanism for strict control on interna tional shipping activities within designated areas through the UN International Maritime Organization (IMO). Countries can declare such areas, and then establish rules for their protection. Additionaly almost the entire Polish coastline has been notified to the European Natura 2000 sites. Inside coastal NATURA 2000 areas some places are covered by increased protection because of belonging to a system of coastal and marine Baltic Sea Protected Areas (HELCOM BSPA). On the other hand intensive shiping in the vicinity of the Polish coast, high population density in the coast, tourism as well as coastal and marine industry necessitate special attention in relation to environment protection. Therefore, inter alia, novel techniques for the surveillance of purity of coast and coastal water are desirable. In the case of large spill - existing combating system provides only partly reducing of amount of oil entering the sea environment. Elimination of a greatest number of small oil spillages or discharges is possible, if well developed techniques and organization systems is used. The paper presents pre-project assumptions for small multifunctional ship designed for inshore activity – especially for port inspections and service, as well as for removal of floating and submerged rubbish and combating small oil spillages. We have analyzed possibility to achieve expected exploitive features of the ship using present knowledge for construction of small ship hulls applying principles of engine and navigational equipment steering for choosing the best route and for optimization the water surface cleaning-works as well as to minimize the energy consumption. We expect, that this ship – owing to main designations thanks to modern technical equipment and sophisticated software – will also fulfill conditions as an educational or as a training vessel.

Keywords: *marine transport, oil pollution, environmental protection, port inspection, port services*

1. Introduction

Oil residues in seawater are an object of concerns and fears for several decades. If the Baltic Sea is considered - well developed system of oil spill prevention is applied, namely:

- aerial surveillance system [1],
- combating system [2].

Also International Maritime Organization (IMO) plays significant role, especially as a consequence of Annex VI of convention Marpol 73/78 [3].

There is obvious, that amount of oil discharges is reduced in the great scale. But appearance of oil is a phenomenon still observed - oiled birds can be evidence [4].

In the case of large oil spill – above mentioned combating system provides only partly reducing of amount of oil entering the sea environment. Furthermore methodical shortcomings of oil combat

still exists (for example legislative and technical principles of oil dispersing in the bulk of water is not appropriate). So the oil contaminations in the shoreline or port-basins still can appear itself. Elimination of greatest number of small oil spillages or discharges is possible, if well developed techniques and organization systems (not existing in the present) is used. Furthermore such activity is advisable due to recognize the Baltic Sea area as a particularly nature sensitive one (PSSA).

Our considerations are focused on the preparation pre-project assumptions of small multifunctional ship designed for inshore activity – especially for local transport, setting port and roadstead installations, port inspections and service, as well as for removal of floating and submerged rubbish and finally: combating small oil spillages.

2. Nature-sensitive areas in the Polish marine zone

International law indicate several nature-sensitive areas in the Polish Exclusive Economical Zone (EEZ) – they are legislated by two European Union (EU) directives: Bird Directive [5], Habitat Directive [6] and by HELCOM, namely Baltic Special Protection Areas (BSPAs) [7].

Above mentioned areas are indicated in the Fig. 1-3. Additionally, legislative works performed by IMO are completed to establish the whole Baltic Sea area as the Particularly Sensitive Sea Area (PSSA) [8].

Fig. 1. "NATURA 2000" Special Protected Areas (SPAs) along the Polish coast

2. Solutions for ship-hull

We have analyzed possibility to achieve demanding exploitive features of the ship by construction of small ship-hulls taking into account principles of automatic engine and navigational equipment for choosing the optimal route as well as for optimization the water surface cleaning-works and to minimize the energy consumption.

Several propositions of construction of the ship has been consider. At first, small ship (Fig. 4a) equipped with the special device situated on both sides of the hull to collect surface pollution. This device was long rotating pipes for transport pollution from the water surface to the drainpipe and further to the tank. Unfortunately the first tests of stability of the ship and durable of the pipe-collector

Fig. 2. "NATURA 2000" Special Areas of Conservation (SACs) along the Polish coast

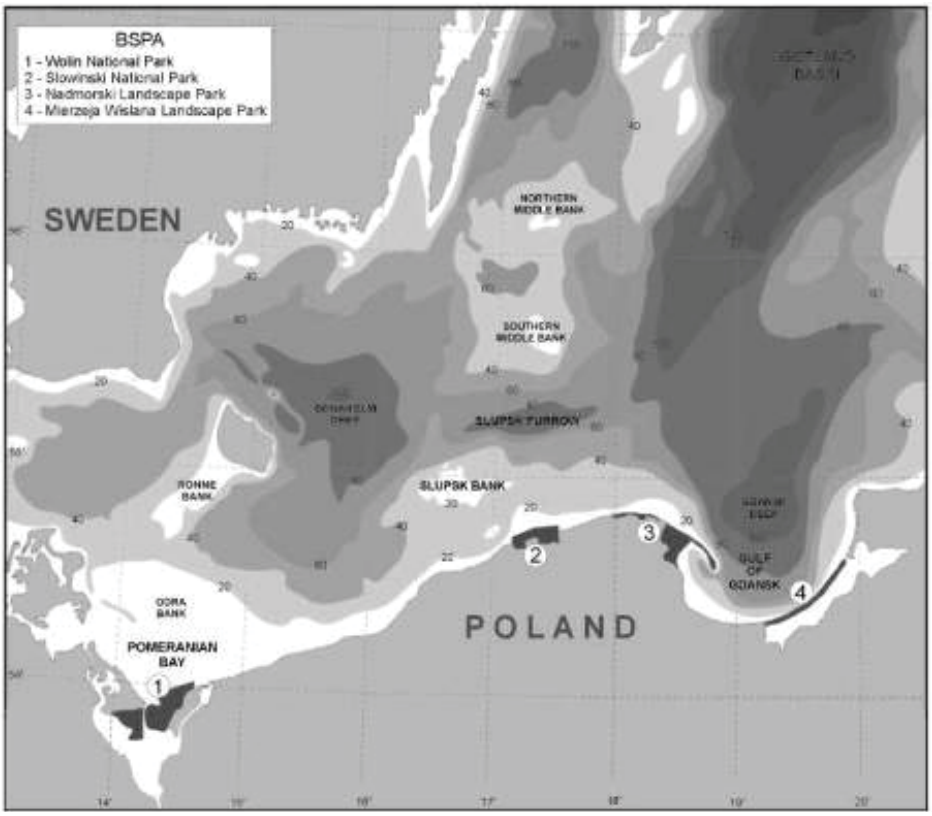

Fig. 3. Baltic Special Protected Areas (BSPAs) at the Polish coast

turned out as so poor. Further versions of the ship (represented by Fig. 4b) taken into account shorter hull and situated in the ship-bow the conveyor for collecting liquid pollutions and solid floating rubbish. One of current concepts considers solution similar to catamaran (Fig. 4c). This solution provides better stability, and small submerging. Such ship would be able to move close to the seaside line, for example to place and collect sorbent parcels in places polluted by oil.

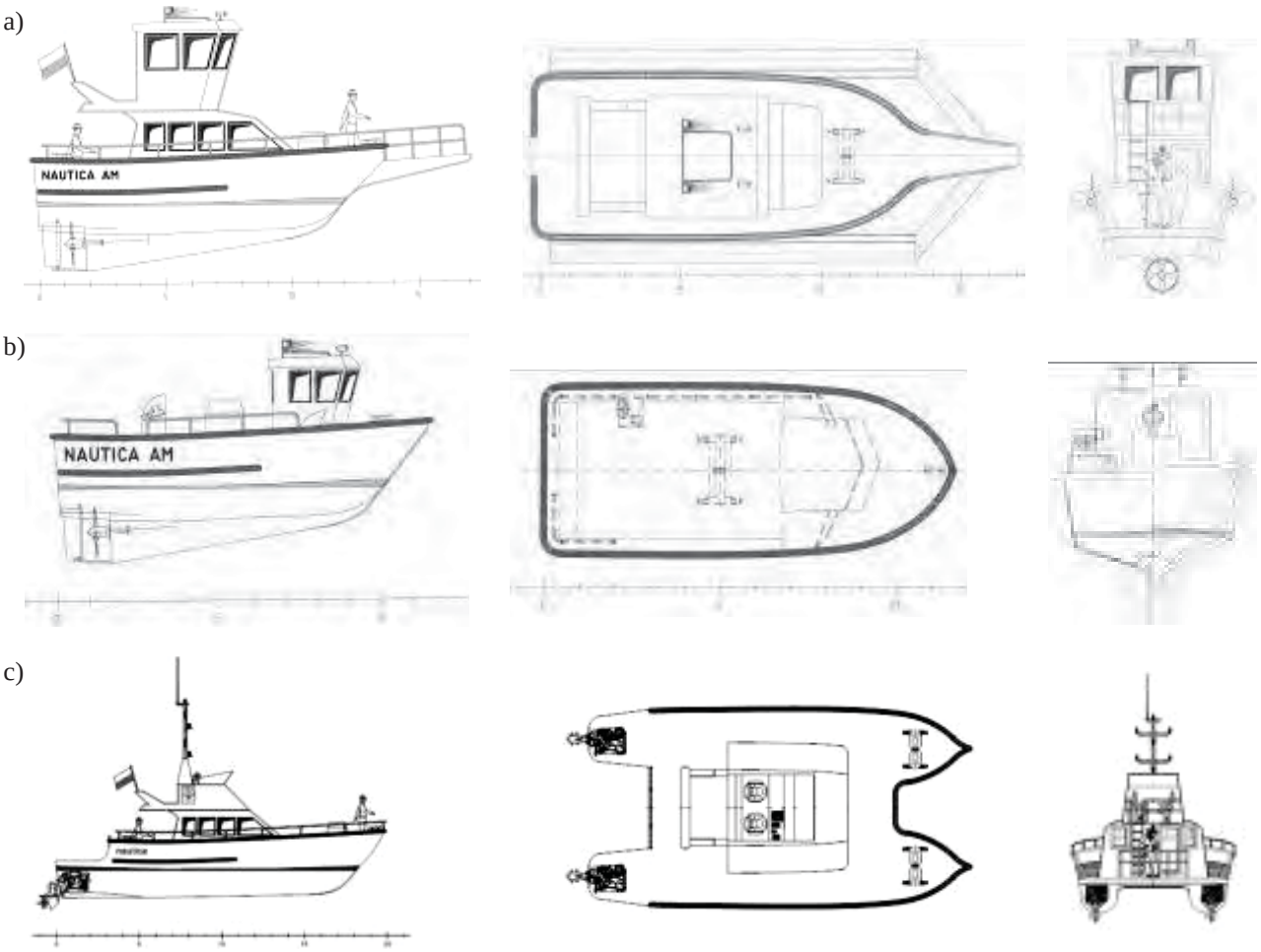

Fig. 4. Chosen concepts of ship-hulls

The continuation of the version from Fig. 4c is a ship with the bottom of cathedral-shape (Fig. 5), driven by the single engine (opposite like version in Fig. 4b). In this case the combined electric/ fuel drive-system is considered - which is possible when integrated intelligence-steering of all vessel devices will be applied.

Fig. 5. One of concepts with a bottom of cathedral-shape

3. Artificial intelligence-steering idea

Up to date solutions for combustion-fuel reduction are taken into considerations. This can be achieve due to artificial-intelligence-steering and engine exchange from combustion-type to electric one (or mixed - combustion-electric drive).

To steering the ship one proposes the use of the methods of artificial intelligence. The system combines the operation of three computer techniques, namely the evolutionary algorithms used for determining the optimal passing path, fuzzy control for steering the ship along the already determined path [9], and multivariable robust controller [10] for the precise steering of three ships.

The data input of the intelligent system of ship steering are information from devices and navigational systems such as: radar system, AIS, ARPA, log, echo-sounder, gyro-compass, anemometer, electronic maps. Steering signals enclose the edition of commands for rudder and driving engine. Information about the condition of the ship is picked by measuring systems from communication interfaces (USB, RS232, RS422, computer measuring cards).

The study of the methodology of functioning the intelligent system of ship steering will make possible making the decision on many levels: marking the route of the passage, steering after the set route, implementation of the anti-collision maneuver, location and undertaking oil pollutions.

4. Conclusions

We expect, that this ship - owing to main designations, thanks to modern technical equipment and sophisticated software - should also fulfill conditions as an educational and training vessel

Presented concepts are not final ones. They can open discussion about necessity of construction such device, and about its functional features. We admit that the possibility to achieve operational demands of such ship, in connection with the reality of construction, is high. Of course there are additional aspects of this problem, like the scale of multifunctionality and economic calculation. But it seems, that taking into account the development of marine traffic and growing number of large scale constructions in the sea [11], as well as nature-sensitiveness of the Baltic Sea and extremely sensitive the Polish coastal waters, necessity of introducing into force of such devices should has high priority.

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