Environment friendly ships for Baltic area

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ABSTRACT

The paper outlines the origin of the E.2772! project from the EUREKA group of European projects. Justification of undertaking the subject is given as well as the structure of institutional performers constituting the project executive consortium. Characterised is the final result in the form of preliminary designs of four modern ecological Baltic short shipping vessels: container carrier, product tanker, ro-ro ship and river-sea type ship. Comprehensive bibliography contains a list of all the project reports, which may be made available to the interested parties after a contact with the project coordinator. The paper opens a series of topical papers selected from the different problems dealt with in the project.

Keywords: EUREKA project Baltecologicalship, project execution, preliminary designs of four ships

INTRODUCTION

The structural changes and enormous acceleration of the world economy cause a necessity of developing new generations of surface transport, including sea and inland waterway shipping. This applies to transportation of the investment and consumer goods as well as to passenger traffic. In the highly developed areas, strongly urbanized and inhabited by wealthier societies, one can hardly imagine further development of the traditional transport of goods through the road or even railway network, to meet the growing demand. With cautious forecasts of the increase of freight transport in the EU territory by approx. 38% by 2010, concentrated in the main land transport corridors and around large urban areas, activation of the sea and inland water transport incorporated into multimodal transport networks becomes a problem of vital importance.

The emphasis put on the development of sea transport has been for the last several years a clear policy of the European Union, where surface transport is to be divided into long distance transport between established and intensively developed central reloading nodes and short distance feeder transport. In the case of sea transport, the latter is defined as short shipping. This problem is also characteristic of the Baltic, which has become practically an EU *Mare Nostrum.*

The amount of cargoes transported annually in the Baltic area reaches 450 million tons. Approximately 5500 thousand trips are performed served by the 500 Baltic ports. In recent years, the annual increase of the volume of transported goods has been as big as 30%. It is estimated that some 5000 ships are operated in the Baltic, 40% of them are older than 20 years and will have to be replaced by new generation ships in the nearest future.

The Baltic short shipping development trends include mainly container carriers (300% increase of the volume of transport in 10 years), passenger ferries and product tankers. The actual structure and size of that new generation fleet will depend mainly on the long term development forecasts of the volume and type of cargo and the passenger tourist traffic.

Regardless of location of the Baltic multimodal transport corridors, ecological requirements will have to be met connected with new conception of the Baltic Sea status as PARTICULARLY SENSITIVE SEA AREA, to be implemented by 2005. That involves a necessity of creating a fleet of specialised new generation Baltic feeder service ships fulfilling strict ecological criteria. Designs of such ships, based not only on the verified design practice but also on the state-of-the-art knowledge, should be on offer in the shipyards, and shipping companies aspiring to participation in the European transport system should provide for operating such ships.

PRO-ECOLOGICAL REQUIREMENTS

Regardless of the type of ship, the following general pro-ecological requirements have to be met :

- Significant reduction of:
  - all kinds of emissions and pollution connected with ship operation
  - effects of possible sea averages and disasters
  - negative effects of the solid waste utilization processes
  - effects of vibration and noise
  - negative effects of ship construction and repair processes.
- Improved safety and reliability of ship operation (structure and systems).
- Application of additional technologies, equipment and systems for proper utilization of the operational waste products.

Sources of hazards to the sea environment from an operating ship are schematically presented in Fig.1.

Meeting all the requirements of the new generation Baltic ships will certainly cause higher construction costs but it is estimated that they will be compensated for by e.g. lower insurance premiums, lower port charges and smaller hazards to the marine environment.

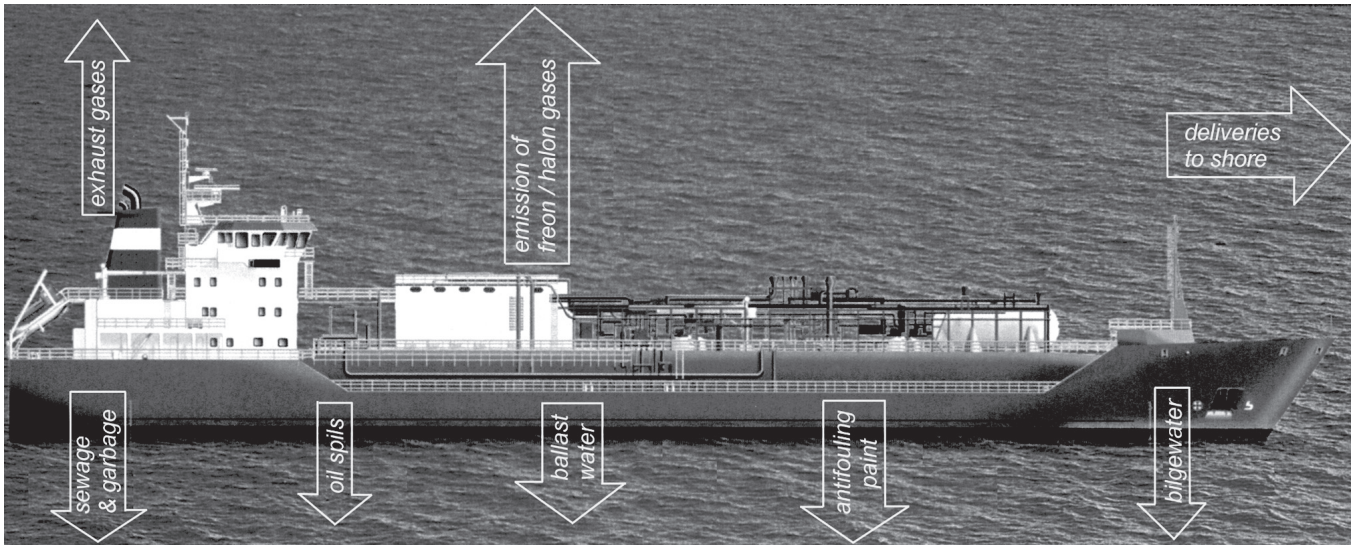


Fig. 1. *Ecological hazards created by ship (acc. to DNV – Maritime Solutions – Clean Performance advertising materials)*

PROJECT EXECUTION

In order to perform the task of establishing the Baltic ecological multimodal transport corridors with new generation ships, a European project E!2772 Baltecologicalship was set up in the EUREKA group and a consortium was formed of the following participants:

Technical universities

- Gdańsk University of Technology, Faculty of Ocean Engineering and Ship Technology – chief executor and coordinator of the whole project; Faculty of Chemistry as responsible for preparations of selected shipbuilding sector companies for the ISO 9000 and 14000 certification
- Szczecin University of Technology, Faculty of Maritime Technology.

Companies from the small and medium enterprise (SME) sector

- SINUS Limited Company, performing design work on the conceptions of 4 types of Baltic ships
- Toka Consulting Company, cooperating in the ISO reviews
- Ship repair yard, which unfortunately withdrew from the project at an early stage.

Foreign partners

- Boy&Partners-Loma Company, Sweden, co-performing the ISO reviews
- Björn Carlsson Ecoship Engineering AB, Malmö, Sweden, performing own design work on the product tanker conception.

The consortium performed the work in two stages.

At the definition stage, studies were undertaken on the needed structure of the Baltic region sea transport as well as design conceptions and requirements of the ships.

At the design and testing stage, designs of the ships were carried out and, as they were being completed, laboratory tests and analyses of hull shapes were performed and also verifying calculations and analyses of machinery, equipment and system solutions were carried out. In effect, the designs were corrected as appropriate and submitted to final evaluation. Parallel work was carried out to recognize the production capabilities of selected Polish shipyards. An advanced modernization conception of a selected shipyard was developed to ensure effective realisation of the contract.

The project participants, both the university teams and the small and medium enterprise (SME) sector companies, created an efficient and well functioning organism which has generated up-to-date designs forming a prospective development offer of the shipbuilding sector in its aspirations for the European operating structural funds.

At the same time, as a consequence of activities in the Swedish branch of the project, in cooperation with Polish specialist groups, 40 shipbuilding sector enterprises, including two medium size shipyards, have been prepared for beginning the ISO 9000 and 14000 standard certification process. The Swedish conception of a product tanker has obtained approval of a Swedish owner and after many rounds of negotiations in different shipyards, final contract talks are in progress in two selected shipyards.

THE SINE SERIES SHIPS

The project comprised the following ship types :

- SINE 202 universal container carrier
- SINE 203 oil product tanker
- SINE 204 ro-ro ship
- SINE 205 river-sea ship.

The designed ships had to fulfil the Det Norske Veritas (DNV) CLEAN class conditions, the first in the world complex set of classification requirements to guarantee ecological cleanness of a ship. A range of different solutions have been applied in the designed ships in order to meet the requirements.

In general, the solutions comprise :

- In connection with the increased safety requirements of ship in operation and in case of disastrous collision, the following solutions have been applied :
  - diesel-electric propulsion system (better use of fuel, minimum engine starting and stoppage time, significant limitation of water pollution by oil from the propulsion system)
  - pod propulsion and steering system (effectiveness increased by at least 10%, better manoeuvrability, less vibration and noise, elimination of rudder, minimum ship backing time, elimination of the cooling system)

- ☆ two separate power plants (breakdown safety of propulsion and hull)
- ☆ double shell in the fuel tank and hold area (elimination of spills).

❖ In connection with restrictions on the emissions of gases to atmosphere and of the operational and technological media to water, the following solutions have been applied :

- ☆ use of low sulphur content fuels
- ☆ use of exhaust-gas catalyzers (limitation of NO_x and SO_x)
- ☆ design constraints on oil spills and cooling medium spills, elimination of freon
- ☆ minimalization of ballast water exchanges in order to avoid the hazards from propagation of microflora and microfauna
- ☆ use of exclusively natural media in the fire fighting systems
- ☆ limitation of the oil content in bilge waters to a 15 ppm level with an automatic STOP device switching the system off when the value is exceeded
- ☆ use of ecologically safe internal and external ship paints
- ☆ use of special ship sewage treatment procedures.

❖ In connection with solid waste treatment aboard ship, to be transferred to shore for utilisation, waste sorting machines have been applied.

Main parameters of the designed ships are listed in the Table.

Fig. 2 presents general arrangement plan and 3D visualisation of the ro-ro ship stern showing elements of the systems necessary to meet the CLEAN class requirements. Figs. 3, 4 and 5 present the product tanker, container carrier and river-sea ship, respectively. The ship documentation has been prepared to the level of preliminary design of the feeder service means of transport.

SUMMARY

- ➢ The Eureka group European projects are an element of system support to the development of complex innovative products of small and medium enterprises obtaining their knowledge from the resources of scientific and research institutions. They create one of the mechanisms of organizing a European research and development network.
- ➢ The project execution consortium, sponsored by the Committee for Scientific Research on the Polish side and the VIANOVA and NUTEK government agencies on the Swedish side, brought together a research potential of 2 technical universities (3 faculties), many small and medium enterprise sector companies from the Polish side and 2 companies of that sector from the Swedish side and effectively combined science, knowledge, theory and design practice in realisation of a complex innovative task.
- ➢ The cooperation proved effective. Four ship designs have been created on the Polish side and three designs (product tanker) on the Swedish side. Forty Polish shipbuilding sector enterprises have been prepared for the ISO 9000 and 14000 standard series certification and also talks are in progress about an order of 4 product tankers for a Swedish owner. These are immediate effects of the cooperation.
- ➢ The obtained and processed knowledge – a basis of the design work – has been gathered together in 159 reports and other source materials, which will also be used for preparing a monograph publication (see bibliography).
- ➢ The product tanker design, selected with the use of synthesis of knowledge from earlier European projects, has been introduced as a subject of continued studies and analyses to the next Eureka group projects (ASPIS).
- ➢ Selected interesting topics of the analyses (in hydromechanics, design, structural design, ship systems, economy, production engineering) performed in the project will be published later on in this journal.

Table

Parameters	Type of ship			
	SINE 204 Ro-ro ship	**SINE 203 Product tanker**	**SINE 202 Container carrier**	**SINE 205 River-sea ship**
L_{oa} [m]	150.76	138.10	138.1	89.45
L_{pp} [m]	147.75	132.0	132.0	87.47
B [m]	24.80	22.50	22.50	11.40
H to main deck [m]	to deck 4 19.60	12.80	to main deck 11.20	5.45
$T_{des.}$[m]	6.00	8.00	7.60	4.40/2.80
T [m]	6.50	8.70	8.55	
DWT	7400	12800	8550	2900
Speed [kn]	20.0	14.0	18.05	12.0/14
Range [n. miles]	8000	6000	10000	2500
Power [kW]	19500	5980	11200	2550
Generator [kW/V]	690	1120/660	1120/660	2x1120/690
Propulsion [kW]	pod 2x6500	pod 2x2200	pod 2x4350	pod 2x700
Prop. Ø [m]	3.8	3.2	3.2	1.7
Pod weight [t]	42		47	25
Load	7200 m^2 – trailer deck	16900 m^3	950 TEU or 475 FE4	TEU 20 Holds – 54 Deck – 36 385 m^3
DNV Class	+1A1, Ro-Ro, Cargo Vessel, E1	+1A1 Tanker for Oil Products, ESP, EO ETC, ICE-!C, RPS, ICS, W1, CCO, LCS (SID)	+1A1 Container Carrier, EO, W1, S.C., RP	+1A1 General Cargo Carrier HC, EO, ICE-1C, RP

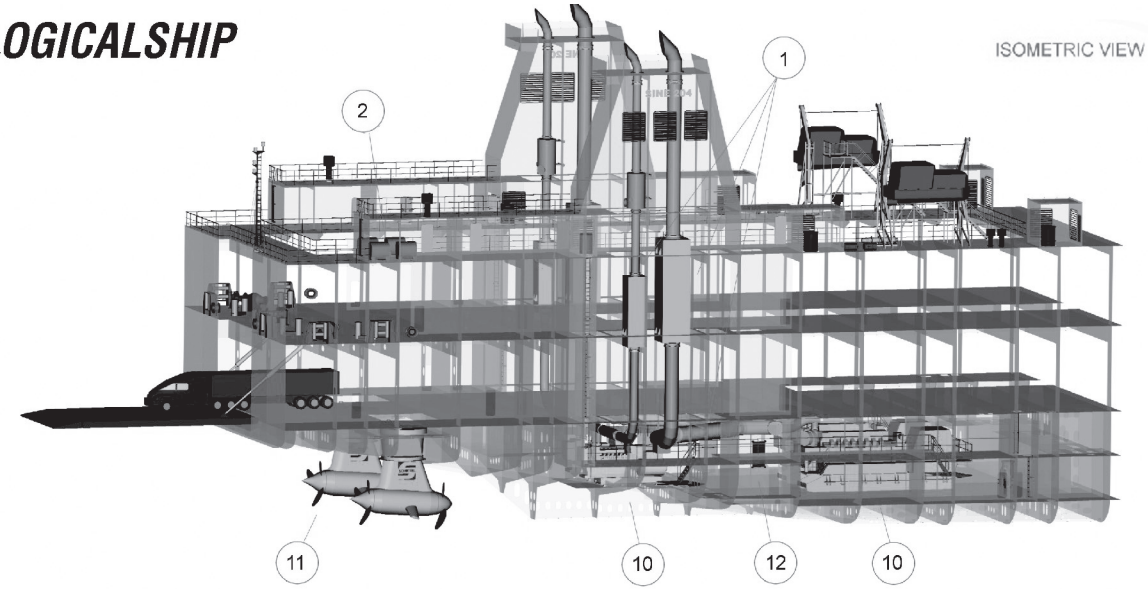
EUREKA

Project E!2772 BALTECOLOGICALSHIP

ENVIRONMENT FRIENDLY SHIP

FOR EXAMPLE RO-RO CARGO VESSEL "SINE 204"

1. Reduction of the NOx & SOx emission to the atmospherefrom combustion machinery exhaust gases.
2. Garbage sorting system.
3. Not any ozone depleting substances are used as refrigerants.
4. Only natural substances are used as a medium in fixed fire fighting systems.
5. The active ingredients in the antifouling are of a non-TBT tipe.
6. Discharge of ballast water are restricted to minimum in order to prevent transport of harmful aquatic organisms and pathogens.
7. Bilge water system is fitted out in oil filtering equipment and 15 ppm alarm combinet with an automatic stopping device.
8. Sewage treatment and discharge are carried out acc. to approved sewage treatment.
9. Fuel tanks with double skin construction.
10. Diesel-electric propulsion system.
11. Podded drive system.
12. Propulsion redundancy system achieved by two separate engine rooms.



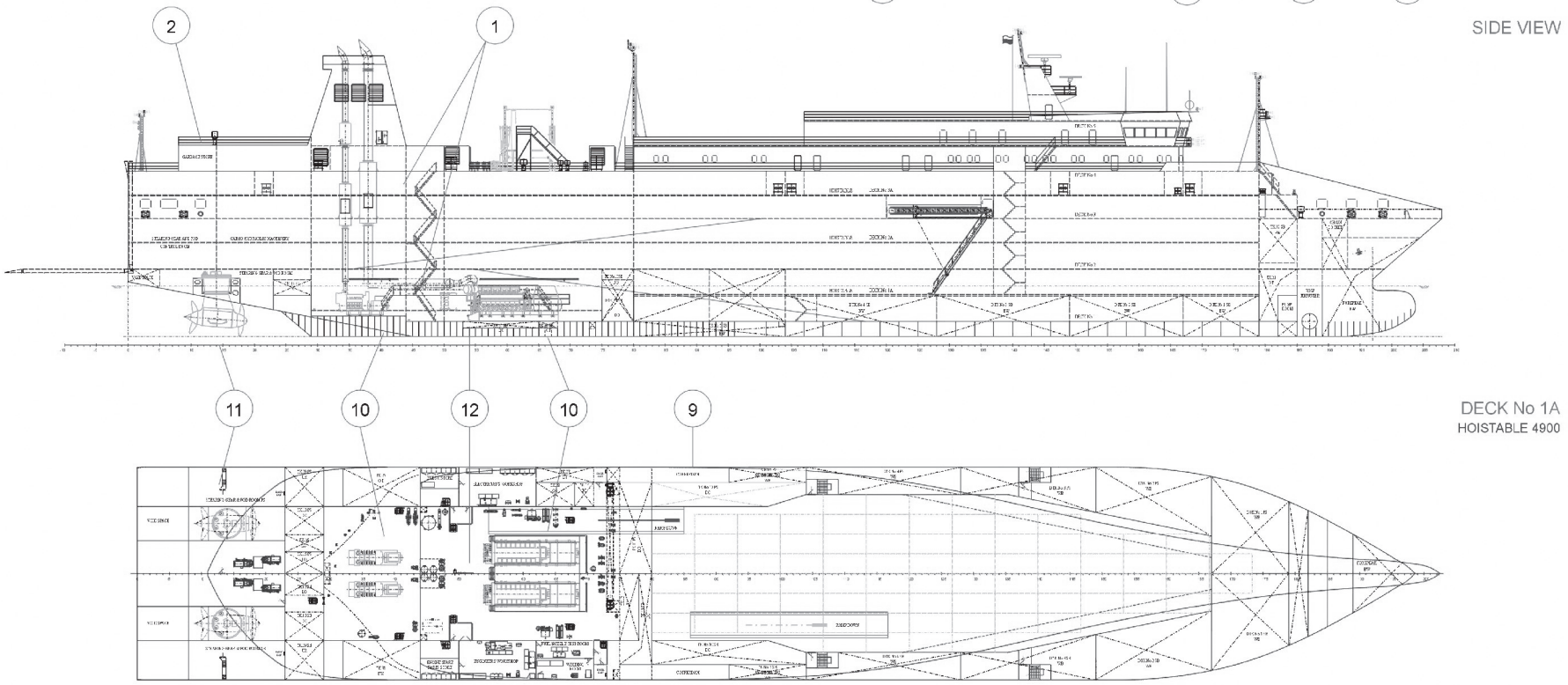


Fig. 2. Ro-Ro ship (SINE 204)

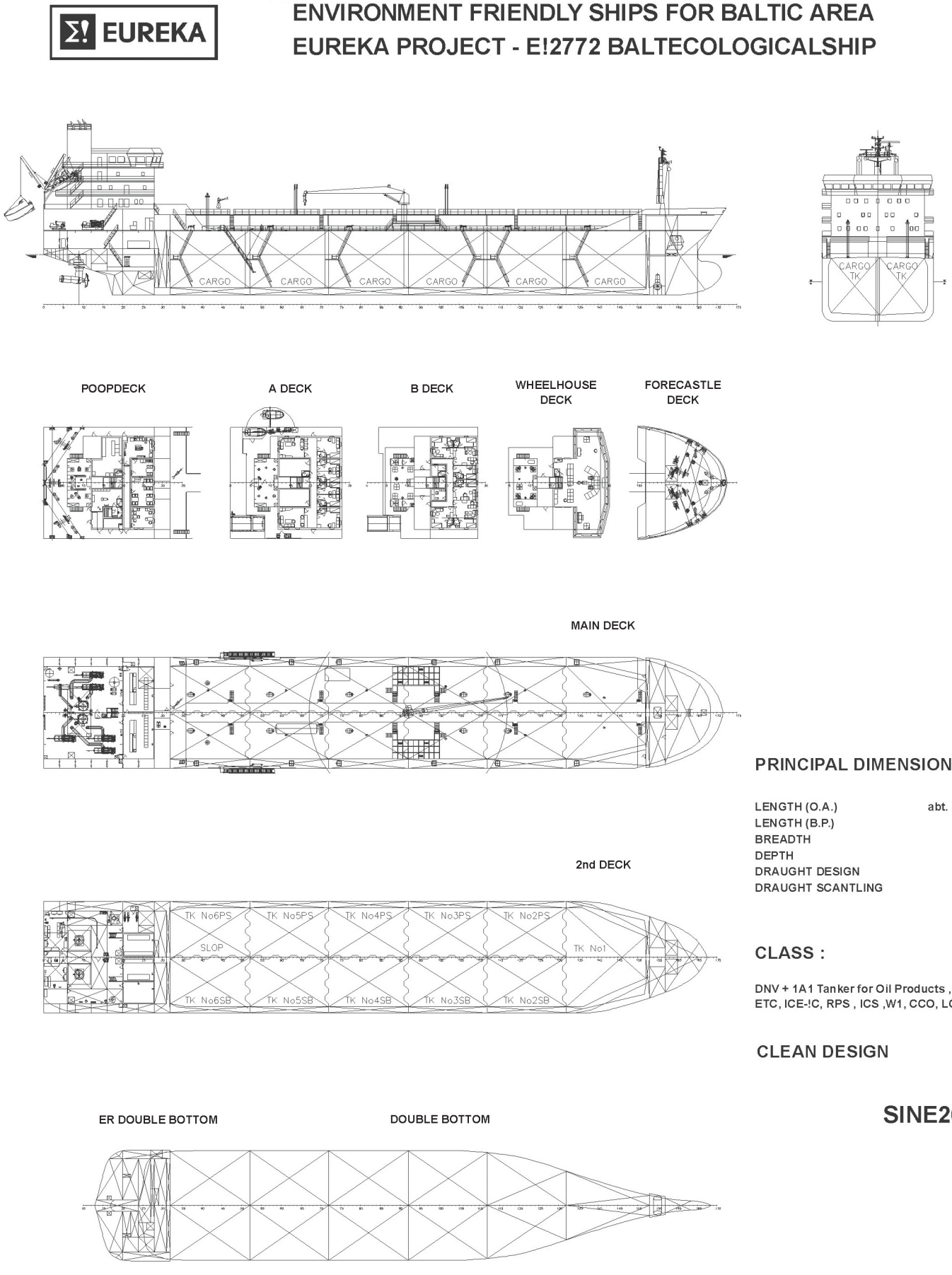


Fig. 3. *Product tanker (SINE 203)*

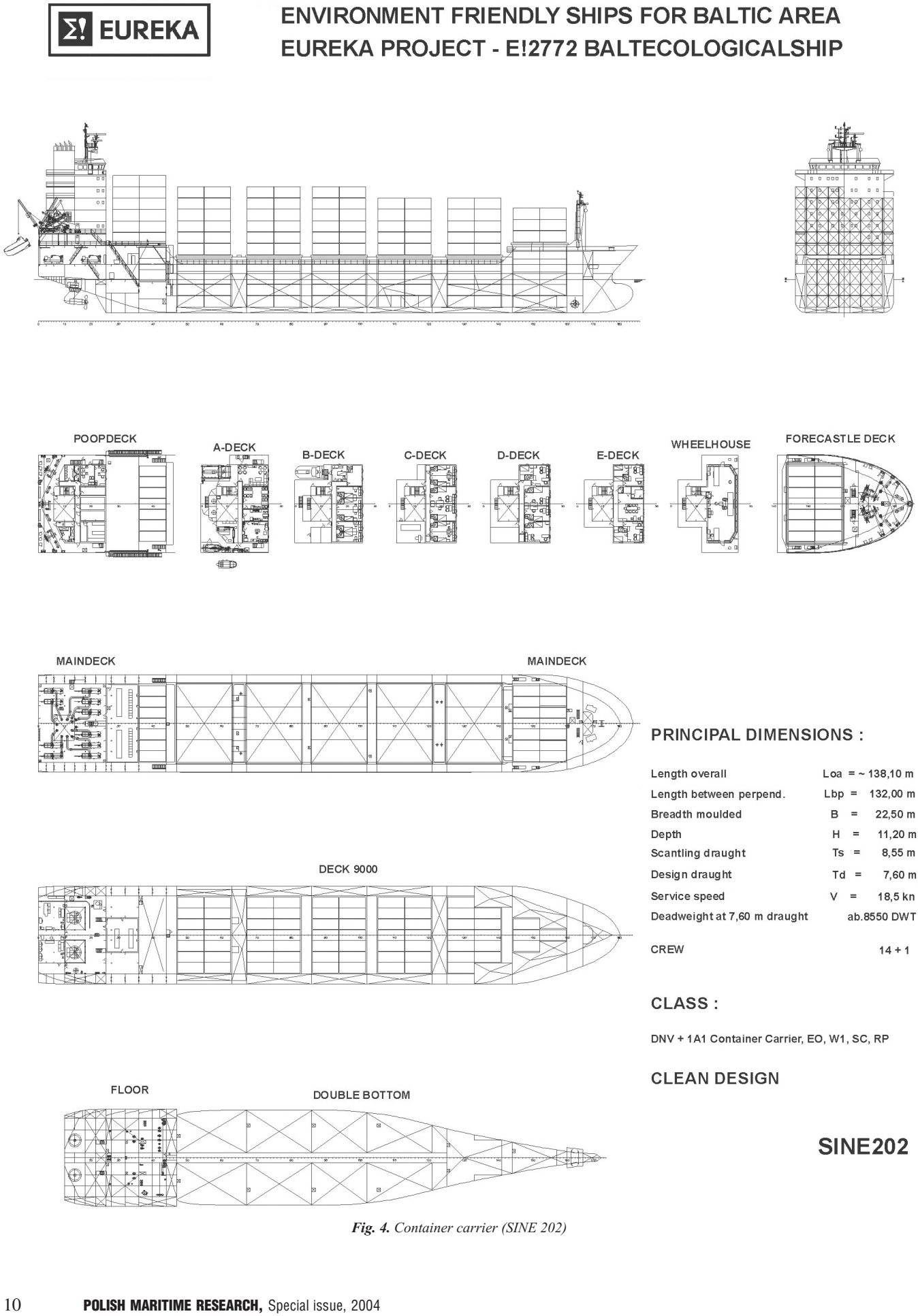


Fig. 4. *Container carrier (SINE 202)*

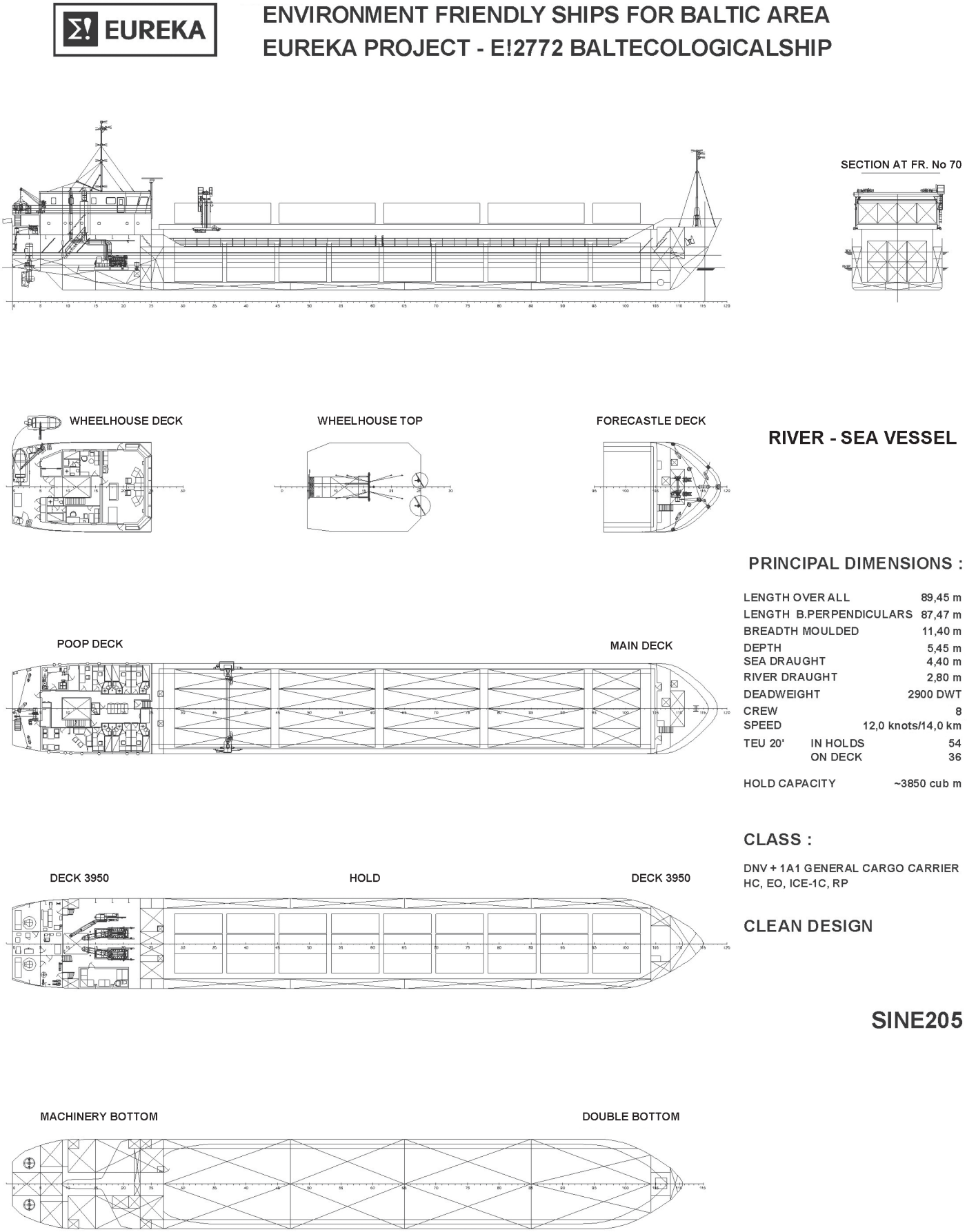


Fig. 5. River-sea ship (SINE 205)

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