The vehicle carrier *Neptune Odyssey* was built in 2009–2010 at Hyundai Mipo in Korea.

SHORT SEA
AN OPERATOR'S VIEW

Navigating regulatory, cost, and environmental issues in the Mediterranean car transport sector

BY GEORGE A. KRIEZIS AND MARKOS N. VASSILIKOS

Our company, Neptune Lines Shipping and Management Enterprises SA, is among the leading short sea operators in the Mediterranean and Black Seas, transporting more than 900,000 new vehicles each year on behalf of the global automotive industry. Over the last 20 years, the company has been active in the particularly demanding and competitive sector of pure car and truck carrier (PCTC) vessels.

Today, the company operates a regular liner service to more than 30 key ports in 17 countries within the Mediterranean and Black sea region. Through diligence, effort, and investment, we have acquired a reputation for safe and reliable ship management and valuable cargo handling. Our reputation is enhanced by the fact that we have managed, through the development of specific procedures and guidelines, to record and maintain one of the lowest claim levels in the industry.

The company fleet is growing in line with the constantly evolving demands of the automotive industry. Currently, Neptune Lines owns and operates 11 PCTC vessels, time charters 4 vessels, and has under construction 2 vessels with a capacity ranging from 400 to 4,200 medium-sized cars.

There are specific characteristics that differentiate the short sea trade from the transoceanic trade, which call for different characteristics for ships employed in such trade, as follows:

- Frequent port calls. For example, over a one-year period (2012), each of our ships averaged 150 port calls
- Small parcels of cars and roll on-roll off (RoRo) cargo to be transported from each port. Part is related to parcels delivered to the ships mainly via land transportation, or directly from manufacturing facilities, and part is feeder service
- Short stay in port (many times for a few hours only)
- Pressure to keep schedule, which requires meticulous programming and extra capacity for speed, to enable the fleet to compensate for any unforeseen delays in ports
- Need for real-time monitoring of cargo quantity and status from the pre-fixing period until the time this is delivered to its receiver

Built by Fincantieri in Italy in 2005–2006, *Neptune Thelisis* is a 7,210–ton DWT vehicle carrier.

- Need to adjust to trade conditions of short sea shipping, as shipping principles of demurrage and dispatch do not apply in general
- Port calls in different countries with different port and environmental regulations and port cost structures.

As a result of these characteristics, the vessels employed require special design features and as a result, are purpose built tonnage. In Neptune's owned fleet, 10 vessels are purpose-built, high-specification tonnage for the company in 4 separate newbuilding projects. The first began in 2000 with 2 vessels built at Barreras shipyard in Spain. In 2005, 2 vessels were built at Fincantieri shipyard in Italy; in 2009, 4 vessels were built at Hyundai Mipo Dockyard in Korea; and in 2013, 2 vessels were under construction at Hyundai Mipo.

Purpose-built tonnage for short sea shipping has a number of characteristics.

Vessel size and capacity. The vessel car carrying capacity is smaller than the transoceanic trade, because the parcels of cars are smaller and there are many delivery locations. However, the size of the vessels, as in the transoceanic trades, has increased over the years as a result of economies of scale and increases in the volume of transported vehicles. As a result, from 1,450 medium car capacity newbuildings, we have moved to 1,750-car capacity and to 3,200-car capacity for the latest newbuilding project.

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Vessel Speed. PCTCs were typically designed for 19-20 knots speed and were operated at these speeds. However, as a result of bunker price increases, speeds have reduced and currently ships are operated at 15-16 knots while they are designed for 17.5-18 knots speed.

Maneuvering characteristics. As a result of frequent port calls, all of our ships are fitted with multiple thrusters. Two of our ships are also twin screw. This permits better maneuvering in ports and enables the usage of fewer tugs in the ports that permit this. There are many Mediterranean ports that permit less/no tug usage for ships with adequate capacity thrusters and this provides substantial savings for the port call costs.

RoRo equipment. The majority of the vessels are equipped with one stern ramp and one quarter stern ramp in the port or starboard side. The arrangement is different than the standard oceangoing PCTC arrangement and provides more flexibility in using ports without developed quay facilities. The vessels have the capability to berth with the stern only and this may be advantageous in crowded ports with limited berth capacity and may reduce waiting time on occasion.

Hydraulic hoistable car decks. These enable automatic operation with short adjustment time for the car decks and are very useful in feeder and short sea trade where frequent adjustment may be needed, or when time is limited for the adjustment. The vessels are optimized for combined car and truck transportation and car deck heights are arranged accordingly.

Machinery system. In the first newbuilding projects of the smaller vessels, twin four-stroke engine installations were preferred for increased redundancy. These also occupied less space, enabling more cargo capacity. However, due to increases in fuel prices, the more economic direct-coupled two-stroke engines have been selected in the larger capacity newbuildings. This is similar to the oceangoing PCTCs.

Propulsion system. Of the 13 company vessels, 11 use controllable pitch propellers (CPP). This provides substantial flexibility for maneuvering operations, rough sea performance, and auxiliary power usage using shaft generators.

Auxiliary power. Of the 13 company vessels, 11 use shaft generators for auxiliary power generation at sea and during maneuvering. By using the shaft generators, more economic production of electrical energy is performed and adequate reserve power is available to operate the multiple thrusters during maneuvering.

Other characteristics. The bridge and the bridge wings are fully enclosed, and this is useful for feeder and short sea service with frequent port calls to protect the pilot and the officers from weather conditions.

Environmental measures undertaken

Neptune Lines is certified by Det Norske Veritas (DNV) under ISO 9001:2008 for quality management and ISO 14001:2004 for commitment to environmental performance. The reduction of emissions from the company ships is of paramount importance. This becomes more important when one considers increases in fuel prices. As a result, a comprehensive program of efficiency improvements is underway for the company ships to reduce their carbon footprint. Following are examples of steps that have been taken.

Reduction of speed. This was the easiest measure to take and since 2011 all company vessels are operated at reduced speed of approximately 16 knots as compared to the 19-20 knots previously. This requires additional ship capacity to handle the same trade but permits fuel savings that range from 8 to 15% depending on ship type and initial speed. As this is an operational measure, it all depends on trade requirements and fleet capacity available.

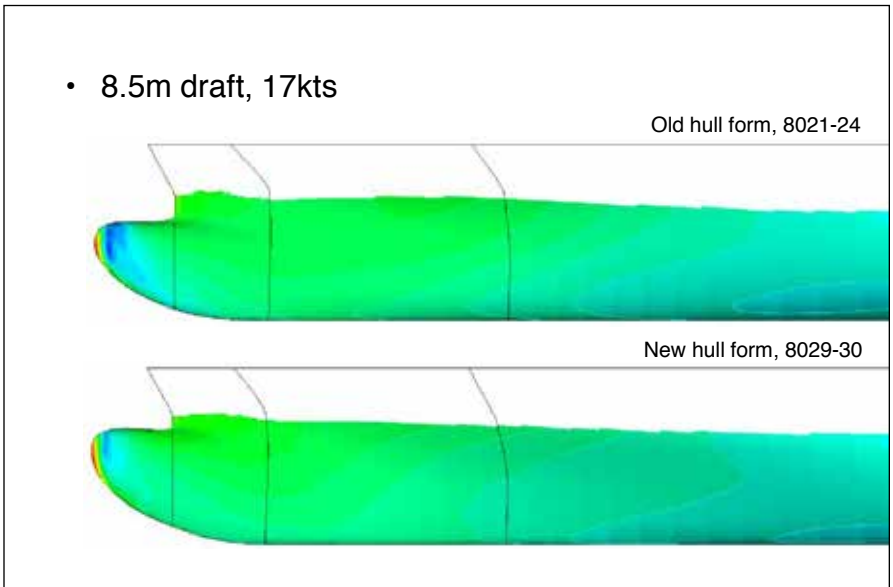
Foul release coatings. Since 2007, we have been testing foul release coatings as antifouling coatings (A/F) for our vessels. This was based on a project in which two sister vessels were coated, one with a conventional A/F coating without full blasting and one with a first generation silicon A/F coating after full blasting. Over the next five years, the ships were monitored. The silicon-applied vessel registered an average 5% fuel savings over the 5 years. This was higher in the first years but the difference reduced in the later years due to slime fouling of the silicon A/F.

Because of these results, three of our company vessels have been coated with third generation Silicon antifoulings from suppliers Sigma (Sigmaglide 990) and Hempel (X3). A fourth vessel was coated last year with an experimental silicon product from Hempel, which was released recently in the market as Hempaguard X7. This was one of the first full applications of the new product, which claims to reduce the sliming effect that is present in the earlier applications of foul release coatings. Results have been successful with all of these products and we are carefully monitoring the performance for the full five-year period of each coating.

Trim optimization and ballast reduction. PCTCs always carry ballast, even in fully-loaded conditions, to ensure adequate stability is available. It is very important to have tools to optimize the use of ballast and properly trim the vessel to minimize the hull resistance of the vessel and also to minimize fuel consumption.

Trim optimization and ballast control are now applied to eight vessels in our fleet. For the Hyundai Mipo-built vessels, we have use

A Neptune company vessel is coated with Sigmaglide 990, a third generation silicon antifouling from Sigma.



This CFD result compares pressure distribution between an old Neptune hull and a new hull.

Image courtesy Hyundai Mipo Dockyard

ECO-Assistant from Future Ship since the end of 2011. For the rest of the ships, we have use SEMT from Anco since December 2012 and this year. Using such software the ships are trying to minimize the ballast and optimize the trim for reduced resistance upon departure from a port.

Improvements as a result of the trim optimization software have been tested and verified; however it is not easy to substantiate the savings achieved in percentage terms.

Reblading of *Neptune Dynamis.* In 2000, the company built two ships with twin screws at Barreras shipyard in Spain. These vessels were built for 21 knots speed in full displacement. At that time, no one cared about the fuel consumption of these vessels, as prices were very low. These ships had the highest fuel consumption in the fleet (ton/nautical mile). We initiated a project to examine ways of reducing energy consumption of these vessels. As a result of this study, it was decided to replace the propeller blades with new units optimized for operation at 16 knots with constant rpm mode to utilize the shaft generator.

The new blades were designed by Rolls-Royce and were replaced during the scheduled drydocking of the vessel. The propeller diameter for the two propellers was reduced from 4.4 m to 4 m. Sea trials before and after the drydocking at the same draft and trim conditions were performed to measure the effects of this propeller replacement. A savings of 15% at 16 knots operating with constant rpm mode was measured with the new blades. The savings reduce to 4% if the combinator mode is used at 16 knots (before and after) but the shaft generator cannot be utilized in such a case. This project has been a success.

Alpha lubricators and drain analysis. We have installed Alpha lubricators on the newest two-stroke vessels. With the installation of these, we have reduced the cylinder oil consumption to very low levels—0.6 gr/kWh (normal is 1.0 gr/kWh). This reduction is assisted by quarterly scavenge drain analyses performed by the lubricant supplier to identify the wear characteristics of the main engine, if any. The reduced consumption is about 100 liters/day and this has been consistent in the last three years of operation of these vessels.

New project HMD hulls

Our latest newbuilding project at Hyundai Mipo Dockyard (HMD) in Korea was signed in 2012. Two ships (hulls 8129 and 8130) are under construction, with deliveries expected early in 2014. These vessels are similar in characteristics to the vessels built four years ago at HMD, but they have a large number of environmental features. The design of the vessels was improved through close cooperation of the company with the shipyard to optimize the ships for the intended short sea trade. The intended speed was reduced from 19 knots to 17.5 knots and the ships were optimized at the new conditions. They are built to the CLEAN notation of DNV.

Following are the measures taken as part of this program.

Optimization of hull lines. This project was a continuation of the previous project. The general dimensions and the capacity of the vessels are the same, while the design draft is modified to the more realistic scantling draft of 8.7 m (from 7.8 m). Using the statistics of average operating drafts of the operating vessels of about 8.2 to 8.5 m and the fact that the previous vessels had less resistance with trim by the bow up to 1 m, the new hulls were optimized using computational fluid dynamics (CFD) analysis for the higher draft and for less trim by the bow. The new hulls are fuller forward and leaner aft.

As a result of the CFD calculation, the effective power of the new hull is about 5% better than the old hull form at drafts of 8.2 to 8.5 m (majority time spent at these drafts) and the resistance is minimized at trim 0.5 m by the bow, which is an achievable target.

Electronic controlled engine. A MAN B&W 7S50ME-C8.2 electronic engine is used on this project. The SFOC of the engine at 75% load is improved from 170 g/kWh for the 7S50MC-C8.2 engine to 166 g/kWh or 2.3% improvement in fuel consumption. An electronic controlled engine also permits balanced operation of all the cylinders of the main engine.

Derated engine. We used a seven-cylinder engine but derated this by 20% to the power of a six-cylinder unit as the speed requirements are reduced. This reduced the maximum power of the engine but results in an efficiency improvement in the fuel consumption. The derated

Rolls-Royce's PROMAS system is installed on hull 8129 before launching.

engine SFOC at NCR load (90%) is improved from 166 g/kWh for the six-cylinder engine of same power to 161.7 g/kWh or 2.6% improvement in fuel consumption.

PROMAS energy saving device. Model tests were performed with three combinations of energy saving devices from different manufacturers and these were compared with the conventional CPP propeller. Such comparison tests are unique in the marine industry and we were able to accomplish it through our close cooperation with the shipyard and the manufacturers. From these tests, PROMAS from Rolls-Royce was selected as the best performing solution. This system is comprised of a specially-designed propeller, a twisted flap rudder, a rudder bulb (Costa bulb), and a special hub cap to integrate the flow from the propeller to the rudder. The reduction in effective horsepower from this energy saving device was measured during model tests at 4.7% as compared to the conventional CPP propeller.

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Innovative Antifouling system. A novel silyl acrylate A/F coating, SEAFLO NEO SL from Chugoku Marine Paints, was selected for this project. This A/F results in an ultra-smooth surface and achieves low friction on the surface of the hull. For high performance vessels, the expected fuel savings are 3 to 4% as compared to a conventional antifouling. This antifouling also has self-leveling properties to provide good long-term performance, and it has low volatile organic compound emissions during application. The average hull roughness of hull 8129 before launching was measured around 70 microns.

Frequency control for important motors. In order to reduce the auxiliary power load needed for operating the vessel, the following systems are equipped with frequency control: steering gear motors, main sea water pumps, and engine room ventilation fans. Three separate systems are installed to control these systems and reduce energy consumption. Significant savings on the power needed for these systems is expected from this application.

Shaft generator. The ship is equipped with shaft generator for more efficient power generation at sea and during maneuvering in port.

Multiple thrusters. The ship is equipped with multiple thrusters for efficient maneuvering in ports with minimal use of tugs.

Ballast water treatment. A ballast water treatment system will be installed onboard this vessel.

Coriolis flowmeters to be installed. Coriolis flowmeters will be installed in the bunker manifold to measure bunker supplies and fuel oil consumption, and for onboard monitoring for the main engine and the auxiliaries.

Shaft power meter. A shaft power meter and performance monitoring system from Kyma will be installed and integrated with the flowmeters to provide continuous measurement of the ship performance. Several kWh meters will be installed in the main switchboard for measuring the actual energy consumption for the auxiliaries.

With the enhanced measurement capabilities installed on these vessels, we will be able to accurately measure the combined environmental effects of the various efficiency measurements and compare these to previous project vessels.

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Regulatory pressures

The Energy Efficiency Design Index (EEDI) is not applicable yet for RoRo and vehicle carriers. There are presently discussions within the IMO to finalize the formula that will apply to vehicle carriers. The final solution will affect the design of the future specialized tonnage for short sea shipping. This could lead to simpler designs of even lower speeds. It should be remembered that we already have EEDI in place; slow steaming due to high bunker prices automatically translates into reduced air emissions. Companies have reacted to high fuel prices by implementing a number of environmental measures as outlined previously, which reduce emissions. It is not yet clear to us whether the EEDI formulation will have a positive result in the attractiveness of future PCTC newbuildings for the short sea shipping sector.

In terms of tariffs, car carriers are high-sided vessels and as a result have high gross tonnage. The majority of port tariffs (pilotage, tugs, port dues) are based on this value. As a result, car carriers are penalized as compared to equivalent deadweight containerships. Different countries in the Mediterranean use different formulas for calculating port tariffs. Efforts have been made and studies have been prepared to convince authorities to treat car carriers more fairly. Nonetheless, further development of the short sea market is hindered by these high port costs. Our larger car carrier vessels cannot economically call a Mediterranean port for a small parcel of cars as the port fees are very high.

As per European Directive 2000/59, a framework was established to control ship generated waste (garbage, sludge, and bilge waters) in European waters. European Union EU countries were required to establish reception facilities for this waste. EU countries have implemented this regime in different ways. The requirements and charges vary among the EU countries, and the end result is that short sea shipping is penalized. The ships are dealt with as vessels not engaged in scheduled traffic with frequent and regular stops. The reason is that we cannot publish a fixed schedule and we usually change ship schedules to optimize our trade. As a result, we are charged with heavy fees related to the reception of ship generated waste. Our budget for 11 ships for these fees in EU ports easily exceeds 300,000 euros per year.

Low sulphur usage

As part of EU directive 2005/33/EC, all vessels trading in EU ports as of January 1, 2010 are required to burn fuel oil while "at berth" with maximum sulphur content limited to 0.1% m/m. This means that after berthing in EU ports, all of our ships switch to burning marine gas oil (MGO) in auxiliary engines and auxiliary boilers.

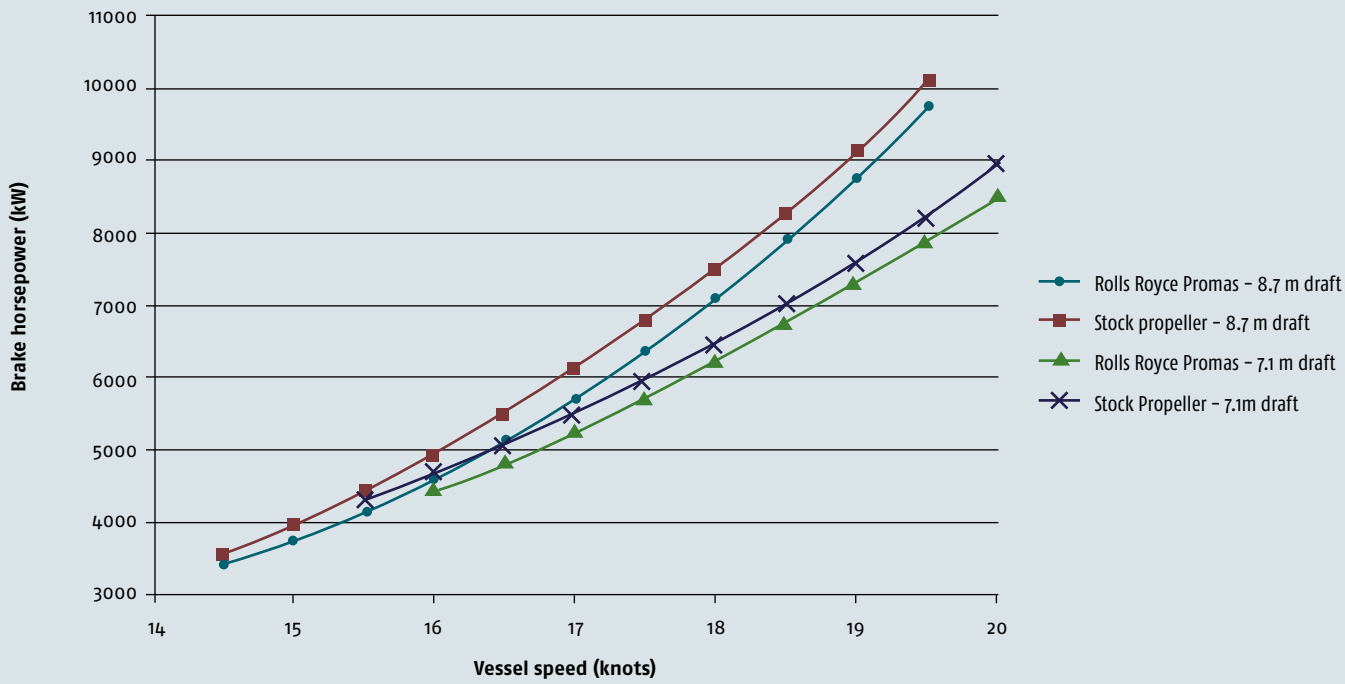
As of January 1, 2012, this regulation applies also to all Turkish ports. No problems have been experienced in transition to this requirement and such procedures are now well established. An additional cost has been added to the short sea operations for the procurement of the more expensive MGO needed for these calls (50-55% more expensive fuel).

ECA zones

The Mediterranean is not yet an emission control area (ECA) zone. There is pressure from EU member countries in the north for this to change in the future. We are presently monitoring the effects of the sulphur limit regulations in the existing ECA regions that will be implemented as of 2015 (sulphur limit of less than 0.1% m/m). The short sea shipping market will change drastically after such a regulation is implemented and large investments will be needed to ensure that ships can be converted to use scrubbing or liquefied natural gas as fuel.

There is a strong possibility that there will be a shift from sea cargo to road cargo as the advantages of shipping by sea will be diminished. Car manufacturers always want to control and reduce their transportation costs, and the short sea shipping market may no longer be viable under such conditions. As a medium-size private company, Neptune

MODEL TEST COMPARISON – STOCK PROPELLER VS PROMAS NO SEA MARGIN



Model tests showed that the PROMAS energy saving device would result in a reduction in effective horsepower of 4.7% as compared to the conventional CPP propeller.

Lines at present has a wait and see attitude for the effects of such regulations.

The EU has been supportive of short sea shipping in an effort to move cargos from the roads to the sea, and there are a number of initiatives and programs implemented to assist the short sea shipping environment.

One such program we participated in is the Blue Belt project of the EU. As part of this project, we installed satellite automatic identification system) transmitters/beacons aboard our vessels so that the EU authorities can track and monitor the ship movements. By monitoring maritime traffic, the final goal is to reduce the administrative burden and the systematic customs controls within EU waters for maritime companies. This is already valid for road freight transport—for example, trucks can cross EU territories without being systematically controlled. In this way, time and money can be saved.

Our company also currently participates in the new Business to Motorways of the Sea (B2MOS) global project, a continuation of the Monitoring and Operating Services for Motorways of the Sea action of 2010. The B2MOS project aims to provide a suitable array of measures in order for ports to become efficient gateways. The ultimate goal is to boost the ability of short sea shipping to compete on more door-to-door corridors and facilitate the development of Trans European Transport (TEN-T) Motorways of the Sea network connecting Europe, bridging the gaps between TEN-T corridors and revitalizing peripheral regions.

B2MOS aims at improving interoperability and pilot information technology solutions for electronic messages and systems for the exchange of relevant transport documents such as the following:

- electronic sea waybill
- electronic rail consignment note
- electronic commercial and transport invoice
- extension of the electronic T2L (customs document) initiative and promoting mutual recognition of this efficient system of proof of the EU community status of traded goods
- interoperability of seaport and river port information systems.

The B2MOS global project is aimed at demonstrating how the application of emerging and existing technologies—sustained by efficient communication procedures and collaborative information exchanges among public and private stakeholders—can improve, promote, and simplify the use of multimodal short-sea services by using the sea. **MT**

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