strategic transport, maritime transport, expeditionary forces, universal transports logistics, multi-purpose support operations forces vessel

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DEVELOPMENT TRENDS OF VESSELS UTILIZATION TO SEA TRANSPORT OF TROOPS AND MILITARY EQUIPMENT

Of particular importance, during expeditionary operations, has the advantage of rapid transit of full equipped military units to the operation area. Deserve particular attention with modern designs multihull vessels, characterized by very high rates cargo capacity and the possibility of redeployment forces at speeds up to 50 knots. An example of such a solution is produced by the shipyard Austal speed catamaran transport (Joint High Speed Vessel). Also, for the Polish Navy designed the Universal Transports Logistics and multi-purpose support ship operations forces.

TENDENCJE ROZWOJU JEDNOSTEK WYKORZYSTYWANYCH DO MORSKIEGO TRANSPORTU WOJSK

Szczególne znaczenie podczas operacji o charakterze ekspedycyjnym ma możliwość szybkiego przerzutu do rejonu działań ukompletowanych jednostek wojskowych. Na szczególną uwagę zasługują nowoczesne projekty okrętów wielokadłubowych, charakteryzujących się bardzo wysokimi wskaźnikami pojemności ładunkowej oraz możliwością przerzutu sił z prędkością nawet 50 węzłów. Przykładem takiego rozwiązania są produkowane przez stocznię Austral szybkie katamarany transportowe. Również na potrzeby Marynarki Wojennej RP powstały projekty Uniwersalnego Transportowca Logistycznego (UTL) oraz wielozadaniowego okrętu wsparcia operacji sił zbrojnych (WOWOSZ).

1. INTRODUCTION

In the current political situation, as the primary threat to world stability is considered local conflicts, as well as asymmetric operations such as international terrorism and organized crime. These threats have forced NATO countries to adapt armed forces to conduct support operations and peace enforcement operations. Mostly these operations are conducted in remote areas from the borders of NATO member states. Operation's

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expeditionary character of contemporary armed forces will need to transit of troops in parts of the world away from their territories up to 5000 - 7000 km in a straight line.

Due to the operation's expeditionary character of today's armed forces strategic transport planning is an important part of modern military operation. The main task of strategic transport is the movement of troops according to plan of their operational utilization. The most serious role in the redeployment of the armed forces and heavy equipment of expeditionary forces rests on maritime transport. Maritime transport is understood as the movement of soldiers, armaments and military by combat ships or merchant vessels between the ports of loading and unloading. [3]

The main advantage of maritime transport is a multi-tasking and the ability to move a large payload over long distances. An extremely important advantage is a relatively low cost of transporting troops and equipment by sea. For instance, is estimated that it is roughly 20 times lower than the cost of air transport. [4]

While the disadvantage of maritime transport is the relatively long duration, which includes loading, transport to port of destination and unloading. Loading time depends primarily on the ability of marine cargo handling port on the applied load and load option. And loading time depends on the suprastructure and infrastructure available in the maritime port of discharge. Time of movement by sea depend on the distance and speed marching of vessel.

2. GENERAL CHARACTERISTICS OF THE MODERN TRANSPORTATION VESSELS

The greatest strategic transport role in the redeployment of the main forces of troops and heavy equipment, belongs to the maritime transport. To accomplish the tasks within the maritime transport may be utilized any ships, but under condition that this action will be reasonable in relation to operational goals. The greatest value of engaged vessels are capable to carry large numbers of troops, equipment, including heavy military equipment and stocks.

The military maritime transport there are two basic ways to load the weapons and military equipment to the naval transport units, they are way: freight and landing.

In the process of loading the amphibious assault ship disembarked a complete set is subdivision with equipment, while the way freight maximize cargo capacity is used. With use of the last method it is possible to separate the freight transportation of the personnel, equipment and stocks. Loading freight method is used when, after reaching the sea port of discharge it is possible to move troops and equipment to forward assembly area, and then complete the formation of military units. The order of loading affect only the size of equipment that is deployed in a way that best fill the cargo area. Using the method of loading freight on a combat or merchant vessel can load about 40-50% of the cargo more than using the method of landing

The method is used for landing when it seeks to shorten the time between the disembarkation of troops, and carrying them into action. In this way, the ships are loaded

[3] Doktryna transportu i ruchu wojsk DD/4.4, Ministerstwo Obrony Narodowej, Sztab Generalny Wojska Polskiego, Warszawa 2007, s. 35

[4] M. Benec, T. Smal, *Wojskowy transport strategiczny jako wyzwanie dla Sił Zbrojnych RP*, Zeszyty Naukowe WOSWL, 1(143)2007, s. 22

transport units included in the combined joint task forces consisting of the maritime and landing components.

At the time of landing amphibious forces transported all sub-units may go directly to the area of operations, while possessing a security assigned to logistics, which allows continue operations until the arrival of successive shipments of logistics. Very important role played by the sequence of loading. Loading is carried out in reverse order to the intended use of equipment on the counter. The disadvantage of this method is under-capacity cargo vessel, which reaches more than 50% of total capacity.

The most important tactical-technical parameters of amphibious assault ship or transport include its ability to load (loading capacity). Loading capacity are specified amount, type and size of cargo, including military equipment, which can take on board at one time. Loading capacity also includes the number of troops landing possible for a single carry for certain distances.

In order to determine the loading capacity of vessels are distinguished five basic indicators of cargo capacity.[5]

The number of soldiers being transported. This is the number of soldiers that can take on board and provide them full support during the duration of the voyage

The number of transported vehicles. It is expressed in square meters of space positioning of vehicles, slightly increased the surface necessary for maneuvering. It can be expressed in the number of standard vehicles which fall on it - such as all-terrain vehicles HMMWV High-Mobility Medium Wheeled Vehicle, cargo-terrain vehicles

Cargo capacity. It is expressed in cubic space for storage of military equipment and supplies.

Landings in capacity. The particular number of air-cushion landing craft, boats or landing craft, which are located on the submersible board.

Airline capacity. Is determined by the number of aircraft that will fit and and will continue to live aboard the space maneuver on deck and the hangar. In this case, the unit of reference is the size of the helicopter CH-46E Sea Knight.

In contemporary maritime forces operate landing craft whose primary mission is to transport soldiers, weapons and military equipment. At the end land transported forces in the form of amphibious assault on the unprepared shore. The main difference between the transport ships and amphibious ship is structural adjustment to the landing troops on potentially hostile shore. Amphibious operation is carried out directly from ship to shore or from ship to shore using means carried by ship.

Modern multi-purpose landing (amphibious) ships (LPD Landing Platform Dock or Amphibious Assault Ship in English - Multi Purpose) have practically all indicators of the loading capacity of four other subclasses in this: [6]

Amphibious ships to carry tanks LST (Landing Ship called, Tank), enabling the transport of heavy weapons and military equipment and land them on the shore.

Landing ships to transport helicopters (LPH Amphibious Assault Ship, Helicopter) These ships have a large helicopter deck. Their major task is conducting landing operation

[5] A. Bursztyński, W. Drewek, M. Zieliński, *Uwarunkowania i możliwości strategicznego transportu wojsk i techniki wojskowej*, AMW, Gdynia 2010, s. 90

[6] Ibidem, s. 91-92

by helicopter, which can simultaneously transport weapons and military equipment, vehicles and armored vehicles

Landing craft - the docks LSD (Landing Ship called Dock), which are used to transport smaller amphibious units in the landing area. These units have molded hold in the hull, access to which is through the stern or bow freeing. In the hold are transported amphibious barges, boats and amphibious landing craft that flow from it after pouring the water, at a planned distance from the shore.

Landing transport ships LKA (called Amphibious Cargo Ship), intended to enable the landing operation, and specially designed for transporting troops, heavy military equipment and material and combat resources.

Contemporary multi-purpose amphibious vessels for the transport of troops in Joint amphibious task forces [7] has a very high ratios of the loading capacity of the transport tanks, helicopters, landing craft and material resources. An additional requirement for multi-purpose transport ships is quick access to the operational areas of destination (joint operation area).

3. STRUCTURES MODERN TRANSPORT SHIPS

The requirements of contemporary maritime theater of operations make it necessary to change the equipment in naval ships to transport troops. This is especially noticeable in the case of modern ships designed for operations under the intra-theater transport.

Modern designs include high-speed transport ships, both units of single-hull and multihull - catamarans and trimarans.

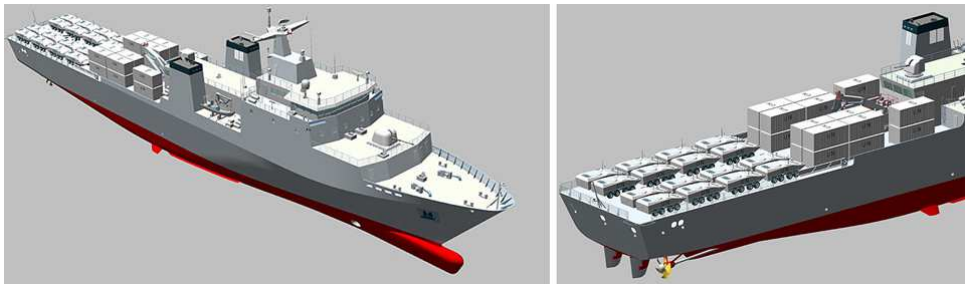
Designers Blohm + Voss shipyard, recognizing the need for modern multi-purpose logistics support ships, based on the proven design MEKO ships have developed a series of universal project of universal transport logistics vessel called MEKO 200 MRV (Multi Role Vessel). The main dimensions of this ship are: total length - 121.0 m at the waterline length - 109.0 m, width - 17,0 m and draft - 4.40 m.

To the handling of transported equipment both at sea and in port the ship will be equipped with a crane with a lifting capacity of 20 tons on the arm of 18 m. The deck cargo can also be adapted to cooperation with helicopters. There is possible designate two airstrip for the landing helicopters up to 14 tons take-off weight. [8]

The propulsion system with a capacity of 2 x 5,200 kW will reach marching speeds over 22 knots. The ship's stocks ensure of 30 days of autonomy.

[7] Joint amphibious task forces – temporary grouping of two or more types of forces covered by a single commander, organized to participate in the landing sea operation – Słownik terminów i definicji NATO AAP-6 (U), MON, BWSN, 1998, s. 174

[8] A. Nitka, *Platformy przyszłości*, Przegląd morski, Nr 9/2008, s. 51-52.



Source: http://irishmilitaryonline.com

Picture 1. The vision of multi-role ship MEKO 200 MRV.

Among the modern construction of single-hull vessels designated to rapid transport of troops in the theater is worth noting the unit designed by specialists of Rolls-Royce concern. To the hull construction was used project of hull of the civilian units the type RO-PAX. The ship is characterized by a high payload capacity and is a rare combination of a troop transport over long distances at high speed. Conceptually, as with the structural unit of cargo space with an area of 2310² square meters will be able to transport 2,500 tonnes of cargo a distance up to 3000 nm with an average speed of 40 knots. In addition, the ship's amidships meets the conditions to be equipped with a helicopter landing area. The parameters are designed to allow landing even with double rotors helicopters CH-47 Chinook.

Source: http://www.rolls-royce.com/marine/products/ship_design/naval_support_vessels/flv/

Picture 2. The vision of a new single hull transport ship.

In March 2001, Capt. Joseph E. Skinder found that individuals multi-hull are faster and more stable in high sea states and consume less fuel than the single-hull units. Interest in multi-hull naval units has increased since the Royal Australian Navy in 1999 - 2001, utilized the 86-meter catamaran HMAS *Jervis Bay* in support of Operations in East Timor. This unit ran as a carrier of troops, supplies and equipment between Darwin and Dili (550 nm) with an average speed of 43 in beating the route there and back within 24 hours. This technology is built in SWATH (Small-waterplane-area twin-hull) vessel was used by the Royal Australian Navy in 107 transport missions from a distance 100 000 Mm, carrying 22,000 passengers, 430 military vehicles, and 5600 loads. [9]

[9] M. Zieliński, *Przemieszczanie wojsk i ładunków drogą morską*, Wojskowy przegląd techniczny i logistyczny, Nr 6/ 2003, s. 36

In United States Navy interest in the rapid transport units has increased, following the adoption of the new national doctrine of pre-emptive strikes, forcing conduct expeditionary operations. In 2002 double-hull ferry *Westpac Express* (HSV-4676) was chartered by Military Sealift Command for the Marine Corps Logistics Prepositioning Ship Program. The unit participated in the logistical exercise *"Cobra Gold 2002"*.

Unit length of 110 m and displacement of over 2 100 t is able, thanks to four diesel engines *Caterpillar 3618* with a capacity of 9720 hp each, carry 970 soldiers to 4000 km at a economic speed of 20 kn. When the economic maximum speed of up to 33 knots the range of action decreasing to 2300 km. Alternatively, the catamaran can carry 153 armored cars *Hammer* or 20 armored personnel transporters.

U.S. Navy has considerable experience in the utilization of multi-hulls units. Three prototype units of High Speed Vessel HSV-X1 *Joint Venture*, TSV-1X *Spearhead* and HSV 2 *Swift*, were used to support operations in the global war against terrorism and during Operation Iraqi Freedom. HSV-X1 termed as *Theater Support Vessel*. This modern catamaran has a 103 meter long, and is characterized by high speed reaching up to 50 and can operate to 2400 nm operational range. It can also accommodate up to 360 soldiers with the military equipment. On the HSV-X1 to the carriage of goods allocated a zone the size of an area of 1124 m^2. Vehicles used to load the upper and lower deck, which can carry 17 LAV III armored fighting vehicles or 14 M2 Bradley infantry transporters. While on the ramp can be transported the pallets with the military equipment.

In order to preserve the ships stability during loading and unloading operations individual vehicles are moving well-defined routes, and deployed in the hold as scheduled shipment. For ease of loading and keeping the unit on a equal keel special water tanks located outboard of the hull of the ship are filled with. These water tanks after stowage are emptied as needed. In addition, she has a airstrip from which they can operate helicopters inclusive CH-46 Sea Knight.

Source: www.maritimequest.com

Picture 3. High Speed Vessel HSV-X1 Joint Venture oraz TSV-1X Spearhead.

Source: www.maritimequest.com

Picture 4. High Speed Vessel HSV 2 Swift

HSV 2 Swift supported relief operations in Indonesia and in the Gulf of Mexico after Hurricane Catrina. In both cases, HSV 2 *Swift* was able to transport loads with high speed and call at ports inaccessible to other vessels. More advanced variant of TSV-1X ships are to be logistic suport vessels TLV-101, TLV-125 providing logistical support for troops being transported.

The construction of these units is based on double-hulled car ferry project. The ships have a loading ramps provide loading and unloading equipment at sea, the shore, unprepared shore and wharf with poor infrastructure. The ships are to have the ability to transport troops, trucks and heavy combat vehicles and helicopters at a marching speed of 45 knots. The experience gained during operation *Westpac Express* is extremely important, because it is based on this unit is expected to create a new, dedicated specifically for the U.S. Navy and U.S. Army multi-purpose high-speed transport ship JHSV (Joint High Speed Vessel).

Source: Austral. JHSV, www.austral.com

Picture 5. JHSV The vision proposed for the U.S. Navy catamaran JHSV.

The vessel (JHSV) of length 103 m, a width of 28.5 3.83 m draft me to be able to transport troops (a battalion-sized), military equipment and supply. Planned unit capabilities include, in addition to seats for 41 person crew 104 seats for the soldiers embarked on a permanent, 46 temporary seats and 312 seats air. The ship is to be able to take on board some 544 tons of cargo. Designed for loading by Roll-on/Roll-off deck underneath the landing strip, is to have a surface area of not less than 1858 m^2. With a cargo ship is to have the ability to transition to 1200 nm at an average speed of 35 knots

marching without refueling, and without charge, at an average speed of 25 knots marching to 4700 nm.

JHSV program combines the needs of the army - Theater Support Vessel (TSV) with the needs of the U.S. Navy and Marine Corps - High Speed Craft (HSC). Even more revolutionary designs are trimarans, which can be used for various transportation tasks, ranging from transport special groups to transport of unmanned aircraft finishing. Trimaran design is based on the inner displacement hull and side quasi-stabilizing hulls. Situated in the main hull of the most important vessels equipment and systems are protected by the side hulls. This can cause the ship will be more resistant to enemy munitions (sea mines) and damage.

United Kingdom, as one of the first states funded the construction of an experimental trimaran HMS *Triton* for the length of 90 m. Sea tests of Triton showed that the new shape of the ship does not cause difficulty in maneuvering, replenishment supplies during the passage of the sea and the landing of helicopters. Ultimately, however, abandoned the concept. [10]

January 16, 2010 modern trimaran USS *Independence* - LCS-2 (Littoral Combat Ship) entered the service of the U.S. Navy. Order for the unit, built by General Dynamics in the Austal USA shipyard ,was submitted October 15, 2005, and construction began 19 January 2006. The ship launched on April 29, 2008. 18 December 2009, there was an official flag raising of the U.S. Navy. The futuristic hull design has been developed based on experience, which achieved the Austal shipyard for the construction of numerous high-speed passenger ferries. [11] This shape offers many advantages such as low draft, high speed, high sea prowess and agility, more efficient power supply and the optimization of aviation infrastructure.

USS Independence, with a displacement of 2,784 tons of the total, is the largest warship made of aluminum,. The dimensions of the ship mainly are: total length - 127.4 m, width - 31.6 m, draft - 3.96 m

Combined CODAG[12] engine room in the system consisting of two gas turbines and two diesel engines that drive four water jet Rolls-Royce thrusters KaMeWa achieves the maximum speed to 44 knots. The average fuel consumption for diesel engines is set at 3.8 t per hour while for the gas turbine at 10.78 t per hour. Ship at a speed of 18 knots may march great distances 4300 nm. [13]

The ship with a capacity of 608 tons of the stern has a large hold, access to which ensure stern ramp and side door on the right side. Loading area, dealing with the greater part of the hull below the superstructure and cargo airfield is 1410 m^2. In the hold there are four lines for transport of cargo such as combat vehicles type Stryker and armored vehicles of the Hammer. Stern ramp allows the launching of small amphibious crafts up to 4 degrees on the Beaufort scale. Lift allows the movement of cargo transported in containers on deck,

[10] http://www.g2mil.com/trimaran.htm; 27.01.2011.

[11] The prototype of the USS Independence - Benchijigua Express was built in Henderson, Western Australia by Austal shipyard, and from April 2005 is operated by shipping company Fred Olsen SA between the Canaries Islands.

[12] CODAG (called Combined Diesel And Gas turbine) - type of engine room, consisting of one or more diesel engines operating at speeds of marching (economic), and one or more additional gas turbines run at maximum speed.

[13] *US Navy Litoral Combat Ship*, Defence Capability Program: Maritime, 2010, s. 81

where they can be transferred ashore by helicopter. The large width of the hull at the stern of the ship allowed design of a stable landing deck for helicopters, which allows to cooperate with two classes of helicopters SH-60 Seahawk or one class of CH-53 Sea Stallion. At the same time the ship hangar allows to secure two helicopters of the class SH-60 Seahawk. [14]

Source: B. Steinman, U.S. Navy New LCS-2.

Picture 6. USS Independence (LCS-2)

4. MODERN TRANSPORT SHIPS FOR POLISH NAVY - PROPOSALS

Also in the Polish Navy will look for solutions to the strategic shift of expeditionary forces for long distances. For the purpose of maritime strategic transport can be used for both civilian units and warships. Of the fleet operating in civilian fleet the most useful to strategic transport of troops are sea-going ferries.

In 1997-2001, the Polish Baltic Shipping disposed vessel capable of rapid transit forces, meeting the requirements of a modern maritime theater. The unit that was fast passenger ship HSC *Boomerang*. Built by Austal Ships catamaran Autoexpress type 82 was a modern structure made completely of aluminum alloys and composites. Planned to operate as a ferry on line Swinoujscie - Malmö took up to 700 passengers and 175 cars or 10 buses and 70 cars. On the ferry there were no cabs and the passengers were sitting in chairs air. Ship has length - 82.30 m, width - 23.40 m, draft - 2.79 m and was equipped with water jet propulsion. Ferry could expand the operating speed of 40 knots (during sea tests even 48 knots). In 2001, HSC *Boomerang* for economic reasons has been sold

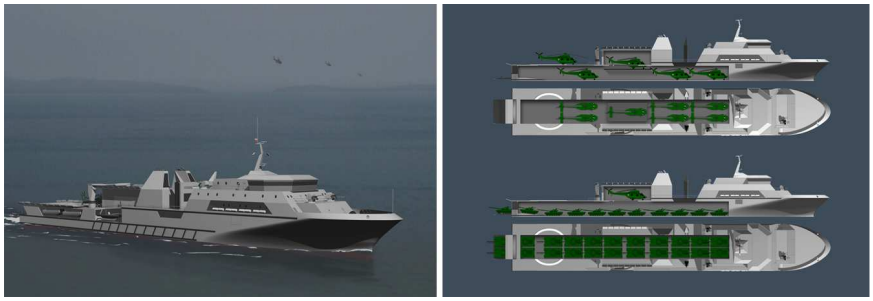
[14] http://en.wikipedia.org/wiki/USS_Independence_(LCS-2) ; 27.01.2011.

Source: A. Wörteler, http://www.faktaomfartyg.se/boomerang_1997.htm

Picture 7. HSC High-speed passenger vessel Boomerang

Polish Navy ships do not currently have the capacity to strategic transport troops. However two projects were designed: Universal Transports Logistics (UTL) and multi-purpose support operations forces vessel (WOWOSZ). [15] This kind of ship must have the ability to transport troops, military technology, including heavy equipment and helicopters, and stocks of resources material and combat in containers. At the same time she must be able to operate in all weather conditions occurring in different regions, as well as for going during the winter, with crushed ice or following icebreaker.

The proposed solutions were prepared projects UTL and quasi-RO-PAX. According to the project UTL could transport about 200 troops, helicopters, and depending on the taken variant to load 60 containers of 20 'or 20 heavy tracked vehicles, wheeled vehicles and 30 medium vehicles.



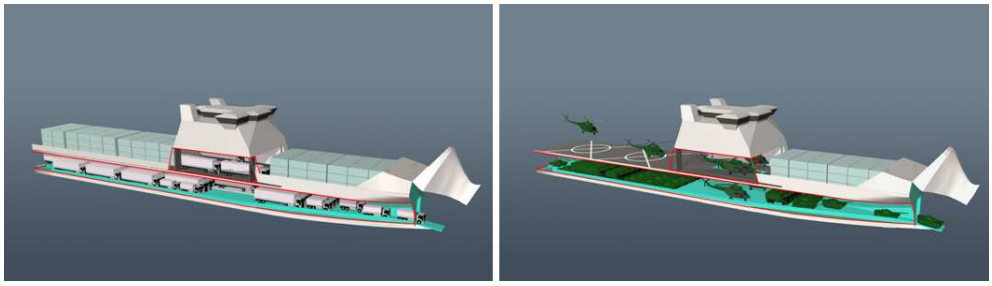
Source: Northern Shipyard, project overview presentation of the logistics and amphibious ships built at Northern Shipyard and the presentation of a draft of the Universal Transports Logistics UTL.

Picture 8. The vision of the Universal Transports Logistics.

Also, Northern Shipyard SA presented a project of the ship Ro-Pax, intended for transport by sea of cargo and troops and military technology with the necessary inventory in relation port - port. The ship was to be able to transport military cargo in containerized cargo or cargo on vehicles, rolling or fixed helicopters in the hold, or self-propelled marine

[15] M. Zieliński, *Propozycje modułowych rozwiązań funkcjonalnych dla Marynarki Wojennej RP*, Rocznik Bezpieczeństwa Morskiego, Gdynia 2009, s. 155-185.

technology. According to the assumptions vessel should also have the capacity to transport 600 troops.



Source: Northern Shipyard, project overview presentation logistics ships and landing craft built at Northern Shipyard and the presentation of a draft of the Universal Transports Logistics UTL.

Picture 9. The vision of the ship RO-PAX.

Table 1 presented comparison the main parameters of a transport logistics universal and quasi-RO-PAX.

Tab. 1. Comparison the main parameters of UTL and RO-PAX

Main parameters of the ship	Unit of measure	UTL	RO-PAX
Overall length of hull	m	125,3	150,0
Length between perpendiculars	m	116,0	142,0
Width	m	18,6	24
Draught design	m	6,7	7,5
Height to main deck	m	7,0	12,0
Height to upper deck	m	9,5	-
Displacement full	t	9100	15000
Deadweight full	t	4100	7000
Autonomy for the crew of the ship	days	30	30
Autonomy for the military ship	days	21	21
Maximum speed	knots	20	25
Service speed	knots	17	20
Operation range at service speed	nm	10000	10000

Bibliography [8]

Currently under consideration is a proposal for acquisition for the Polish Navy Multi-ship dock with a continuous air deck, equipped with modern navigation systems, command, communications and technical monitoring, and air defense systems and missile. ORP *Prince Jozef Poniatowski* (so she would be called) that served as the base function of amphibious and special forces, carrier aircraft and helicopters of naval aviation. It would also fulfill the tasks of heavy ship logistics, heavy rescue units and hospital ship. The unit, which is able to meet the requirements of is the Mistral class ship.

Mistral is a unit of single-hull length of 199 meters and a displacement of the full 21 thousand tons. From the deck can simultaneously operate six helicopters, including one

weighing off 33 tons. The hangars can accommodate up to 16 large machines, and in case of an entity as carrier of helicopters, it is possible to operate up to 35 lighter helicopters. The ship can also carry up to 900 troops or transport 40 light tanks. From the deck of the ship can also operate four boats and two amphibious hovercraft.

CONCLUSION

Complemented by the most common currently in fleets of new multi-purpose amphibious units Amphibious Assault Ship - Multi Purpose can be quickly transports, whose structures borrowed from the commercial market. JHSV have a high carrying capacity, enable the transport of several hundred special forces troops, or infantry, as well as military equipment and stocks of material resources. Have a possibility of co-operation with helicopters, and in many cases can carry amphibious units. These units can reach speeds from 35 to 45 knots, are characterized by a large operational range and autonomy. Futuristic shapes of these ships, such as the USS *Independence*, and U.S. ships experimental *Sea Fighter*, or *Sea Shadow* have to make these vessels more difficult to detect by technical means of observation.

Modern multi-purpose projects of transport ships and of naval logistical support to include single-hull designs and multi-hull. It seems that the best option for units of this type are these which are proven in civil fleets, multi-hull and high speed ferries. Spectrum utilization of modern multi-hulls transport units is broad, ranging from strategy distant redeployment through the activities as "intratheater transportation" and ending with the units to conduct humanitarian assistance missions or amphibious operations. Additionally, thanks to a relatively small draft can call at ports that are available for single-units of similar capacity.

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