

Safety of Oversize Cargo in Ports and in the Sea Transport

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ABSTRACT: Author of the paper analyzes problems related to the safety of the oversize cargo in ports and in the sea transport. Various modes of transport are used to carry oversized units that often include maritime transport. Transport of oversized cargo includes non-standard large and heavy pieces of cargo, such as electric transformers, reactor vessels, wind turbines, airplane fuselage or nuclear power plant components. The above paper is based on results of research oversized cargo in the Elpo Service Company and Pol-Mare Ltd. forwarding consulting agency.

1 INTRODUCTION

Shipments requiring handling of oversize cargo in maritime transport are increasing and due to their size, weight or specific character of carriage, require individual solutions.

There are special handling installations on the terminals, factory sites, ports and docks for the oversize transport. The applicable safety rules, i.e. issued by the International Maritime Organization, the Road Administration or Rail Administration, should be strictly respected.

Every case of handling, stowage and securing of such cargo must be done under the supervision of the surveyors. Moreover adequate calculations should be made prior to the shipment and necessary permits and certificates should be obtained [2].

This type of cargo includes e.g. drilling platforms and marine wind turbine bases. Their enormous parameters require individual approach to loading and unloading operations. The port location is one essential aspect decisive for the port capability of

handling heavy and super heavy cargoes. It is the location that makes some of the seaports unable to handle the heaviest and largest pieces of cargo. Only port's close proximity to the sea makes it competitive on the market of super heavy cargo pieces. Over short distances such cargoes may be towed to the place of destination or transported over longer distances by the so called heavy lift carriers. These are vessels for the carriage of oversize and heavy cargo, including super heavy and heavy lifts [2].

The author the paper is an independent Surveyor, sworn Expert Polish Chamber of Maritime Commerce (PCMC).

PCMC is a nationwide, voluntary and self-government organization of business entities running activities under broadly defined maritime economy. The principal purpose of the activities of the Chamber is to create conditions for using the sea as a natural factor of economic development and also supervises the activities of the team of sworn experts that consist of 150 specialists of different branches.

2 DEFINITIONS OF OVERSIZE CARGO

The explanation of the definition of the oversize cargo is a key and realtes not only maritime transport, but to all modes of transport. There is not precise, and the only unique definition of the oversize cargo.

In rail transport oversize cargo exceeds standard loading gauge or exceeds permissible axle load of the railway. Such a situation is called extraordinary delivery, which means, such transport can cause difficulties in rail transport and it is necessary to take special technical and/or operating actions. In inland shipping oversize cargo is cargo, that overcomes the vessel's length or/and width or which overcomes the standard air draft of the vessel (vertical clearness of bridges, gates etc.).

Below are oversize cargo definitions in the different modes of transport: road, rail, inland shipping, sea and air transport.

The parameters of cargo differ from each other, which effects in the multiplicity of means of transport engaged in the oversize transport. Sometimes even specially designed to transport a particular type of oversize cargo (Fig. 1).



Figure 1. Elpo Service Company specializes in transportation of oversized cargo, weighing over 370 tons of submarine type Kobben. Source: Elpo Service Company

In road transport oversize cargo exceeds maximal permitted parameters of standard road vehicle or exceeds permissible axle load of the vehicle. In consequence, there are oversize vehicles instead of oversize cargoes (Fig. 2).



Figure 2. Pol-Mare Ltd. specializes in transportation of oversized cargo. Source: Pol-Mare Ltd.

It could be said, that in all cases "oversize" determinants are:

- 1 cargo dimensions,
- 2 cargo weight (Fig. 3),
- 3 available cargo space on the vehicle,

- 4 permissible pressure and stress on the loading surface,
- 5 permissible stress on surface of road/rails.



Figure 3. Pol-Mare Ltd. specializes in transportation of oversized cargo - shunt reactor and floating crane "Maja". Source: Pol-Mare Ltd.

In the sea transport the oversize cargo is defined as: break bulk or general cargo unit, which overcome the parameters of standard cargo units. It means, it weights hundreds or even thousands of tons and its dimensions is counted in tens or even hundreds of meters. In intermodal transport, oversize cargo is the cargo, that exceeds the average permissible parameters of means of transport in terms of size, shape, or/and permissible pressure and stress on the loading surface of minimum one mean of transport.

Oversize cargo, also referred to as non-standard or over standard, is cargo whose transfer requires the use of special means of transport and lifting facilities with a capacity adequate for cargo weight [3].

Taking into account the dimensions, weight and shape of oversize cargo, we can divide it as follows [5]:

- 1 ordinary oversize cargo – all kinds of steel structures, small size industrial machines and equipment, working machines, small tanks and many others. If their weight does not exceed 25 tons, and their dimensions slightly exceed standard parameters allowed in road transport, i.e. length of 15-16 m, width of 3.5-4.0 m and height of 3.0-3.5 m. This type of cargo can be carried by normal road vehicles, that is a truck tractor with a semi-trailer, uncovered, equipped with proper marking equipment and securing's;
- 2 long pieces – mainly include structural components for civil engineering projects, e.g. spans, pillars, gantry crane or wind turbine elements; other type comprises reactors and columns for the chemical and refinery industries; their length may reach 40, even 60 meters, while the other parameters do not exceed standard sizes (Fig. 4 and Fig. 5).

3 OVERSIZE CARGO IN MARITIME TRANSPORT



Figure 4. Pol-Mare Ltd. specializes in transportation of oversized cargo - turbine elements. Source: Pol-Mare Ltd.



Figure 5. Pol-Mare Ltd. specializes in transportation of oversized cargo - turbine elements. Source: Pol-Mare Ltd.

1 special oversized cargo – this includes, among others, large elements of combustion chambers for power stations, machine components for open pit mining, steel structures, tanks for food industry and breweries. With their large dimensions, these cargo pieces often happen to have relatively small weight.

Therefore, there is no adverse effect on the road surface, but there are restrictions due to the cargo parameters. Some pieces of cargo may be 5 m long, 7 m wide and 6-7 m high;

2 heavy compact lifts – machines such as transformers, generators and turbines. Their characteristic feature is a large weight relative to volume. The same refers to industrial presses or marine engine crankshafts. Some of these may weigh 200 tons up to even 300 tons. They can be transported by land, where multi-axle semi-trailers are needed for the carriage;

3 heavy lifts – these include machines and equipment for civil engineering, boilers, various types of tanks, housings for power plant machines, ship parts (hull sections, superstructures, hatch covers, etc.);

4 rail wagons, tram cars, complete technological lines for metallurgical, automobile, chemical or power engineering industries. The weight of such pieces generally ranges from 70 to 100 tons;

5 spacious cargoes – these include various types of structures, bridge spans, drilling rigs, cranes (fixed and mobile), large diameter pipes, port gantry cranes etc. These pieces of cargo may weigh, say, 900 tons and have a height of 40 meters. Such objects cannot be carried by road; the only way is by sea, sometimes by river.

Oversize heavy and super heavy cargoes in global maritime transport is on the rise. Handling of these untypical pieces of cargo requires proper port infrastructure, as well as skillful personnel that participates in cargo operations. Besides, particular need arises to assure safety of navigation for vessels carrying such pieces, especially in restricted waters [2]. At present, heavy lifts are handled in ports that have relevant experience and appropriate equipment. Super heavy and heavy cargo pieces belong to the group of oversize and heavy cargoes, i.e. cargoes whose dimensions and/or weight exceed standard freight parameters, which calls for specialized vessels and specific cargo-handling methods.

Description of oversize cargo often described as “heavy lifts”, are those measured from tens to hundreds of meters and weight hundreds or even thousands of tons. Some of extra-large oversize units are being transported on special, unique ships, built on purpose. The example of such is the Semi-Submersible ship (SEMI). The floating oversize cargo (on barge or by itself) is positioned on deck which is flooded and submerged underwater. When the ballast is pumped out, the deck comes up and oversize cargo remains on dry deck (Fig. 6). The oversize cargo could be loaded by heavy crane (floating or shore) with load capacity from 100 to 2000 tons and over. In every case, during loading and the sea passage, it should be taken into account following safety factors:

- 1 distribution of the weight of the cargo,
- 2 centre of gravity and centre of inertia of weight,
- 3 transverse moments,
- 4 torsion and vibration,
- 5 stability of the loaded ship.



Figure 6. Pol-Mare Ltd. specializes in transportation of oversized cargo - shunt reactor. Source: Pol-Mare Ltd.

Legal basis for oversize transport in Poland in the sea transport is The Polish Maritime Code issued on 18 of September 2001. There is not any particular law regarding oversize cargoes, therefore carrying such type of cargo, apart from the ship's Loading and Stability Instructions, one must follow the standards of Safe Practice for cargo Stowage and Securing, and other safety procedures enforced by the IMO Conventions. The institution of Maritime Code, however in different forms, is enforced in all Maritime Countries [9]. The following International Regulations shall be obeyed when carrying the oversize cargoes:

- International Convention for the Safety of Life at Sea (SOLAS), 1974;
- International Convention on Load Lines, 1966
- International Convention for Safe Containers, 1972 (CSC));
- International Regulations for Preventing Collisions at Sea, 1972 (COLREGs);
- Code of safe practice to cargo stowage and securing (CSS IMO Code);
- Regulation of the local Maritime Administrations [10]. Regarding the oversize transport, the local law imposes on the Administration the duty to monitor and supervise the movement of such cargoes.

In practice it is limited to one time permit given to the water crafts carrying oversize cargoes, for entering the port and to navigate on the waters under jurisdiction of the said administration (Fig. 7).



Figure 7. ELPO Service Company specializes in transportation of oversized cargo. Source: ELPO Service Company

It applies however to all ships departing from the standard parameters for draft, dimensions and maneuverability. Due to the variability of the oversize cargoes, apart from General Regulations originated from the Port Regulations, the regulations referring the oversize cargoes alone are not defined, and the permit for movement is given for one passage only. It should be emphasized that in every case the additional tugboat assistance should be given and frequently, second pilot. The terms of the additional insurance coverage for the carrier will be produced. In case of the Polish ports such Port Regulations origin from the Directives, Announcements and Orders of the Director of the Maritime Office

Transport of the oversize cargoes by the sea vessels, i.e. sea barges or ships, demands the specialized port infrastructure. This is the main factor defining the port's capability to perform the oversize cargo handling operations. In Poland that kind of services could be provided in Port of Szczecin-Świnoujście, Port of Gdańsk and Port of Gdynia. All ports are easily accessible by the road and rail and, additionally, Port of Szczecin-Świnoujście is a river port.

In Szczecin, the oversize cargo is handled either by mobile crane „Gottwald” of 100 tons load or by floating crane of 200 tons load. Due to that, oversize cargoes could be handled at almost every quay, but most often such a cargo is handled at the Terminal or

at the Duty Free Zone. In Port of Gdańsk oversize cargoes are handled at the Port Free Zone by mobile Crane of 100 tons load.

The other port operator owns floating crane of 63 tons load. Additionally, Gdansk Shipyard “Remontowa” owns floating crane of 200 tons load, and Polish Ship Salvage Company owns the biggest floating crane “Maja” of 300 tons capacity (Fig. 8).



Figure 8. Polish Ship Salvage Company owns the biggest floating crane “Maja”. Source: Pol-Mare Ltd.

3.1 Pol-Mare Ltd. in transportation of oversized cargo

Pol-Mare Ltd. forwarding consulting agency specializes in comprehensive handling of oversized cargo and has been active on the forwarding market since 2001 [6]. Pol-Mare Ltd. specialize in handling of transport strategic importance cargo, military and hazardous ones of all classes, and in transportation of oversized cargo (Fig. 9).

Pol-Mare Ltd. provides comprehensive services of oversized and heavy cargoes transportation – equipment, structures, heavy machinery, etc. – wherever they might be located.



Figure 9. Pol-Mare Ltd. specializes in transportation of oversized cargo - military equipment. Source: Pol-Mare Ltd.

Transportation of oversized cargo is a task, where one is looking not only for a reliable service, but also for the one that has specialized knowledge and long-term expertise.

This service requires special equipment, thorough advance planning and agreements, permits and

specially trained staff. With the optimal combination of the most appropriate transportation modes freight is delivered quickly and safely even on the most complex routes.

Pol-Mare Ltd. arranges transport for shipments, both domestic and foreign in: hinterland and sea.

During the whole forwarding process Pol-Mare Ltd. ensures a comprehensive superintendence of loading the cargo, its fixing, and assistance during the transportation itself [5]. Pol-Mare Ltd. collaborate exclusively with the best sub-contractors who were checked in respect of reliability and quality of services rendered by them, and in particular, in respect of safety of the cargo entrusted to for transportation. Confirmation of care Pol-Mare Ltd. takes of the highest standards is status of the Authorized Economic Operator (AEO) [2].

Basing on knowledge and experience Pol-Mare Ltd. offers an optimal selection of means of transportation, complete superintendence of loading, fixing, and realization of the carriage.



Figure 10. Pol-Mare Ltd. specializes in transportation of oversized cargo - shunt reactor. Source: Pol-Mare Ltd.

Pol-Mare Ltd. organizes in cooperation with the Elpo Service Company moving heavy cargo from the means of transport to the reach of reloading devices (and the other way round) with the hydraulic slide method (Fig. 10).

Pol-Mare Ltd. realizes carriages using road, railway, inland and sea means of transportation, including charters of vessels. In order to ensure safety of the cargo, Pol-Mare Ltd. makes use of the highest quality equipment and latest technologies for loading and fixing of cargo, what is the guarantee of high quality of services rendered. As part of comprehensive services Pol-Mare Ltd. organizes transport of, among other things, such cargoes as oversized steel structures, hulls of vessels, heavy machinery and motor vehicles, equipment for heavy, mining and power industries (boilers, reactors, turbines, transformers, gear transmissions, parts of wind towers, etc.). In sea transport of oversized cargo Pol-Mare Ltd. renders comprehensive in ports handling in the scope of: reloading, storage and fixing the load on vessels [4].

Experienced and well qualified staff Pol-Mare Ltd. shall ensure professional realizations of services tailored to the individual needs.

Pol-Mare Ltd. also render complete ship agency services. In order to ensure high standards of handling strategic and military cargoes, has implemented in Pol-Mare Ltd. the quality management system integrated with the Internal Control System certified by the Polish Centre for Testing and Certification (PCBC SA) and by Quality Certification Centre of the Military University of Technology (the AQAP Certificate).

Pol-Mare Ltd. is a founder member of the Polish International Freight Forwarders Association (PIFFA). PIFFA is a voluntary self-governing organization associating the entrepreneurs who run economic activity in the scope of services in international and national freight forwarding, logistics, transport, customs agencies as well as other services related with the goods turnover. The Association acts within the territory of the Republic of Poland.

3.2 Elpo Service Company in seaports

Elpo Service Company has been active on the market since 1991 and specializes in solving technical problems related to heavy objects transshipment using hydraulic systems. Elpo provides its services in seaports, railway discharges, halls and on rail or road bridges.

Moving bulky loads in ports is a very narrow specialization, and technologies used in Poland does not stand out from the global level. The biggest challenges in this field take on Elpo Service Company (Fig. 11).



Figure 11. Elpo Service Company specializes in transportation of oversized cargo. Source: Elpo Service Company

The company is equipped with hydraulic kits and different accessories that can be connected to any kind of moving, lifting, spreading and pushing system, which ensure the stability of performed services.

Hydraulic sliding system is built on the basis of hydraulic Wheelchair slide, connected to hydraulic lift cargo, and can be moved on the respective beams. This allows to implement projects in which the use of a rigid system is inadvisable or impossible; sliding movement is safer, faster, the system is also more portable, because there is no additional charge to raise it to put on the system rigid, and most importantly, ensures equal distribution of pressure on the load and the ground regardless of the inequality (Fig. 12).



Figure 12. Elpo Service Company specializes in transportation of oversized cargo - shunt reactor. Source: Elpo Service Company

Elpo offers wide range of lifting & hydraulic services for different industries:

- hydraulic skidding systems for heavy items repositioning,
- hydraulic lifting & lowering system for large-size items,
- machines repositioning,
- hydraulic lifting system for bridge spans,
- steel constructions, grips and beams strength testing,
- hydraulic & tens metric heavy objects weighting (Fig. 13),
- other services, which require using lifting appliances.

Each oversized cargo is a major logistics challenge for shipping companies that need to have the knowledge and means to achieve it. A separate specialization in connection with the resolution of problems related to the movement of heavy and bulky loads are in ports in discharges station, halls, bridges, viaducts road and rail.

In the case of Elpo highest load were towers IMECA 1 and 2 produced by Energomontaż Gdynia (their height reached more than 40 meters and weighed approx. 800 tons each), the longest element loaded on the pontoon was a bridge designed to connect two oil platforms, produced by the Gdynia VISTAL (length 120 m, weight 1,100 tons), and the heaviest load on the pontoon is weighing approx. 2,200 ton ship built also by VISTAL.

The traditional solution is the so called rigid systems, however, during loading by sliding pieces of heavy and bulky loads applied hydraulic sliding system built on the night HWS 280, which combines hydraulic systems. As a result, the company can implement projects where the use of rigid systems is inadvisable or impossible.



Figure 13. Elpo Service Company specializes in transportation of oversized cargo - submarine type Kobben. Source: Polish Naval Academy.

The practice also shows that the movement of the hydraulic sliding system is secure and faster, and the system is more mobile because there is no need to raise additional charge to put it on the system rigid. It also provides a uniform distribution of pressure on the load and the ground regardless of the shape and inequality.

4 CONCLUSIONS

The transport of oversized cargoes has big impact to economic development in every country but it is still very differently organized in separate countries. This transportation of non-standard cargo (oversize) creates non-standard problems. Some of Extra Large oversized units are being transported on special, unique ships, built on purpose. In every case (during loading and the sea passage) we have to take into account such properties of the load as distribution of the mass of the cargo, centre of gravity and centre of inertia of mass, transverse moments, torsion or vibration and stability of the carrier included. These problems are different than in other kind of transport.

To summarize, transport of oversized and heavy cargo by sea are arranged in the following phases:

- Loading scheme layout and mounting aboard.
- Loading layout and stock securing scheme.
- Determination of oversized type and degree
- Verification and approval of loading and mounting scheme.
- Transport options and route coordination.
- Rolling stock and freight services reservation (large time reserve required for irregular transportations, and use of special purpose transporter stock).

Thus many international regulations have to be followed when carrying the transport oversized cargoes. The biggest challenge when moving bulky loads in ports is undoubtedly logistics. The work must be done efficiently and safely, often also under the pressure of the deadline by which load should leave the wharf. On the other hand, physics has its laws and speed of bulky loads is low, installation and dismantling also requires time and occupies space.

The most frequent question within the transport processes is the question of safety. This question is very complex and includes a lot of detailed questions

and analyses which is necessary to conduct to answer the question of oversize transport safety factually, precisely, simply but most of all on the basis of the real data.

REFERENCES

- [1] Chmieliński M., Pałucha K., Logistics activities important for the safety of the transport equipment province-tem and explosives carried out by specialist tangential civilian operator Material Management and Logistics 09/2016 ISSN: 1231-2037.
- [2] Chmieliński M., Pałucha K., Identification of activities in the charge of the safety of transport of cargo requiring special conditions in terms of logistics, forwarding port wo sea. Material Management and Logistics 12/2016 ISSN: 1231-2037.
- [3] Galor A., Galor W., Problems of domestic oversize cargo transport related to the transport in the South Baltic Region. Oversize Baltic, www.transportoversize.eu/en/articles/id/4032/ (online access 28/01/2017).
- [4] Logistics for oversize <http://www.portalmorski.pl/zegluga/project-cargo-and-heavy-lift/1740-logistyka-dla-ponadgabarytow> (online access 01/28/2017).
- [5] Oversized Loads <http://pol-mare.pl/pl/oferta/ladunki-ponadgabarytowe> (online access 01/28/2017).
- [6] Marine bulky loads <http://www.gospodarkamorska.pl/Stocznie,Offshore/morskie-ladunki-wielkogabarytowe.html> (online access 01/28/2017).
- [7] Oversize Transport Handbook POLAND <http://www.transportoversize.eu/files/Main/strategy/Oversize%20Transport%20Guidebook-%20Poland.pdf> (online access 01/28/2017).
- [8] Moving Machinery <http://www.elpo.pl/index.php/pl/przemieszczanie-maszyn> (online access 01/28/2017).
- [9] The Act of 18 August 2011. On maritime safety. (Dz. U. No. 228, item. 1368, as amended).
- [10] Act of 20 December 1996. Ports and harbors. (Dz. U. of 2010. No. 33, pos. 179)