



A Study on the Current Situation of Safety Management of Bohai Bay Ro-Ro Passenger-Ship Terminals in Shandong Province in China

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Abstract. Roll-on/roll-off passenger-ship transport plays an important role in the national economy, and safety condition of the transportation mode is a key factor to ensure the economic development. Actually, the port is where the ro-ro transportation starts and also where it ends. Port traffic volume reflects the transportation condition and the port safety level is crucial to the ro-ro transportation mode. This paper analyzes the basic situation of Bohai Bay ro-ro passenger-ship terminals in of Shandong Province in China, including the port enterprises, traffic volume, cargo type and share. Besides that, the current situation of government safety supervision and enterprise safety management are also analyzed. As a result, the overall safety situation and the safety management condition of Bohai Bay ro-ro passenger-ship terminals in Shandong are illustrated. On this basis, targeted suggestions are concluded to address the safety problems and improve the safety management in the future.

Keywords: Bohai bay · ro-ro passenger-ship terminals · safety management · Shandong province

1 Introduction

Roll-on/roll-off (hereafter referred to as “ro-ro”) passenger-ship transport is a mature transportation mode through decades of development, but maritime accidents, such as “Sewol” sinking accident in Korea, “Dashun” sinking in China, happens occasionally, causing life and property damage. Majority of ro-ro transportation safety studies focus on the shipping line and the vessel conditions. However, port safety management and supervision accounts a large part for the safety of this transportation mode [1]. After “Zhonghua Fuqiang” fire accident in 2021, government departments in Shandong province realize that the terminal safety management is crucial to the ro-ro transportation. This paper presents a comprehensive analysis of the current situation of safety management of ro-ro passenger-ship terminals in Bohai Bay of Shandong Province and puts forward safety management advice to help further improve the overall safety of ro-ro transportation.

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2 Basic Situation of Ro-Ro Passenger-Ship Terminals in Bohai Bay of Shandong Province

2.1 Port Enterprises

There are four port enterprises involved in ro-ro passenger-ship transport in Shandong Province, which are Shandong Port Group, China Yantai Salvage, Dongying Haixin Port Co., Ltd, and China Railway Bohai Railway Ferry Co., Ltd. There are eight passenger terminals and 19 berth ports for Bohai ro-ro passenger-ship transport, which are located in Yantai, Weihai, Longkou, and Dongying.

The designed berthing capacity of each passenger terminal in Shandong Province is above 10,000 tons, with the largest being 50,000 tons. The designed passenger throughput ranges from 350,000 to 4 million passengers per year, and the designed vehicle throughput ranges from 72,000 to 300,000 vehicles per year. According to the requirements of the Shandong Provincial Department of Transportation, Shandong province is the first in China to require all large vehicles at ro-ro passenger-ship terminals to be equipped with security inspection equipment. In terms of vehicle security inspection, all passenger terminals are basically equipped with various types of security inspection equipment and vehicle image analysts and vehicle security inspectors. In terms of passenger security checks, each passenger terminal is equipped with multiple X-ray baggage scanners and security metal detector doors and image analysts and personnel security inspectors.

2.2 Traffic

From 2017 to 2021, Yantai Port Group of Shandong Province dispatched 6.396 million passengers and 1.974 million vehicles. The number of passengers dispatched from the Weihai passenger terminals of Qingdao Port of Shandong Port Group was 1.92 million, and the number of vehicles dispatched was 252,000. The number of passengers and cargoes dispatched from some terminals in recent years is shown in Fig. 1, Fig. 2, Fig. 3, and Fig. 4.

During the period 2017–2021, the number of passengers dispatched from passenger terminals in Yantai increased significantly in 2018, precisely, by 36.2%. In 2019, the

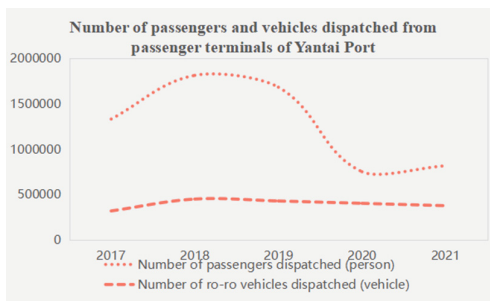


Fig. 1. Number of passengers and ro-ro vehicles dispatched from passenger terminals of Yantai Port from 2017 to 2021 (ro-ro vehicles include trucks and cars)

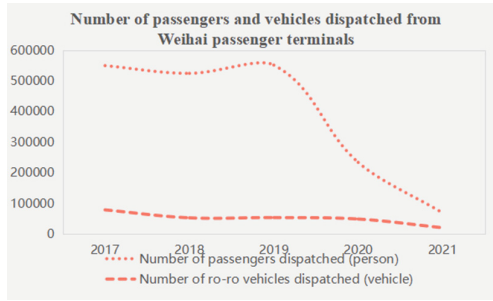


Fig. 2. Number of passengers and ro-ro vehicles dispatched from Weihai passenger terminals from 2017 to 2021 (ro-ro vehicles include trucks and cars)

amount of increase was reduced by 7.2%, so that the number of passengers dispatched reached 1,683,000. After a continual decline in 2020, the number of passengers improved slightly in 2021, rising by 8.7%. The number of ro-ro vehicles dispatched rose by 41% to 449,000 in 2018. After that, the number of ro-ro vehicles dispatched declined year-on-year to 376,000 in 2021, with a drop of around 16%. Over the five years, the number of ro-ro vehicles dispatched from Weihai Passenger terminals showed a downward trend, remaining essentially flat between 2018 and 2020 before dropping to below 20,000 in 2021. The number of passengers dispatched fluctuated slightly until 2019 and began to fall sharply by 2020, with a drop of up to 57.7%. In 2021, the number of passengers dispatched continued to fall to 68,000, reaching the lowest point in the five years.

As can be observed, prior to the outbreak of the COVID-19 pandemic, the number of passengers dispatched from all major passenger terminals showed a general upward trend. However, due to the combined effects of the pandemic and the “separation of people and cargoes” policy formulated as a result of the vessel “Zhong Hua Fu Qiang (China Fortune)” incident, the number of vehicles dispatched at all major passenger terminals showed an overall trend of decline. Despite this, the number of passengers dispatched from Yantai Port still showed an upward trend in 2021, indicating that the passenger transport market is recovering with the effective control of the pandemic. Once traffic volume returns to the pre-epidemic level, the conflict between supply and demand will be aggravated.

2.3 Cargo Type and Share

The main types of cargoes sent by port enterprises in Shandong Province are light industrial and daily-use products, seafood, agricultural products and by-products, steel, and rubber products. Taking Yantai as an example, the main types of cargo dispatched from the passenger terminals of Yantai Port from 2017 to 2021 were daily-use products, accounting for 54%, followed by empty trucks, accounting for 23%. Cargoes categorized into “Others” accounted for 16%, ranking third. Agriculture, forestry, animal husbandry, fishery, and mechanical equipment each accounted for 5% and 2%, while other cargoes such as steel and metal, construction materials, grain, and pesticides and chemicals accounted for a very low percentage. In the case of the passenger terminal of China Yantai Salvage, steel and timber accounted for the most, precisely 16% each. Mechanical

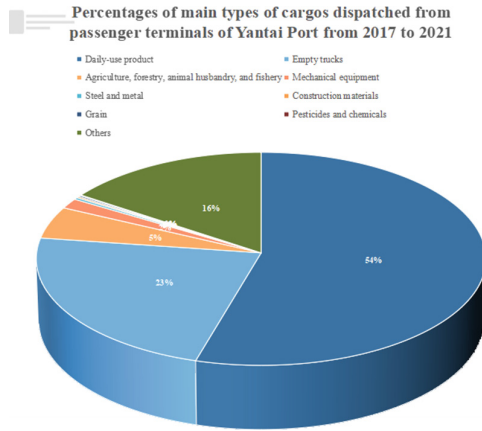


Fig. 3. Percentages of main types of cargoes dispatched from passenger terminals of Yantai Port from 2017 to 2021

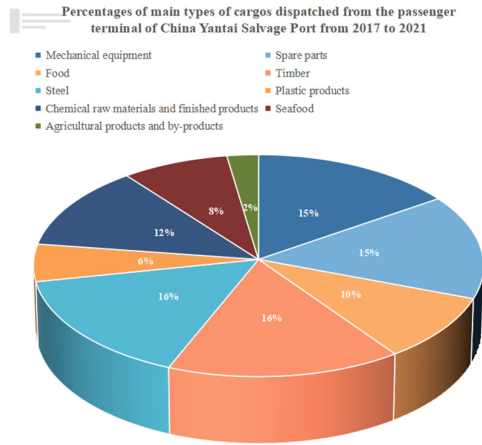


Fig. 4. Percentages of main types of cargoes dispatched from the passenger terminal of China Yantai Salvage Port from 2017 to 2021

equipment and spare parts each accounted for 15%, tied for second. Chemical raw materials and finished products accounted for 13%. The remaining types of cargo accounted for a relatively low percentage.

From the perspective of transport, the types of cargoes transported are essentially general cargoes. However, in certain specific cases, general cargoes can also be dangerous. For example, silica sludge is a general solid waste and general cargo and is not considered a dangerous good. But silica sludge can be dangerous under certain conditions, and it was its spontaneous combustion led to the fire onboard the vessel “China Fortune.” Additionally, the cases where drivers maliciously carry dangerous goods in their general cargoes consigned and deliberately misreport or conceal dangerous goods as general cargoes still exist.

2.4 Summary

There are four-port enterprises for ro-ro passenger-ship transport in Bohai Bay (Shandong, China), with eight-passenger terminals and 19 berth ports. The port enterprises are equipped with equipment and facilities for passenger and vehicle security checks. Also, the hardware facilities of the passenger terminals are in good condition, and the overall transport capacity meets the transport demand. Nonetheless, in recent years, the number of passengers and vehicles dispatched from the passenger terminals has fluctuated greatly. Passenger terminals should adjust their safety management measures in time to cope with the impact of fluctuations.

From the viewpoint of cargo transportation, the types of cargoes passing through the passenger terminals in Shandong are basically general cargoes. Although some of these cargoes are not dangerous goods, they can be dangerous under certain conditions. Besides, the problem of misreporting and concealment still occurs occasionally, posing a certain risk to the safety of ro-ro passenger-ship transport. With the development of society, new cargo types keep appearing, bringing new challenges to the security inspection of ro-ro passenger-ship terminals.

3 Current Situation and Analysis of Safety Management

3.1 Safety Supervision

Safety supervision of ro-ro passenger-ship transport involves the transport sector (maritime department, road transport management department, port, and waterway transport management department), public security department, and emergency management department [2]. Taking industrial management as an example, the Ministry of Transport, the Shandong Provincial Department of Transportation, and local port and maritime authorities all have regulatory functions.

According to the plan of the Ministry of Transport, in order to strengthen the safety management of ro-ro passenger-ship terminals, Shandong Province has carried out a series of safety supervision measures for ro-ro passenger-ship transport. Firstly, the information filling system for onboard cargoes is implemented, and the online declaration system for ro-ro vehicles and onboard cargoes in Bohai Bay is being gradually promoted. Secondly, the regional linkage mechanism is put into practice to achieve information sharing, and the ro-ro passenger-ship terminals and shipping companies have jointly established a regional information sharing system, and initial results have been achieved. Thirdly, the security inspection mechanism is implemented, the inspection process is optimized, and the "Positive List" of ro-ro passenger-ship transport cargoes is reported. Last but not least, the training system for security inspectors is established to strengthen training and assessment.

3.2 Safety Management of Enterprises

3.2.1 Port Security Inspection Management

In terms of security inspection, the boarding inspection process of ro-ro passenger ships at all passenger terminals is basically the same. The process is that passengers or vehicles

enter the terminal, and then relevant documents and fees are handled, and then security inspection is conducted, and then the passengers or vehicles enter the waiting area (loading area), and then boarding inspection is conducted. Subsequently, the passengers or vehicles enter the waiting area (loading area), followed by boarding inspection, and then ships leave the port. Passenger terminals of all port enterprises are equipped with security inspection gates, X-ray machines, handheld metal detectors, real-name verification check devices, and other equipment and facilities for passenger security checks, and have identity information checking office used by the port police station for real-name verification checks. Meanwhile, each ro-ro terminal is equipped with vehicle security systems for vehicle security checks, realizing remote monitoring and docking, and implementing closed-loop management of ro-ro operation sites.

In the process of passenger security check, a real-name ticketing system is strictly implemented, and passenger security check is carried out in advance, ensuring that all the personal and carrying items of passengers are checked. The linkage between the port and the police station is strengthened, and dynamic inspection is implemented for the ticket hall and the waiting hall, to ensure the safety of people boarding the ships.

In the process of vehicle security check, the mechanism of advance declaration of cargo information on ro-ro vehicles is firstly implemented to complete preliminary screening and confirmation of cargo information on vehicles and strengthen the audit of cargo information filling process. Secondly, ship-shore communication and joint check are carried out, the responsibilities of both sides are clarified, and the joint confirmation of ship-shore security check is implemented. The process of vehicle security check is roughly divided into four steps, which are preliminary vehicle check, declaration, mechanical check or manual check (car), and handling of security check formalities. The first step is to conduct a preliminary check for the vehicle. That is, the appearance, cab, cargo area, trunk (car), and other parts of the vehicle should be roughly checked in terms of security. If the vehicle meets the requirements for security inspection equipment check (mechanical check), the security inspection equipment is used for checking the vehicle. Otherwise (if the vehicle exceeds the width limit, length limit, or carries live animals, etc.), the vehicle is manually checked (manual check). The second step is to implement the electronic declaration. In accordance with the requirements of the Safety Management Guidelines for Ro-Ro Passenger-Ship Terminals, a system for filling in vehicle and cargo information is put into use. With the help of information technology, and information declaration system for the cargoes carried by vehicles on board was developed. By means of the system, drivers can fill the information online by scanning a QR code through WeChat or following the WeChat service account. The third step is to conduct mechanical checks. The security equipment can collect the outline image of an object, and the image analyst will compare the cargo information with the image, and suspicious goods need to be manually double-checked to confirm. The fourth step is to conduct manual checks. The last step is to handle the security check formalities. The boarding permission will be granted for the vehicles that are in line with the vehicle security requirements.

Port enterprises strictly comply with the ro-ro passenger-ship transport “blacklist” system. According to the regulations of the system, once any cargo shipper, carrier, and logistics distribution station, as well as vehicle or driver, is found misreporting and

concealing ro-ro cargo information or carrying dangerous and prohibited goods, it will be included in the “blacklist,” reported to the relevant higher authorities, and punished in accordance with the relevant provisions.

It was reported that dangerous goods such as corrosive substances, inflammable substances, toxic substances, self-heating items, and other miscellaneous items prohibited from boarding the ships were found during the security check at all major passenger terminals, effectively reducing the safety risks of ship operations. The security inspection equipment and staffing at all major passenger terminals meet the daily security inspection work requirements and can effectively carry out security checks before people and vehicles board the ships.

3.2.2 Other Safety Management

In terms of the emergency management system, all port enterprises have continuously improved and revised their emergency plans in accordance with the new guidelines for the preparation of emergency plans. With the linkage of the emergency evacuation plans for passengers and vehicles and the relevant plans for ships, the scientificity and applicability of the plans are further enhanced. Besides, joint re-analysis and rehearsal of the emergency process are conducted with the shipping companies. By doing so, not only the coordination and cooperation are strengthened, but also the ship-shore joint disposal capability is further enhanced in case of emergency.

In terms of personnel training, personnel technical training is the starting point. Personnel technical training is strengthened, enterprise teaching materials and assessment and evaluation standards are developed, and internal training for enhancing the safety inspection skills and knowledge of hazardous chemicals of employees are arranged. Only after passing the examination can they be put on duty, and their ability to perform their duties is continuously strengthened.

3.2.3 Existing Problems

Firstly, problems exist in port security checks. Port security check faces problems such as a serious shortage of security inspector and the aging of large security inspection equipment, which bring hidden dangers to the safety of ro-ro passenger-ship transport [3]. In the process of ro-ro passenger-ship transport, there are various kinds of trucks and goods on board, and the port cannot fully identify all kinds of dangerous goods and analyze the composition of each kind of goods. With the emergence of new cargo types, the pressure on port security checks further increases. At the same time, ro-ro vehicles require source control, which needs to be further strengthened. If effective control is not carried out at source and during transport, overloading, secretly loaded dangerous goods, and illegal transport will be frequent, and port security needs to bear huge security risks. In addition, some passenger terminals use large vehicle security inspection equipment with a cobalt-60 radioactive source. After the outline image of the object is collected for comparison, suspicious goods still need to be manually reviewed to confirm where the accuracy cannot be ensured. Also, security equipment needs to be upgraded and replaced.

Secondly, the joint disciplinary mechanism is still immature. Currently, when dangerous goods are secretly carried on board or misreported, only the vehicle or the driver will be embargoed. Therefore, there is a lack of joint disciplinary action against the cargo owner and the shipper.

Thirdly, the integrated information construction needs to be further implemented [5]. Ro-ro passenger-ship transport involves multiple industries such as source manufacturers, logistics and distribution, road transport, port, and shipping enterprises. The management standards are not uniform among the industries, and there is a lack of effective information sharing.

3.3 Summary

In terms of safety supervision of ro-ro passenger-ship transport, the management departments have taken a number of measures to strengthen the safety management of ro-ro passenger-ship transport, reduce the level of accidents, and strive for emergency rescue time, to ensure the safe operation of ro-ro passenger-ship transport in Bohai Bay [4].

In terms of enterprise safety management, all port enterprises have been able to strengthen the implementation of the entire personnel production safety responsibility system, consolidate basic safety management, and ensure the configuration of equipment and facilities. Also, the security check of ro-ro passenger-ship transport and the safety management level of the ports are improved.

At present, ro-ro safety management still faces some problems. In the face of complicated cargo types, overloading, secretly loaded dangerous goods, illegal transport, and other phenomena, the port security check is still inadequate, the security inspectors need to be trained, and their abilities need to be improved, and security inspection equipment needs to be upgraded and replaced. For the act of secretly loading and misreporting dangerous goods, the establishment of a joint disciplinary mechanism should be promoted, and the integrated information construction needs to be further strengthened, so as to achieve effective information sharing among different industries involved in ro-ro passenger-ship transport.

4 Conclusion and Suggestions

To sum up, the ro-ro passenger-ship terminals in the Bohai Bay of Shandong Province have established a relatively ideal management system and mechanism and a relatively ideal system of regulations and standards. The safety management capacity and level have been continuously improved, the safety risks have been effectively controlled, and the safety situation of ro-ro passenger-ship transport is stable and orderly.

Currently, the port enterprises should increase the security inspection equipment, and improve the security inspection capacity. Besides, temperature and combustible gas detection equipment should be added for vehicle security checks, the detection capacity of security check equipment for large vehicles should be enhanced, and more efforts should be put into the realization of intelligent identification and judgment of security inspection equipment.

In response to the problems such as increased passenger ticketing and waiting time for boarding the ship incurred by the temporary control measure of “separation of people and cargoes,” the ro-ro passenger-ship terminals in Bohai Bay of Shandong Province should devise some measures such as carrying out temporary waiting measures, providing people-oriented services, and setting more ticket counters, to improve services effectively.

In the future, the source management of goods carried by ro-ro vehicles needs to be strengthened, and the information-sharing mechanism needs to be improved. The information technology should be used to achieve the sharing of information on ro-ro vehicles, goods, administrative penalties, and “blacklist” credit information.

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