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Research on safety management of inland river sand carriers in Tianjin

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Research on safety management of inland river sand carriers in Tianjin

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Research paper: **Research on safety management of inland river sand carriers in Tianjin**

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With the continuous developing of the Tianjin Port, the demand for sand is increasing day by day. Driven by economic interests, a large number of sand carriers from inland rivers that do not meet safety standards are illegally involved in sand transportation. Due to the intrinsic defects of the inland river ships and the lack of proper safety management, the accidents of this type of ships have frequently occurred, which has brought great hidden dangers to the navigation safety of Tianjin Port. Therefore, carrying out research on the safety management of the Tianjin Port's sand carriers and implementing a comprehensive treatment of the them is an important basis for ensuring the safety of navigation.

The main research object of this paper is the inland vessels that participate in sand transportation in Tianjin Port. First, the reasons for the occurrence of inland river sand carriers are introduced, and the reasons for the high risk of inland river ships are briefly analyzed. Through the ten years of Tianjin Port's accident statistics involving inland river sand carriers and related typical case studies, the technical characteristics of the inland river sand carriers and the operation methods in Tianjin Port have been summarized. Summarizes the harm brought by the inland river sand carriers, and the relevant experience in the management of sand carriers in Tianjin and other regions. Finally, the paper puts forward some suggestions by analyzing the difficulties and existing problems in the safety management of sand transporter.

Developed countries strictly formulate their own regulations and technical specifications, and strictly comply with the implementation. There is basically no such problem in those countries. If developing countries do not involve large-scale port construction projects, there will be no case of inland river ships as described in this paper. It can be seen that the inland river ships carrying sand on the sea is a problem with national characteristics that appears

under the current circumstances in China.

Keywords: inland river ship; sand carriers; safety management.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIS	Automatic Identification System
CCG	China Coast Guard
CII	China Immigration Inspection
COLREGS	International Regulations for Preventing Collisions at Sea
CPA	Closest Point of Approach
GT	Gross Tonnage
MBLR	Municipal Bureau of Land and Resource
MSA	Maritime Safety Administration
NT	Net Tonnage
PSC	Port State Control
SOA	State Oceanic Administration
TCPA	Time of Closest Point of Approach
VDR	Voltage Dependent Resistor
VHF	Very High Frequency

CHAPTER I

Introduction

1.1 Statement of problem.

With the rapid development of China's economy and the further expansion of import and export trade, China's ports have entered a new round of construction and development climax. The construction of the project will require the use of a large number of engineering ships, and the construction will mostly be carried out in the shallow depth of the mudflat and near the port area. It is very difficult to find a large number of sea-going vessels that are suitable for the local water depth and meet the construction requirements in a short time. Inland river ships are generally larger in width and less draught, which is suitable for shallow water construction work and short-distance transportation of construction materials. As a result, a large number of inland river ships have emerged to participate in the construction of the port .

Tianjin Port, as the northern international shipping center and international logistics center, also saw a large number of inland river ships participate in the construction of the port during the construction process. And these ships play a decisive role. Tianjin Port’s offshore projects have attracted a large number of inland river construction ships and sand carriers. According to statistics, during the peak period, there were more than 1,000 inland river construction vessels and sand carriers in Tianjin waters.

In the construction of Tianjin Port, there is a huge demand for sand. Most of the works

are carried out on beaches with shallow water depths or in the vicinity of the port area. It is difficult for large-size sea-going construction vessels with large draughts to meet the needs of large-scale sea-related projects for centralized construction. As a result, a large number of inland river construction ships and sand carriers, which are poor in ship conditions but suitable for shallow water construction operations, have flooded into Tianjin Port and participated in the construction. As the above two types of ships do not meet the operational standards, the maritime traffic accidents caused by them increase year by year. Inland river sand carriers have once been the main factor leading to vicious maritime traffic accidents. Inland river sand carriers have poor technical conditions, low crew quality, and many hidden safety hazards in internal management (Yan, 2009). They also have many illegal operations and high accident rates.

a. The condition of the ship is poor.

According to investigations, more than 80% of ships engaged in sand transportation are inland river ships. The technical condition of this type of ship is poor. Most of the hulls are corroded and damaged, and there are major defects in anti-subsidence and hull strength. Inland river ships are mostly flat-bottomed single-hull ships, with low freeboards and no watertight requirements for hatch covers. It is not suitable for sea navigation in terms of structure, stability and equipment. When sailing in the sea area, due to its own poor condition, the ship is prone to sink when encountering bad weather.

b. The crew is of low quality.

The quality of the inland vessels' crew is relatively low. They have not received training for survival and life-saving at sea, and know little about safety knowledge and regulations. The crew members do not know much about the hydrological and meteorological conditions of the navigational areas. The lack of knowledge about the

management of the vessels has caused the ship to be in a relatively dangerous situation most of the time.

c. Ships lack effective management.

Sand carriers are mostly self-employed and most of them are not managed by regular ship management companies. There are also some ships that are affiliated with ship management companies for management. However, affiliated companies only receive management fees but do not implement related management responsibilities (Wang, 2015).

d. The illegal operation is widespread.

Shipowners have caused the ship to overload due to the pursuit of profits. The technical characteristics of the inland waterway itself are not suitable for sea transport. In addition to overloading, the handling performance of the ship is severely limited. The freeboard of the inland river ships is originally small, and overloading makes it even lower. This resulted in a reduction of the reserve buoyancy of the ship and a significant decrease in its resistance to sinking.

1.2 The purpose of research.

This paper takes the inland river sand carriers in Tianjin as the research object, based on the research object status and some existing safety management problems, starting from the concrete empirical data, to study the root cause of the problem. From the aspects of improvement of management mode, technical specification innovation, and formulation of laws and regulations, it is proposed to reasonably solve the safety management measures for sand carriers. If it can effectively solve the problem of

safety management of sand carriers, it has very important practical significance.

1.3 Basic ideas for the research.

This paper mainly analyzes the basic situation of sand carriers in Tianjin, and summarizes the specific problems and hazards existing in such ships. Afterwards, based on the typical accident cases that occurred in Tianjin in recent years involving inland river sand carriers, a comparative analysis of the differences in the technical standards of inland river ships relative to sea-going vessels was conducted. Introduce the specific measures adopted by the Tianjin MSA and in-depth analysis of the safety management difficulties of the sand carriers. Based on the reality of China, it proposes targeted countermeasures to solve the safety management of sand carriers in Tianjin.

This paper has studied the accident data and adverse effects caused by sand carriers in the Tianjin Port in the past ten years. Through the research of typical accident cases and on-site investigation and research of related ship data, the general situation of sand carriers in Tianjin Port, the causes of ship accidents, and the problems and hazards of sand carriers are analyzed. Then elaborated on the specific regulatory measures taken by the Tianjin MSA, the results achieved, and the remaining problems. Finally, it proposes to solve the safety management of sand carriers from the aspects of improving relevant regulations, obtaining local government support, and improving the joint enforcement mechanism.

1.4 The research methods.

1.4.1 Literature analysis.

Based on the research purpose, this paper searches for and collates various documents and summarizes the contents of related documents. The author mainly understands the development of the safety management of sand carriers through the Internet, libraries, and access to internal data. It also refines the opinions and research results of relevant scholars on this issue and further summarizes practical and feasible countermeasures. The relevant scholars' views on the issue and the research results are refined, based on which the summary of practical and feasible countermeasures is concluded.

1.4.2 Survey research.

Field investigation of the specific situation and problems of the research object. Participate in special research symposia on issues. Conduct interviews with individual subjects in order to obtain detailed and accurate first-hand information and provide more accurate data support for the research

1.4.3 Comparative analysis.

This article also used the comparative analysis method to compared and analyzed the technical standards of inland river ships and sea vessels. Use data calculations to arrive at a conclusion that meets actual conditions. Correct specific measures to better propose solutions.

1.5 The research content.

1.5.1 Research scope.

The areas under the jurisdiction of the Tianjin MSA are the following A, B, C, D, E, F, G, H, I points and the sea area between the coast (Tianjin MSA, 2015).

A：38°37′00″N/117°30′00″E.

B：38°37′00″N/118°30′00″E.

C：38°18′00″N/118°48′00″E.

D：38°18′00″N/120°20′00″E.

E：38°30′00″N/120°20′00″E.

F：39°08′00″N/120°10′00″E.

G：38°50′00″N/118°40′00″E.

H：39°00′00″N/118°05′00″E.

I： 39°14′00″N/118°30′00″E.

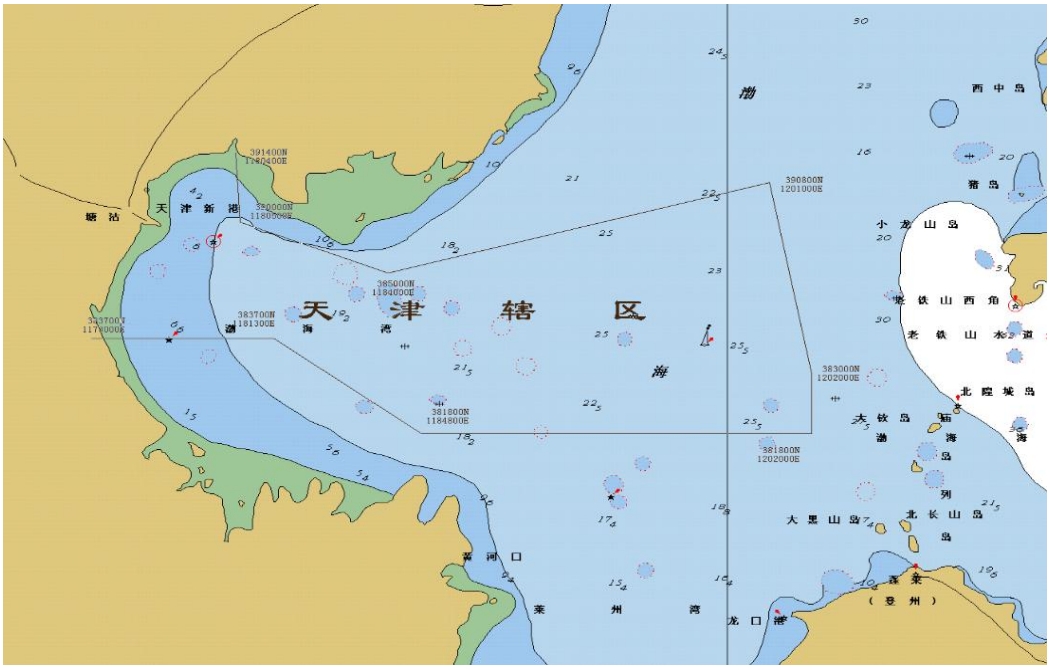

Figure 1.1: Tianjin MSA area.

Source: Tianjin MSA, 2015.

1.5.2 The object of management.

Construction operator: refers to the general name of the unit involved in the construction of a wading project, an owner, or a business management unit.

Sand carriers: It refers to the general name of the ships that provide sand for the construction of sea-related projects and temporary unloading sites.

Ships for construction work: It refers to the general name of ships engaged in sea-related construction operations, including dredging vessels, grab ships, mud barges and auxiliary ships, as well as ships engaged in safety management of the project site and personnel transportation.

Employees: refers to the general name of personnel engaged in the construction of projects related to the sea, including the management personnel and operating personnel of the construction units, and the crew of the ships.

CHAPTER II

Causes and status quo of inland river sand carriers.

2.1 Causes of inland river sand carriers.

In recent years, with the growth of China's economy, the economic development of the port and navigation industry has developed rapidly. In June 2002, Shanghai's Yangshan Port started construction. Large-scale land reclamation has created the largest amount of landfills in China, and the demand for sand has increased dramatically in the short term. A large number of sand carriers have gathered in the waters of Zhejiang and Shanghai. In 2006, the Bohai Rim Port Group headed by Tianjin entered the construction peak, and the continuous expansion of the port project has led to a surge in demand for sand (Cui, 2015). On the one hand, vessels engaged in transportation operations along the coast have deep drafts and high transportation costs, which are not suitable for the needs of the short-distance sand transportation market. On the other hand, due to the overcapacity of inland river vessels engaged in transportation in the neighboring provinces, a large number of inland river sand carriers transported into the Bohai and engaged in short-distance sand transportation.

Sand is indispensable building materials for infrastructure construction such as highways and housing. Take Jiangsu Province as an example. The province is a large consumer province of sandstone and other mineral building materials. However, there

are a limited number of sand that can be mined locally. Most of them need to be transported through waterways. The suburbs of Tianjin originally smashed stones that had been excavated and then transported them by land traffic. However, in recent years, environmental protection agencies have imposed higher requirements on air pollution, the original production technology has failed to meet the requirements, and manufacturers have been forced to shut down. This has led to a significant reduction in the amount of sand transported by road. And the demand for sand cannot be met, resulting in a shift in transportation to the sea. However, most of the ships engaged in sand transport are inland river ships. The technical condition of the ship itself is poor, the crew members do not have corresponding certificates of competency, and the ship's operation and management are also poor. These have led to frequent water traffic accidents and even the occurrence of serious accidents involving the sinking of ships, which has brought serious threats to the safety of water transportation.

2.2 Accident statistics and typical case analysis.

2.2.1 Statistics of accidents from 2005 to 2014.

During the ten years from 2005 to 2014, there were 283 accidents and 226 emergencies in the Tianjin waters. Among them, there were 55 accidents and 78 emergencies involving inland river sand carriers, accounting for 19% and 35% of the total. There were 36 shipwrecks, of which 26 ships were inland river sand carriers, accounting for 72% of the total. There were 40 deaths, of which 34 were involved in inland river sand carriers, accounting for 85% of the total. Among them, the situation in 2007 and 2010 was more serious. In 2007, the number of sunken ships accounted for 100% of the total, and the number of deaths and disappearances accounted for 94% of the total. In 2010, the number of shipwrecked vessels accounted for 67% of the

total and deaths and disappearances accounted for 73% of the total.

Table 2.1: Accident Statistics of Tianjin Sand Carriers in 2005-2014

Year	Accident/emergencies	Inland river sand carriers	Number of sunken ships	Inland river sand carriers	Death	Inland river sand carriers
2005	42/18	1/0	0	0	0	0
2006	42/16	1/0	2	1	0	0
2007	44/25	11/8	8	8	18	17
2008	26/34	5/12	5	3	5	5
2009	22/26	9/9	3	3	0	0
2010	21/33	5/20	6	4	15	11
2011	22/16	7/7	6	4	0	0
2012	22/17	8/12	3	3	1	1
2013	23/20	4/4	1	0	1	0
2014	19/21	4/6	2	0	0	0
Total	283/226	55/78	36	26	40	34
Percentage of total		19%/35%		72%		85%

Source: Statistics of Water Traffic Accidents of Tianjin MSA over the years.

2.2.2 Typical case analysis.

At 2323 on May 4, 2017, the Liberia-ship MV. ALPHA GALLANT collided with the Chinese ship MV. Chujiang 168 in the 38°50′.2N/118°18′.9E. MV. ALPHA GALIANT was a international ship, and MV. Chujiang 168 was an inland river sand carrier (Tianjin MSA, 2017).

a. Ship condition.

Table 2.2: The particulars of MV. ALPHA GALLANT

The particulars of MV. ALPHA GALLANT			
Name	ALPHA GALLANT	Flag	Liberia
Ship type	Bulk carrier	GT	92992
NT	60544	Length overall	291.98 m
Breadth moulded	24.70 m	Total power	16700 KW
Owner	FAIRPLAY SHIPMANGEMENT S.A.	Operator	ALPHA BULKERS SHIPMANAGEMENT INC.

Source: Tianjin MSA accident investigation report in 2017.

Table 2.3: The particulars of MV. Chujiang 168

The particulars of MV. Chujiang 168			
Name	Chujiang 168	Flag	China
Ship type	Dry cargo ship	GT	1139
NT	638	Length overall	66.4 m
Breadth moulded	11.92 m	Total power	520.00 KW
Owner	Anhui Chujiang Shipping Co., Ltd.	Operator	Anhui Chujiang Shipping Co., Ltd.

Source: Tianjin MSA accident investigation report in 2017.

Before the accident, MV. ALPHA GALLANT navigation equipment, navigation aids and various machinery and equipment are in good working condition. The sirens, taillights, and neon lights of MV. Chujiang 168 were in an unusable state. In the event of an accident, the ship loaded about 1,500 tons of sand.

b. Crew situation.

MV. ALPHA GALLANT had 20 crew members for this voyage. All crewmembers hold the corresponding certificates of competency. The ship meet the minimum safety manning certificate requirements and the crew members involved were not fatigue.

MV. Chujiang 168 minimum safety manning certificate requires 7 persons. There were 3 crew members on the voyage. None of the 3 crew members had a valid crew qualification certificate, and the ship manuscript did not meet the minimum safety

manning requirement.

c. The process of the accident.

MV. ALPHA GALLANT was sailed from Tianjin Port at 2030 on May 4, 2017. MV. Chujiang 168 was loaded with about 1,500 tons of sand, and was sailed from the Caofeidian berth to Huanghua Port at about 2030 on May 4.

At 2309, MV. ALPHA GALLANT radar found MV. Chujiang 168. MV. ALPHA GALLANT speed was 12.7kn and course was 100 °. MV. Chujiang 168 speed was 5.6kn and course was 188 °. The distance between the two ships is 3.64 nautical miles. The angle between the two ships is 86.2 ° and the CPA is 0.51 nautical miles. The following figure shows a screenshot of the MV. ALPHA GALLANT VDR. In the figure, "38" is MV. Chujiang 168.

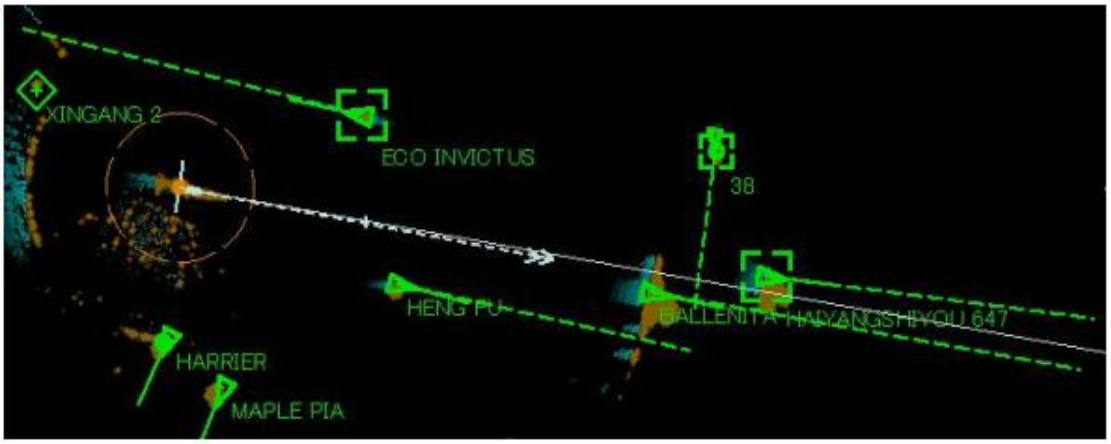

Figure 2.1: The screenshot of the MV. ALPHA GALLANT VDR (1).

Source: Tianjin MSA accident investigation report in 2017.

At 2314 hours, MV. ALPHA GALLANT radar alerted that there was a risk of collision. MV. ALPHA GALLANT speed was 13.1kn and the course was 100 °. MV. Chujiang 168 speed was 5.1kn and the course was 207 °. The distance between the two ships is 2.53 nautical miles. The CPA is 0.51 nautical miles, and the TCPA is 9.54 min. The relative position of the two ships is shown below.

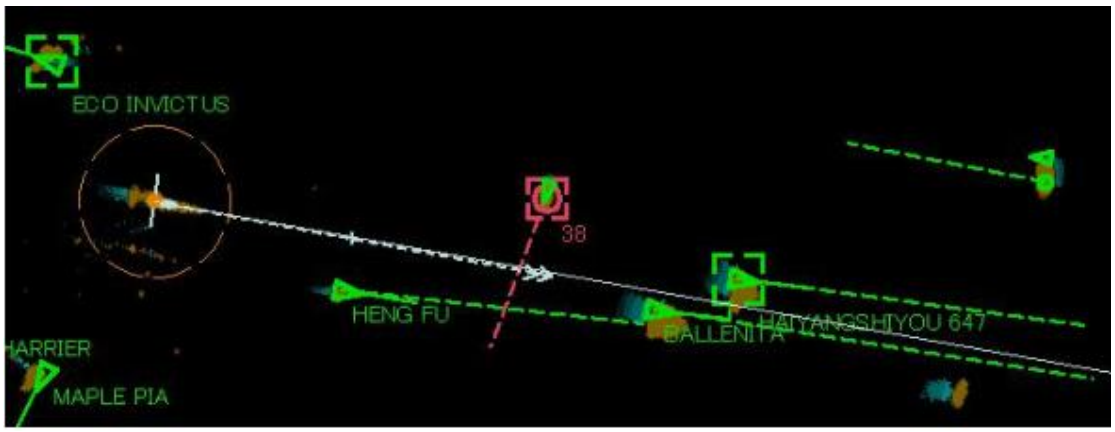

Figure 2.2: The screenshot of the MV. ALPHA GALLANT VDR (2).
Source: Tianjin MSA accident investigation report in 2017.

About 2 minutes later, MV. Chujiang 168 found MV. ALPHA GALLANT through the radar. `MV. ALPHA GALLANT speed was 13.2kn and the course was 100.1 °. MV. Chujiang 168 speed was 5.5kn and the course was 227 °. The distance between the two ships is 2 nautical miles. The CPA is 0.16 nautical miles, and the TCPA is 5 min. The relative position of the two ships is shown below.

Figure 2.3: The screenshot of the MV. ALPHA GALLANT VDR (3).
Source: Tianjin MSA accident investigation report in 2017.

At 2319, the speed of MV. ALPHA GALLANT was 13.2kn. Turn Port side at 3 degrees to avoid MV. Chujiang 168. The course of MV. Chujiang 168 was 230 °, the distance was 1 nautical miles. The CPA was 0.16 nautical miles, and the TCPA was 3.5 min. As shown below.

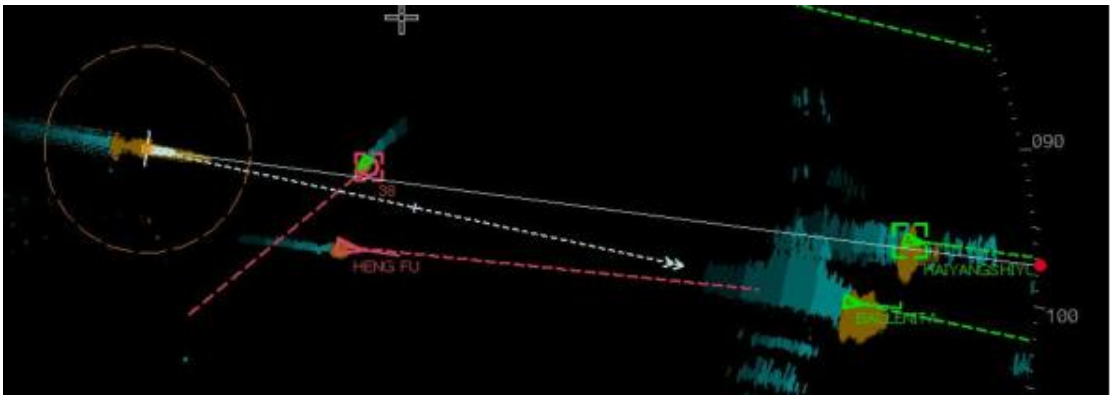

Figure 2.4: The screenshot of the MV. ALPHA GALLANT VDR (4).

Source: Tianjin MSA accident investigation report in 2017.

At 2121, the speed of MV. ALPHA GALLANT was 13.1kn and the course was 97 °. MV. Chujiang 168 speed was 6kn and the course was 243.2 °. The distance between the two ships is 0.55 nautical miles. The CPA is 0.12 nautical miles, and the TCPA is 2.2 min. As shown below.

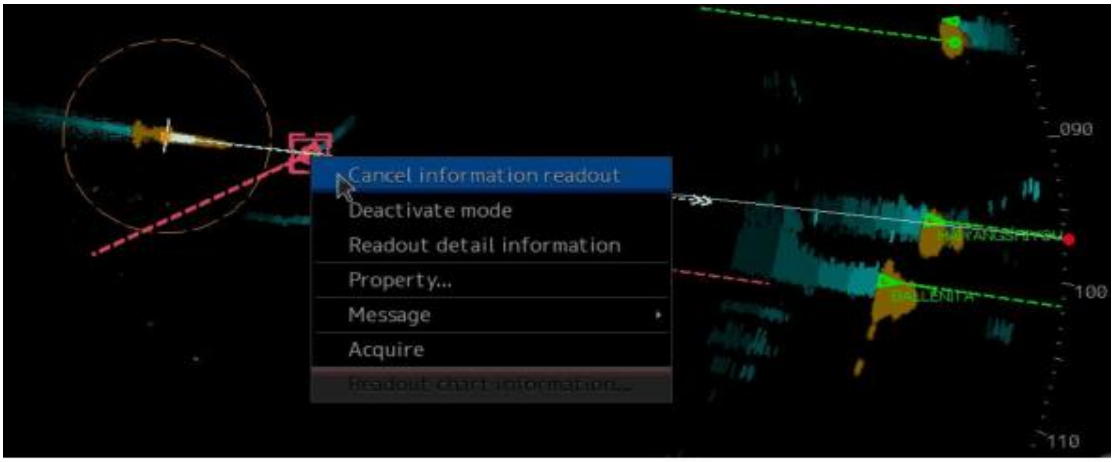

Figure 2.5: The screenshot of the MV. ALPHA GALLANT VDR (5).

Source: Tianjin MSA accident investigation report in 2017.

At 2322, MV. ALPHA GALLANT turned to port side, at a speed of 13kn. The speed of MV. Chujiang 168 was 5.6kn and the course was 269 °. The distance between the two ships is 0.32 nautical miles. As shown below.

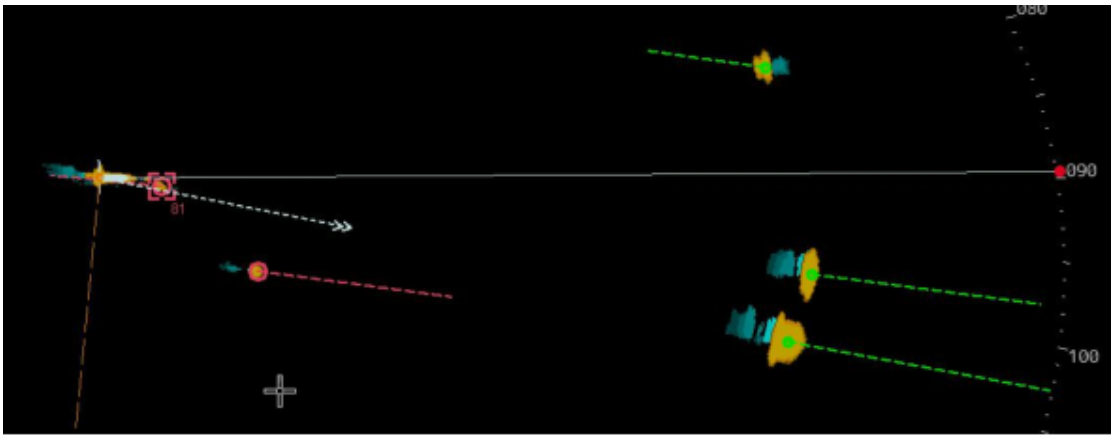

Figure 2.6: The screenshot of the MV. ALPHA GALLANT VDR (6).

Source: Tianjin MSA accident investigation report in 2017.

At 2322, the two ships collided. The course of MV. Chujiang 168 was 290 °, and the course of MV. ALPHA GALLANT was 83 °. The relative position of the two ships at the time of collision is shown below.

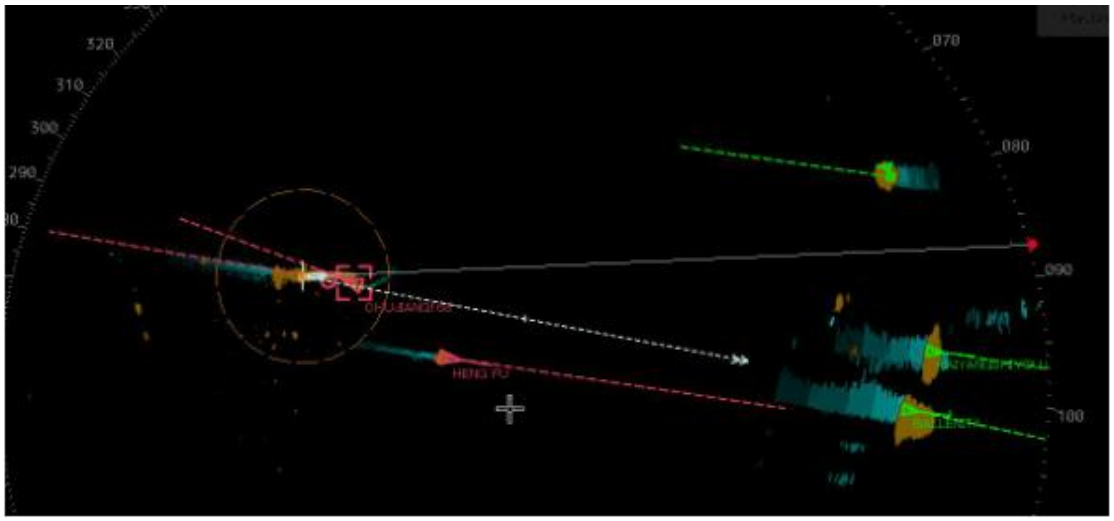

Figure 2.7: The screenshot of the MV. ALPHA GALLANT VDR (7).

Source: Tianjin MSA accident investigation report in 2017.

d. Loss of accident.

The accident resulted in a 3.3m x 0.8m hole in the ballast tank of MV. ALPHA GALLANT on the starboard side of the bow and a mark on the starboard side. MV.

Chujiang 168 was deformed, the No.1 cargo hold collapsed, and the No.2 cargo hold entered water.

Figure 2.8: The loss of MV. ALPHA GALLANT

Source: Tianjin MSA accident investigation report in 2017.

Figure 2.9: The loss of MV. Chujiang 168.

Source: Tianjin MSA accident investigation report in 2017.

e. Analysis of the cause of the accident.

The failure of both ships to comply with the COLREGS was the direct cause of the accident. MV. ALPHA GALLANT did not take significant actions to avoid MV. Chujiang 168 and did not examine the effectiveness of the action carefully. When the two ships again pose a risk of collision, MV. ALPHA GALLANT cannot take timely and effective measures to avoid collisions between the two ships. MV. Chujiang 168 did not maintain a regular watchkeeping and did not find the danger of collision with MV. ALPHA GALLANT in time, blindly took measures to avoid collisions, resulting in a collision between the two ships.

MV. Chujiang 168 is a inland river vessel. Navigation aids equipped on ships do not have the function. Ship crew lack the necessary professional knowledge and skills and are not qualified to sail on the sea. At the same time, MV. Chujiang 168 did not meet

the minimum safety manning requirements and the crew did not obtain the corresponding certificates.

2.3 Inland river sand carriers technical analysis.

The following is a comparison of the technical requirements for inland river sand carriers and the requirements for sea-going vessels combined with the hydro-meteorology and sea conditions in Tianjin Port. It mainly compares the requirements of stability, load line, anchoring equipment, life-saving appliances and so on.

First introduce the hydrological and meteorological conditions in Tianjin Port. According to the statistics of Tianjin Port and related departments, the hydrological and meteorological conditions in Bohai Bay are as follows: The probability of wind scale greater than 6 is about 5%. The probability of wave height greater than 2 meters is approximately 3%; the probability of wave height 1.3 meters to 1.5 meters is approximately 4.5%; the probability of wave height 1.6 meters to 2 meters is approximately 3.86%. The number of frozen days on the sea is about 65 days a year. The number of days with fog visibility less than 1km per year is approximately 10 days.

2.3.1 Stability.

The requirements for the ships in the Inland A-class navigation area and in the sheltered water are relatively close. There is a certain gap between the requirements for the ships in the Inland B-class navigation area and in the sheltered water, and further restrictions on the wind and waves are required. For vessels in the Inland River

C-class navigation area, the problem of the roll angle was not considered when designing. It should not be used for maritime sheltered water.

Therefore, it is strictly forbidden that vessels in the Inland River C-class sail navigation area at sheltered water. If no measures such as increased freeboard or load shedding are applied, the vessels in the Inland A-Class navigation area shall be restricted to a maximum of 6 in the state of the sea in which they sail, and the visual height shall not exceed 2 meters. the vessels in the Inland B-Class navigation area shall be restricted to a maximum of 4 in the state of the sea in which they sail, and the visual height shall not exceed 1.5 meters.

2.3.2 Loading line.

Select two typical ships MV. Suhuaiji 4472 and MV. Wanfunan 0518 as examples and calculate the freeboard values in different navigation area. The calculation results are shown in Table 4 and Table 5 respectively.

Table 2.4: The Freeboard Value of MV. Suhuaiji 4472 Under Different Navigation Areas.

Navigation area	Coastal	Sheltered water	Inland A-class	Inland B-class	Inland C-class
Freeboard (mm)	445	445	474	387	152

Table 2.5: The Freeboard Value of MV. Wanfunan 0518 Under Different Navigation Areas

Navigation area	Coastal	Sheltered water	Inland A-class	Inland B-class	Inland C-class

Freeboard (mm)	622	622	642	499	300

From the above two tables, it can be seen that the freeboard value of the Inland A-class navigation area calculated according to the specifications for inland river ships is similar to the value of the coastal and sheltered navigation areas. The freeboard value of the Inland B-class navigation area is slightly smaller, while the freeboard value of the Inland C-class navigation area is significantly smaller than the coastal and sheltered navigation areas. Therefore, the ship should be required to have deck hatch closure equipment, drainage equipment and crew protection facilities.

2.3.3 Anchoring equipment.

Take the aforementioned two typical ships, MV. Suhuaiji 4472 and MV. Wanfunan 0518 as an example. The requirements of the anchorage and anchor chain for the sheltered navigation area are not much different from those for the Inland A-class navigation area and the Inland B-class navigation area. Moreover, taking into account that the ship is generally left with a corresponding design margin, it can be required that the anchoring and mooring equipment of the ship meet at least the requirements for the mooring and mooring equipment for the vessel in the Inland B-class navigation area.

2.3.4 Life-saving appliances.

a. Survival craft.

There is no requirement for the survival craft on inland river ships. For the sea-going

ship: The inflatable life raft should be equipped for cargo ships sailing in the sheltered area and with a length greater than or equal to 25 meters. The number of occupants can not be less than 100% of the total number of ships.

b. Personal life-saving appliances.

Compared with the requirements of inland river ships and sea-going ships, it can be seen that: There is not much difference in the requirements for the life jackets. The inland river ships requires 110% and the sea-going ships requires at least 100%.The requirements for the lifebuoys of sea-going vessels are higher than those of inland river ships. Not only are they more quantitative, but some of the lifebuoys require self-igniting lights, self-activating smoke signals, and buoyant lifeline.

2.4 General situation of sand transportation in Tianjin.

2.4.1 The source of sand and the regular route for the transportation of sand.

The main sources of sand in Tianjin Port include Huludao, Yingkou, Yantai, and Caofeidian. Among them, black sand is mainly from Caofeidian, yellow sand from other places above. Ships that transport sand are mostly inland river vessels, but there are also a few sea-going vessels. From Caofeidian to Tianjin, there are regular routes for sand carriers, and several sand carriers are often lined up for sailing. Some of them are overloaded. Most of the sand carriers are sailing during the day and some of them are sailing at night. The route is on the north side of Caofeidian and crosses the anchorage of Tianjin Port to Tianjin Linang, Nanjiang, Nangang and other ports. The route is about 30-35 nautical miles, and the longest distance is only 10 nautical miles from the shoreline.

Table 2.6: Tianjin sand source distribution.

No.	Province	Source	Legal sand mining area	Receiving place
1	Liaoning	Huludao, Suizhong, Yingkou and Dandong	In the upper reaches of the Yalu River in Dandong, 14 legal sand mining areas have been designated.	Tianjin
2	Heibei	Luanhekou, Caofeidian and Heiyanzi	None	Tianjin
3	Tianjin	None	-	-
4	Shandong	Penglai, Laizhou and Rizhao	None	Tianjin, Jiangsu

According to statistics, from January to August 2011, the number of sand carriers entering and leaving Tianjin Port was 27,262, which was the highest in history. The monthly statistics are as follows:

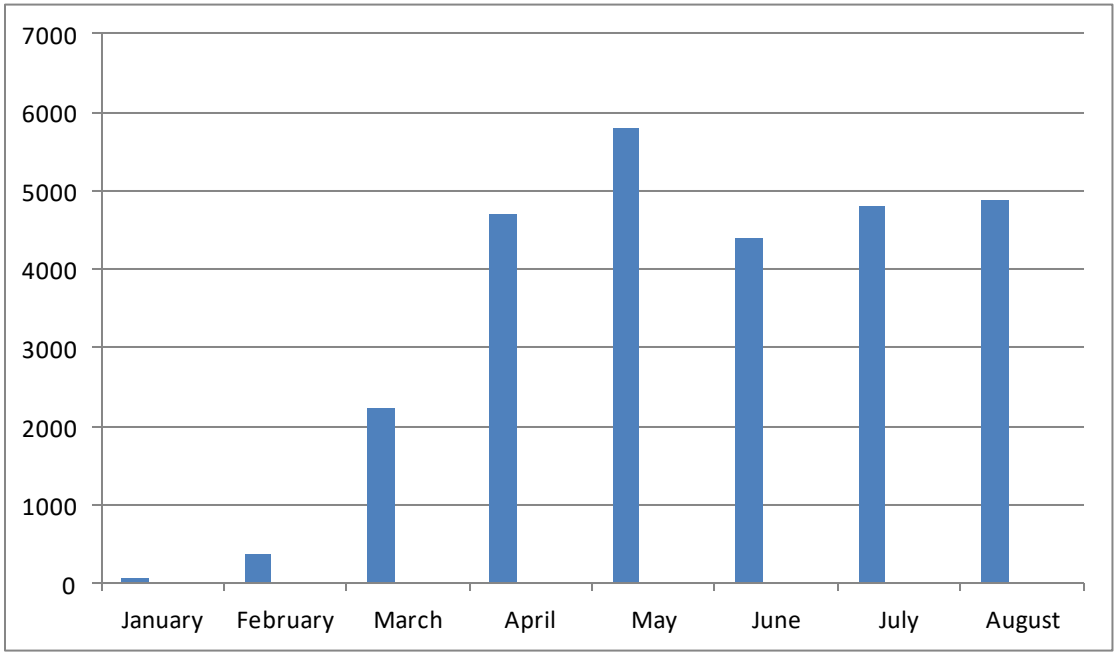

Figure 2.10: Tianjin Port sand carriers statistics from January to August 2011.

2.4.2 Distribution of unloading points and use of sand.

According to statistics, there are 27 unloading points along the coast of Tianjin, which are located in Dongjiang, Nangang, Lingang, Hangu and Nanjiang. 10 of them are illegal unloading points and have not gone through relevant procedures. 70% of these sand are used for land construction and 30% are used for coastal construction. The total demand for sand for coastal projects is 109.7 million tons. Currently, it has used 2.11 million tons, and it still needs 8.86 million tons. The estimated demand for sand on land construction is 25.6 million tons. It can thus be seen that the source of sand is mainly focused on land construction, and the use of sand in the sea-related projects only accounts for a small part of the total amount of sand.

Figure 2.11: Distribution of unloading points in Tianjin Port

2.4.3 The trading mode between the sand carriers and the sand unloading points.

The illegal unloading point and the sand carriers are cash transactions, so as to avoid the supervision of relevant departments and to avoid the responsibility of sand transport and mining. This results in the lack of necessary safety supervision for sand carriers, and the safety of those ship are completely controlled by themselves. Due to the fact that the owner is mostly an individual shipowner, there is no economic power to invest a lot of money in the transformation of ships and the provision of safety equipment, and the ship conditions of sand carriers are extremely difficult to improve. The way of cash transactions is the root cause of the lack of management of sand carriers.

CHAPTER III

Major hazards and management experience in Tianjin

3.1 Major hazards.

Chapter II has analyzed that due to the technical conditions and staffing of the inland sand carrier itself, it is easy to cause collisions and sunken accidents, and direct loss of personnel and property. In addition, the sand carriers will also bring harm to the navigable environment, sand source environment, and local society. Moreover, this hazard has an expanding trend.

3.1.1 Impact on the navigation environment.

The sand carrier sails disorderly within the route and does not obey the command of the VTS. They seriously hamper the normal traffic order and pose a safety risk. There are a large number of chemical tankers and oil tankers in Tianjin Port. Once a sand carrier collides with them, it will cause leakage of chemicals or oil. This will seriously pollute the marine environment and endanger people's lives and property. Some sand carriers have not signed any agreements or contracts with the employers. If shipwrecks occur, the shipowners often do not show up. The shipowner did so in order to evade the legal sanctions and the victim's claim. Even if the shipowner shows up, there is no money to salvage the shipwreck. Since the employer did not sign the

contract, it would refuse to invest in salvage. As a result, many sand carriers could not be salvaged after they were sunk. This seriously affected navigation safety (Zhang, Sun, & Zhou, 2014).

3.1.2 Impact on the sand source environment.

Illegal mining of sand has brought huge ecological disasters to the sand source. Sand is not only a precious mineral resource but also an important part of the marine ecological environment. It plays an irreplaceable role in maintaining the marine environment, protecting the marine shoreline resources, and maintaining the coastal landforms.

At the same time, the fishery in the sand source area has also been greatly affected. A water area in Qingdao used to be a natural breeding area for Wenchang fish, noodle fish and pike crabs. However, with the illegal mining of sea sand, the habitat of these marine organisms has been severely damaged and the number has dropped dramatically. Due to the serious illegal mining, some shoreline beaches have been retired to the houses of shore residents. In the late 1990s, due to illegal mining, a collapse accident occurred on Changdao, Yantai, resulting in the collapse of more than one hundred houses. The illegal mining near the shore has also caused the local coastline of Rizhao, Shandong, to recede nearly 100 meters (Zhao, 2011).

3.1.3 Impact on local society.

Since the majority of inland rivers carriers are self-employed, their economic strength is weak and their ability to resist risks is seriously insufficient. In the event of a crew fatality, it is not capable of handling the claims of crew members' families. The sand

carriers accident has caused many public disturbances. In 2008, a sunk accident occurred in MV. Wanaijiang06 and 2 people died. Many seafarers' families gathered at the Tianjin MSA, seriously affecting their normal operations. In 2009, the "4.15" accident in Dagang caused 10 deaths. More than 200 family members of the dead crew gathered in the Dagang District government. In 2010, MV.Fenggang501 sank, 8 people died and more than 100 people gathered in Xingang MSA. In 2010, MV. Haiyun137 sunk. Three people were killed in the accident and more than 90 people gathered in Binhai New Area Government. In 2012, an explosion occurred on MV. Dongninghu1278, causing 6 deaths. More than 100 people gathered in Dagukou MSA. The occurrence of several incidents has seriously interfered with the normal social order and the social influence is extremely poor.

3.1.4 The hazard of inland sand carriers continues to increase.

From the investigation of the accident, it has been found that the ship type used for transporting sand has begun to show a trend of large-scale. From the past 1,000 tons to nearly 10,000 tons, the ship's scale and the load of sand have increased. These ships cannot provide any construction drawings. Some of the ships' certificates provided are forged. The number of crew members has increased to nearly 20, and they do not have corresponding crew certificates. Many accidents of this type of ship occurred in Bohai Bay, causing huge loss of personnel and property, which poses a great threat to the equipment of the port and the navigational safety of the ship.

3.2 Regulatory experience in other places.

For the safety management of inland sand carriers, the following literature has conducted targeted research with distinctive regional characteristics.

3.2.1 Bohai

Wang Wei described the negative impact of the disorderly mining of sand and gravel on the society, and analyzed the problems existing in *Difficulties and countermeasures in recovery of gravel and sand mining in Bohai Sea area* (Wang, 2011). It emphasized that relevant legislation should be strengthened to establish industry standards. It also requested the local government to lead various departments to carry out management, at the same time carry out various aspects of publicity, highlighting the source of management. Wang Jian analyzed the characteristics of sand and gravel vessels in Bohai Bay in *Study on Safety Management Countermeasures for Sand Carriers in Bohai Bay* (Wang, 2011). It summed up the technical defects and regulatory difficulties of the inland river sand carriers and put forward targeted recommendations for strengthening the safety management of sand carriers in the Bohai.

3.2.2 The Taiwan strait

Qiu Huazan proposed in *Reflections on the Effective Supervision and Management of Taiwan Sand Carriers in Xiamen Port* that it is the classified management of sand carriers (Qiu, 2012). It describes the status of classified management research and the application of such management measures. Wang Xianshui analyzed human factors, ship factors, and environmental factors in *Analysis and Countermeasures for the Safety of Sand Carriers in the Taiwan Strait* (Wang, 2011). It proposed that shipowners should promptly update the status of ships, avoid vicious competition in the market, use special inspections instead of PSC, and conduct regional cooperation.

3.2.3 Yangtze River, Pearl River and other inland rivers

Xu Yan analyzes the status quo of inland river sand carriers on the trunk of the Yangtze River in *Research on the Current Status and Countermeasures of the Management of Sand Carriers in the Yangtze River Trunk Line* (Xu, 2013). From the accidents involving sand carriers that occurred in the Yueyang area, the main causes of the accidents were summarized, and solutions to the problems were proposed accordingly. Zhou Zhibin introduced the distribution of the sand field in the Pearl River estuary in *On the Pearl River Estuary Sand Carriers Management Status and Countermeasures* (Zhou, 2008). It analyzes the management status of sand carriers, and proposes specific measures such as strengthening source management, preventing overloading of sand carriers, regulating the sand carriers market, ensuring the interests of sand carriers owners, strengthening seafarer education, and strictly controlling ship inspections. Liu Ruoqiu summarized the hazards of sand carriers in the middle reaches of the Yangtze River in *Research on the Countermeasures against the Outstanding Illegal Acts of Controlling Ships in Sand Shipments* (Liu, 2010). It sums up the measures for controlling outstanding illegal acts of sand carriers. Li Changbin analyzed the problems in the safety management of sand carriers on the Xijiang River in *Supervision Issues and Countermeasures for Xijiang Sand Carriers* (Li, 2009). It put forward solutions to strengthen company management, strengthen crew education, enhance management transparency, and strengthen dynamic management. Fu Chaojie analyzed the many reasons for the complex and difficult management of ships in sand transport in Hanjiang in *On the Standard Management Measures for the Promotion of Sand Carriers for Hanjiang* (Fu, 2010). It learns from the successful experience of Hanjiang sand carriers management, and puts forward specific countermeasures and suggestions from the aspects of strengthening inspection and certification, strengthening communication and contact between departments, and promoting the management of inland river sand carriers.

3.3 The experience of Tianjin.

3.3.1 Strengthen safety management.

a. Conduct centralized management according to the situation.

Tianjin Maritime Bureau combined with the characteristics of Tianjin Port, using on-site inspections, ship visas and safety control, gradually found out the basic situation of the wading construction units in the area. They surveyed the location of the unloading point and carefully quantified the amount of unloading at each point. Through these tasks, they have initially mastered the basic information, customary routes, and working hours of inland rivers sand carriers, laying a foundation for carrying out special management.

From November 1, 2007 to November 1, 2009, the Tianjin MSA focused on the rectification activities of inland river ships involved in sea-going transport. The two-year rectification activities has largely stopped the spread of inland river sand carriers. On March 11, 2011, the Tianjin MSA jointly organized special treatment of inland river sand carriers in the Bohai with MSA units such as Liaoning, Hebei and Shandong, and severely cracked down on illegal activities.

b. Increase supervision.

First, Tianjin MSA urge the wading construction operation units to carry out operations in strict accordance with the contents and requirements of the approval of the MSA, and intensify the investigation and punishment of the transport operations vessels employed by the operating units. They strictly investigated the violations of overloading, incomplete certificates, insufficient staffing, etc., and proceeded with

serious treatment in accordance with relevant laws (Zhang, & Geng, 2011).

The second is to rely on the "1+3" maritime dynamic supervision model (1 is command center, 3 are VTS, maritime patrols and onshore patrol forces) to enhance the regulatory effect (Yuan, & Liu, 2012).

The third is to divide it into different levels of regulatory grids in combination with reality. The customary route for sand transportation and the wading project site are the focus of safety management. Rationally deploy existing law enforcement forces, combine the power of VTS and maritime patrols, and strengthen the safety management of ships involved in the construction of water-related projects.

c. Use the power of local government to participate in safety management.

Through years of governance, the Tianjin MSA has gradually realized that there are many regulatory agencies involved in the management of gravel industry. It will be difficult to effectively manage it if they rely solely on the MSA. Through concrete practice, the local government takes the lead in organizing the joint enforcement of all relevant departments to be the most effective means of combating illegal sand mining and sand transport (Zhang, 2011). Therefore, Tianjin MSA actively reported to the local government in the work of rectifying the inland river sand carriers. And they regularly report safety management information and strive for the strong support of the Tianjin local government.

3.3.2 Regulate sand transport at sea.

After several years of special remediation, the situation of transporting sand and stone by sea by inland river ships in Tianjin has been restrained, but it has not been

eradicated. The demand for sand has always existed. Therefore, relevant departments need to regulate the sand shipping market.

a. Let the employees of the sand carriers participate in the safety management.

First, actively promote the wading project builders to join the safety management, and require them to sign safety responsibility agreements with the construction vessels and constructors and report them to the maritime department. For those who have not signed related agreements, no construction permit will be issued (Li, Ma, Ma, Chen, Zhang, & Qiao, 2014).

Second, establish and improve the interview mechanism for wading project builders and conduct timely and effective interviews with relevant responsible persons of the project. For wading project projects with major safety risks, regular interviews are conducted to ensure the effectiveness of interviews (Wang, 2015).

The third is to establish a construction risk deposit system. Only after paying the risk security deposit can the construction be allowed. In this way, it is possible to guarantee the payment of compensation for traffic accidents involving sand carriers.

b. Implement the access system for sand transportation.

The first is to strengthen the access management of wading project construction units. For those wading engineering units that do not comply with the safe operating conditions or have not established a corresponding safety management mechanism, no permit shall be issued (Chen, & Wang, 2008).

The second is to strengthen the management of the access of sand carriers and the crew working on them. Formulate access conditions for sand carriers in line with the characteristics of the region. For example, in the Bohai Sea Region, the unified

standard formulated the *Special Measures for Special Campaigns for Sand Carriers in the Bohai* and *Provisional Regulations for the Provisional Simplified Inspection of Ships Operating in the Bohai Sea*. Licenses are issued for ships that meet the conditions for safe operation. Strictly inspect whether the sand carriers involved in the construction of water-related projects have a permit. It is forbidden for construction vessels without licenses or without the consent of the MSA to enter the construction area.

The third is to intervene in water-related projects in advance, and pay attention to strengthening the links with local governments, port management departments and other units. Grasp the project information early, communicate with the owner in advance, publicize related laws and regulations, and promptly put forward regulatory requirements.

c. Regulate sand market.

The Tianjin MSA gradually regulates the sand transport activities at sea and guides the sand carriers to formality, so that the management of sand carriers is changed from disorder to order.

First, provide necessary information services and technical support for companies or individuals that legally mine and transport sand. To legitimate enterprises, issue permits in a timely manner and actively support the sand mining enterprises to operate according to law (Zhou, 2009).

Second, guide and encourage qualified ships to enter the sand transport market. For ships that do not fully meet the requirements for navigational safety, they are required to be equipped with appropriate navigation safety, communication and life-saving equipment in accordance with relevant technical requirements. After meeting the standards, they may agree to engage in short-distance transportation of sand in the

designated area.

Third, the employers are required to select sand carriers that meet the safe operating conditions and standards, and organize sand carriers to accompany navigation.

Fourth, to improve the crew's skills, companies should train seafarers in the areas of safe operation and navigation knowledge to meet the needs of safe navigation at sea.

CHAPTER IV

Difficulties and existing problems in safety management of sand carriers

4.1 Difficulties in safety management of sand carriers.

4.1.1 Many departments that manage sand transportation have resulted in inefficiencies.

The sand industry involves mining, transportation, loading and unloading, and sales. The management department involves various departments such as harbor master, MSA, SOA, and CII. Most aspects of safety management go beyond the scope of the MSA's rights. Different departments have different regulatory authority and work goals. Therefore, there is a problem of coordination when the problem of sand transportation needs to involve multiple departments. A single department can't cure the problem based on its own authority (Huang, 2011). The problem described earlier in this paper is mainly the issue of sand in the transport sector. According to the working authority of the MSA, management can only be strengthened at the transportation stage, and it is impossible to fundamentally solve the problem.

Although the local government attaches great importance to the management of sand carriers, specific tasks are borne by different functional departments. The focus of the work of various departments is different, and some departments even have negative

attitudes in the coordination process, which creates great difficulties for joint management among departments. Subsequent management is also difficult to follow up in a timely manner, resulting in the incomplete resolution of the problem of the safety management of existing sand carriers.

4.1.2 It is difficult to improve regulatory cooperation when information is unbalanced.

According to investigations, sand carriers engaged in marine transportation in Tianjin sea area mainly come from Shandong, Anhui, and Fujian provinces, and the locations for ship registration are not local. The certificate held by the crew is also obtained by the local MSA of the province they belong to. Due to the low level of information sharing, most of the ship and crew's certificate information is difficult to identify effectively, which brings many problems to the site's safety management and subsequent investigations that may involve accidents (Xu, Zhou, & Yang, 2009). Ships are very mobile. A large number of inland river vessels that go out to carry out transportation operations make it difficult for the competent authorities at the port of registry to manage them. The untimely sharing of information between management departments has resulted in inefficient management of safety.

4.1.3 Disposal of illegal acts is difficult.

a. The effect of administrative penalty is minimal.

Most illegal sand carriers do not have relevant certificates. When the MSA punished illegal sand carriers, it was often impossible to determine the object of punishment because of the lack of ship information. Even if the subject of the penalty is clarified

by other means, if the ship owner does not cooperate with the work of the MSA (such as refusing to pay the fine), the maritime administrative penalty will be difficult to implement. In addition, the amount of fines is limited. Compared to the huge profits from the transport of sand, the amount of fines imposed by administrative penalties is far from sufficient deterrent to illegal transport. In practice, the phenomenon of illegal sand transportation continues after penalties have been paid (Cao, 2012).

b. It is difficult to take administrative compulsion.

In fact, many ship owners have deliberately evaded and refused to cooperate. Even if a large amount of cost is used to implement the enforcement measures, if the seized ship does not have effective control of the public security and CCG, it will seek opportunities to escape and continue illegal traffic activities (Wang, 2008).

c. It is difficult to investigate and collect evidence.

The cases involving illegally sand carriers have features such as unclear on-spot, related physical evidence, and lack of effective witness testimony. At present, the measures against illegal sand transport are mainly investigated on the spot. If the law enforcement officers cannot shoot or collect evidence of the illegal activities being carried out by the parties concerned, the subsequent evidence collection will be difficult. Many of the evidence collected is not persuasive in the judicial process and therefore administrative penalties cannot be effectively implemented.

4.1.4 Lack of law enforcement has led to the lack of timely and effective management.

a. The remote operation area of sand carriers has led to difficulties in effective

management.

First of all, sand carriers are often operated far away from the shore, where law enforcement forces are weak. In addition to sheltering and supplying, they basically do not berth. Secondly, most of the unloading operations are carried out in shallow areas far from the main port area. The unloading point is set up temporarily and the operator has no fixed location. These factors, to some extent, have brought difficulties to the limited maritime management forces.

b. The time characteristics of the operation of sand carriers have also brought difficulties to the implementation of effective management.

Most of the sand carriers are loaded and unloaded during the day and sailed at night. This mode of operation makes it easier for them to escape the supervision of cruise ships. Individual illegal sand carriers even berth and unload sand during weekends and holidays, which poses a great challenge to safety management. At the same time, construction projects are scattered over long coastlines, most of which are places that patrol boats cannot reach, resulting in the inability of the MSA to monitor them effectively.

4.1.5 The management of the source of sand is difficult.

a. The source of sand mining is difficult to manage.

Due to the large mobility of ships and the fact that most ships adopt night-time operations in order to evade management, it is difficult for them to carry out round-the-clock supervision. In addition, because some regulatory authorities only pay attention to approval and do not pay attention to on-site management, illegal sand

mining are rampant (Zhong, 2008).

b. The source of sand unloading is difficult to manage.

Most of the sand carriers can unload the sand directly without using the quayside loading equipment after reaching the destination port (Lv, 1994). This unloading method often takes only two or three hours to complete. Dispersion of operation sites and short operation hours make it almost impossible for the relevant management departments to manage them in unloading sector.

c. The source of consumption is difficult to manage.

On the one hand, some construction companies have the phenomenon of subcontracting the sand supply business and do not sign contracts, causing the management department to have blind spots in the management of sand carriers. On the other hand, the management of sand market is not standardized enough, and the situation of illegal mining and selling of sand is ubiquitous. Individual units unilaterally pursue interests and do not pay attention to safety responsibilities, resulting in long-term chaos. There are sand carriers employment units even interfere with the management of administrative authority, resulting in a large number of ships that do not meet the safe operating conditions into the Bohai.

d. It is difficult to manage the source of construction of sand carriers.

Due to the authority of the management, the construction inspection of the sand carriers shall be performed by the ship inspection department of the construction site. Due to the limited power of local ship inspection departments, the corresponding supervisory duties cannot be effectively implemented. This has caused many sand carriers to engage in sand transportation operations without survey, and the ship's own safety risks are extremely high (Li, 2014).

e. The government of the port of registry does not fully play its role in safety management.

Most of the inland river sand carriers come from underdeveloped provinces, and the economic development of their regions is slow. This led the local government to initiate the idea of using the ship transportation industry to drive the development. However, the limited transportation market in the port of registry has resulted in a large number of ships being forced to go out to expand their businesses, making it difficult for the authorities in the port of registry to manage them.

4.2 Existing problems in safety management of sand carriers.

4.2.1 Sand resources are unevenly distributed.

China's sea sand resources are relatively abundant, but the distribution is uneven. At present, there are no relevant plans for the mining of sea sand by the state and local governments. The provinces and cities (such as Tianjin), where there is a demand for sand, do not have sufficient sea sand resources, while the provinces with rich sea sand resources have strict control over sea sand mining due to relatively less demand for sea sand. Nowadays, it is impossible to plan the development and utilization of sea sand from the perspective of the state. The practice of all provinces and cities is also difficult to unify, resulting in a serious contradiction between supply and demand (Yu, Song, Luo, Wu, & Fan, 2015).

According to research, the total demand for sand for onshore and offshore projects in Tianjin is about 500 million tons, 30% for sand for offshore projects, and 70% for

sand for land construction. In contrast to the huge sea sand demand, there is no sea sand resource in the Tianjin. The large amount of sea sand required for project construction mainly comes from Liaoning, Hebei and Shandong. Unlike Tianjin, the above three provinces have relatively less demand for sea sand, and therefore they strictly control sea sand mining. This led to the prominent contradiction between the supply and demand of sea sand in the Bohai Bay region.

4.2.2 There is a conflict between policy restrictions and demand.

In recent years, due to the country's increasing emphasis on the protection of the environment and resources, the exploitation of sea sand is limited. In 2010, the SOA suspended the use of sea areas for sea sand exploitation in the Pearl River estuary. Guangdong and Zhejiang provinces have also issued corresponding regulations for the protection of the marine environment, clarifying the protection of marine resources and cracking down on illegal sand extraction. Liaoning, Hebei, Shandong and other provinces have similar regulations and strictly control sea sand exploitation. Sea sand is a good building material, and the demand for it grows year by year. Tianjin's large number of projects involving sea-related projects and urban construction have huge and continuous demand for sand. Although the state and some local governments have limited the exploitation of sea sand, some people have even driven their illegal mining of sea sand under the draconian interests. This has led to rampant illegal sand mining.

4.2.3 Huge profits drive illegal sand transport.

Since 2007, the MSA and some local governments have cracked down on illegal mining and transportation of sea sand. However, the illegal sand transport has not been eradicated. The root cause lies in the lucrative profits of the sand transport

industry. A kiloton-class sand carrier with an investment of approximately RMB 10 million can create huge benefits of several hundred thousand yuan each day, and can recover all the investment in less than one year.

Driven by the huge profits, the illegal sand mining at sea has intensified. Since most of the sea sand does not have legal sources, the first link in the sand transport industry is illegal. This has resulted in the illegal operation of the entire sand transport industry chain.

The rise of the sand industry has driven the development of the shipbuilding and repairing industry. As an important part of the sand industry chain, sand carriers are built in large numbers. In order to extract huge profits, without the permission of the relevant departments, shipowners privately built or reconstructed dry bulk carriers to transport sand. The shipbuilding industry chain has also been initially formed, and it has become a production line for illegally sand carriers.

4.2.4 The technical standards for sand carriers are difficult to determine in the short term.

China's ship construction and inspection specifications are divided into two branches, inland river ships and sea-going ships, which are formulated by the state. The specifications are issued and updated by the MSA of the Ministry of Transport every year, which have corresponding legal effects and standardize the standards for shipbuilding and inspection work. The renewal of the standards of the sea-going vessels is revised with reference to the adjustment of the corresponding international conventions and the actual situation in China. The inland river ships conducts a professional evaluation in accordance with the requirements of the sea-going vessels, and then updates or revise it according to the conclusion. There are strict boundaries

between the two kinds of ships, but the technical parameters, ship equipment and other aspects are similar. This has led to a relatively vague demand for sand carriers, and there is no clear rule for shipowners to implement. This has led to chaos in management and has prevented legal sand carriers from being effectively protected.

CHAPTER V

Improve safety management advices

The number of departments involved in inland rivers and gravel vessels is numerous, and the relationship between management areas and jurisdictions is complex. Concretely, it involves the links of mining, transporting, unloading, and selling. The MSA only deals with part of the transport link. In order to effectively solve the current problems, each link involves departments that should work together. At the same time, local governments should also organize the relevant regulatory authorities involved in the incident, and formulate policy measures and industry technical standards suitable for regional development.

5.1 Strengthen planning to solve the contradiction between supply and demand.

5.1.1 Unified planning for reasonable exploitation of sea sand resources.

From the point of the environmental problems caused by sea sand mining and the rational use of resources, sea sand near the coast should not be mined. It is necessary to fully investigate the state of the country's sea sand resources from the national level and rationally plan the sea sand mining area. At the same time, sand mining companies should be encouraged to sand in deep-sea areas (20 kilometers away from the shoreline). This will be an effective measure to further regulate the sand industry.

In response to the demand for sand in Beijing-Tianjin-Hebei region and the Bohai Rim, local governments should strengthen cooperation in this regard. The government should delineate the mining area where resources are abundant and suitable for exploitation, and specify the time and conditions. In this way, resources can be rationally exploited to achieve the purpose of regulating the order of the sand mining market.

5.1.2 Strengthen regional cooperation.

Local governments in the Bohai Rim area should strengthen coordination and rationally plan the exploitation and utilization of sea sand in the region to solve the contradiction between supply and demand existing in the region and standardize the sea sand industry. While strengthening cooperation in the development of sea sand, it is necessary to join forces with local governments and departments in increasing efforts to crack down on illegal sand transport operations.

5.2 Improve laws and industry technical standards.

5.2.1 Improve local regulations.

At present, Fujian Province, Zhangzhou have made useful attempts to regulate legislation at the sea sand source. Zhangzhou had passed local laws and regulations to promulgate *the Regulations for the Control of Sand Mining in Zhangzhou*, which clarified that the management of sand mining is led by local governments and coordinated by various units such as MBLR, SOA, MSA, Port Authority, and CII.

This will regulate the management of the sea sand from the source of the mining and will effectively affect the regulatory issues of the other parts involved in sea sand.

In terms of the current status, Tianjin can establish local regulations in the transportation sector. In this regard, Guizhou Province made a useful attempt. Its *Waterway Traffic Management Regulations of Guizhou* issued in 2007 clarified that the waterway enterprises engaged in commercial transportation should meet the relevant requirements of the region in addition to meeting the national regulations. Moreover, it clarifies the standard ship types that should be adopted by operators engaged in water transport. The standard ship types are to be published by the relevant departments in Guizhou Province. Tianjin can establish local laws and regulations regarding the safety management of ships assisting in coastal wading projects, in order to clarify issues such as technical requirements, operational standards, and legal responsibilities. This can provide favorable legal protection for dealing with the actual problems that currently exist.

5.2.2 Establish special technical standards for sand carriers.

In view of the situation in Tianjin, the government should formulate technical standards for sand carriers suitable for the region. The relevant departments shall carry out special survey of ships engaged in the transportation of sand. For ships that meet the standard requirements, they may be allowed to engage in appropriate transportation operations. In this way, ships with poor technical conditions can be phased out. Local governments should strengthen the management of shipyards. Strengthen safety management from the stages of ship design, construction and inspection to ensure that the ship meets the requirements for safe navigation.

5.3 Regulate the sea sand industry.

5.3.1 Strengthen the management of all aspects of the sea sand industry.

Tianjin can coordinate the surrounding areas to issue corresponding laws and regulations as soon as possible to regulate the sand mining activities. At the same time, for the designated area for sand mining, the SOA should effectively supervise the sand mining activities. The Tianjin MSA shall work with CII, CCG, and SOA to increase the management of sea sand transport links. Local governments should ban illegal unloading sites and approve legal terminals to carry out sand unloading operations.

5.3.2 Improve the illegal cost of sand ship.

The *Administrative Compulsion Law of the People's Republic of China* was implemented on January 1, 2012, which enriches the regulatory means that the regulatory agency can adopt. It will strengthen the management of ships engaged in the illegal transportation of sand. In the future, penalties for illegal companies and personnel should be increased. For example, ships with poor shipping conditions should be demolished, and illegally sourced sea sand should be confiscated.

5.3.3 Strengthen the propaganda about sand ship safety.

The government can use news, radio, and other methods to publicize the safety issues related to sand carriers. Shipowners and employers of sand carriers should also strengthen safety training for employees so that safety awareness will be deeply

rooted. The management department can strengthen the propaganda of the sand carriers by issuing promotional materials and posting reminder slogans. The VTS can broadcast safety tips to warn the sand carriers and other ships in the surrounding waters.

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