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Analysis of cruise ship mass rescue operation in the East China Sea : take Shanghai search and rescue region as an example

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ANALYSIS OF CRUISE SHIP MASS RESCUE OPERATION IN THE EAST CHINA SEA

-TAKE SHANGHAI SEARCH AND RESCUE REGION AS AN EXAMPLE

By

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The People's Republic of China

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DECLARATION

I certify that all the material in this dissertation 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 dissertation reflect my own personal views, and are not necessarily endorsed by the University.

Signature: CAO Xun

Date: 30 June, 2021

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Supervisor's affiliation: Dalian Maritime University, China

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ABSTRACT

Title of Dissertation: **Analysis of Cruise Ship Mass Rescue Operation in the East China Sea-Take Shanghai search and rescue region as an example**

Degree: **Master of Science**

In recent years, the global cruise market has continued to prosper. Although the Covid-19 pandemic in 2020 brought global cruise ships to a standstill, the cruise industry generally believes that this will not change the long-term trend of the cruise market. China is the main growth point of Asian cruise market, and Shanghai cruise home port has become the largest cruise port in Asia. In 2022, the world's largest cruise ship will soon be laid out in Shanghai. Shanghai, a port city with prosperous cruise activities, should be prepared for danger in times of peace while benefiting from the growth brought by cruise economy, and prepare to deal with the risks of mass rescue operation brought by cruise ship.

This dissertation focuses on the relevant theories and systems of international organizations, Chinese and foreign governments, as well as demonstrating and analyzing MRO of cruise ships using the perspectives of Chinese and foreign scholars and typical cases. The emergency management theory and the concept of MRO are introduced at the outset of this dissertation, and seven MRO difficulties for cruise ships are examined. Subsequently， the dissertation study the overall development of the global, regional, and Chinese cruise market in a macro sense, and then delves into the specific development of the Shanghai cruise market. And then,

the dissertation describes the general situation of China SAR system, including the evolution of CMRCC, the construction of the SAR system, relevant SAR laws and regulations, and the maritime distress communication system. The important content is to summarize the Shanghai SRR's characteristics, examine the cruise routes and deployment, introduce the Shanghai SAR system, and assess the capability of professional SAR forces in Shanghai. Last but not least, some recommendations for optimizing MRO work are made, including deepening exchanges and cooperation, improving professional rescue ability, strengthening MRO plan construction, and personnel training.

KEYWORDS: cruise ship, Shanghai, SAR, SRR, MRO

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LIST OF ABBREVIATIONS

AIS	Automatic identification system
CCCPC	Central Committee of the Communist Party of China
CISAR	Catastrophic Incident Search and Rescue
CLIA	Cruise Lines International Association
CMRCC	China Maritime Search and Rescue Coordination Center
COVID-19	Corona Virus Disease 2019
CRS	China Rescue and Salvage
DMU	Dalian Maritime University
EEZ	Exclusive Economic Zone
h	hour
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
IMRF	International Maritime Rescue Federation
IAMSAR	International Aeronautical and Maritime Search and Rescue
km	kilo meters
Kt	Knots
kW	kilo Watt
m	meter
MOTPRC	Ministry of Transport of the People's Republic of China
MRCC	Maritime SAR Coordination Center
MRSC	Maritime Rescue Sub-Center
MRO	Mass Rescue Operation
MS	Motor Ship
MSA	Maritime Safety Administration

MT	Motor Tanker
MV	Motor Vessel
nm	nautical mile
NSARC	National Search and Rescue Committee
OSC	On-scene Coordinator
SAR	Search and Rescue
SDP	SAR Data Provider
SMC	SAR Mission Coordinator
SRR	Search and Rescue Region
US	United States
USCG	United States Coast Guard
VTS	Vessel Traffic Services

CHAPTER 1 INTRODUCTION

1.1 Research background

The oceans and marginal seas cover approximately 360 million square kilometers, accounting for nearly 71 percent of the earth's surface (Lutgens, Edward, & Tasa, 1992, p.269). For a long time, humans have been exploring the ocean, passing through it, relying on it to obtain living material and achieve civilization's development and progress.

A cruise is a mode of transportation that was once used to transport mail across oceans. With the advancement of more efficient transportation and communication technology, cruise ships have gradually transitioned from freight transport to passenger transport, and became a popular tourism product. Cruise tourism flourished in Europe and North America, and then spread to become a global tourism product. (CHEN, 2017, p.1). According to CLIA statistics, the number of global cruise passengers increased at an annual rate of 5.3% from 2009 to 2019, and the number of global passengers had reached 29.7 million in 2019 (CLIA, 2021, p. 21). Asia market has become the second largest cruise market in the world (Real, 2019). In recent years, China's cruise market has developed rapidly. From the perspective of the calls of cruise ships, Shanghai Wusongkou International Cruise Terminal has ranked first in Asia (Lau & Yip, 2020, p.4).

As we all know, safety is the foundation and guarantee for the healthy development of every industry. With the development trend of large-scale ships, giant cruise ships are constantly emerging. The world's largest cruise ship, the Wonder of the seas of

Royal Caribbean International, to be deployed in Shanghai in March 2022, with a gross tonnage of 228,000 and 8,764 maximum people on board capacity (Shanghai Municipal People's Government, 2021). Undoubtedly, it will add more safety pressure to the intensive cruise activities in Shanghai. Once a serious incident happens to such a mega ship, it will threaten the safety of numerous passengers and crew members. If not handled properly, it may lead to a terrible disaster.

The South Korean "MV Sewol" is a profound lesson. In 2014, the "MV Sewol" sank at Jindo island, resulting in 304 deaths with serious consequences. The unfavorable performance of the South Korean government's emergency response in the incident triggered a wide range of social influences, resulting in a serious political and social crisis as well as a crisis of government trust (Dosta, Kim, & Ringstad, 2015, p.36). South Korean President Park Geun-hye apologized three times to the entire country, and Prime Minister Zheng Hongyuan resigned. The maritime police force was disbanded, and the national disaster and accident prevention system was reorganized. The South Korean people's support for the government has fallen from 71 percent to 47 percent, which is the lowest point in South Korean history (CHEN, 2017, p.4).

China has a coastline of 18,000 kilometers and a sea area of 4.73 million square kilometers, with numerous coastal ports and dense shipping activities (Embassy of the People's Republic of China in Sweden, 2021). As China's unique professional SAR forces at sea, CRS bears the enormous responsibility of serving as the last line of defense for maritime safety. In 2021, MOT Rescue and Salvage Bureau Director Wang Lei stated that CRS should expand its professional rescue and salvage capabilities to be better prepared for dealing with potential "catastrophe scenarios" (WANG, 2021). As a result, with the flourishing cruise market as a backdrop, it is vital to select Shanghai as a representative object for conducting prospective and

preventive study on potential MRO at sea.

1.2 Research methodology

This dissertation mainly adopts the following research methods:

(1) Organization and government studies. In the IAMSAR Manual and related guidance, the IMO has related discussions on MRO. For many years, IMRF has conducted MRO research projects and hosted four international MRO conferences. The USCG places a high value on MRO work and publishes MRO-related plans and operation manuals. The CMRCC has compiled the “Manual of mass rescue operation on cruise ships”, with 13 modules in the rescue operation chapter that are extremely useful for practical work.

(2) Literature research. Recognize the status of the domestic and international cruise markets, the construction of China SAR system, MRO response theory, and the construction of China SAR system etc. In particular, I am paying more attention to the SAR staff with practical experiences of MRO or SAR, their recommendation will be more targeted and practical.

(3) Study of the cases. By comparing typical cases, we can gain a better understanding of the current state of China SAR system and mechanism, resource allocation, on-scene rescue, and so on. In addition, I will quate relevant cases to support to the pertinent suggestions made in this dissertation.

1.3 Current studies

1.3.1 Emergency management model

According to the emergency management theory, emergency management is usually

divided into four stages: (1) mitigation, (2) preparation, (3) response, and (4) recovery. Such classifications are helpful to define the specific work and allocate resources. Although the main objectives of each stage are not the same, the activities of each stage usually overlap. Emergency management is also periodic and repetitive in nature, the government constantly draws lessons from events, and then optimizes the work at various stages to cope with the greater crisis that may arise in the future.

Different stages have different main tasks: mitigation activities usually identify and analyze risks, and take targeted measures to reduce or mitigate the possible damage caused by incidents. In some cases, mitigation activities also occur in the recovery stage of major disasters. Preparedness is different from mitigation, its goal is not to reduce or eliminate risks, the task for preparedness is improving the ability to deal with emergencies by making plans, strengthening training and conducting exercises. Response refers to the measures taken after an emergency, including establishing an incident command system and taking rescue actions for human life, environment and property. Recovery is usually in the later stage of incident disposal, such as post-disaster reconstruction and resettlement of people in distress (Lindsay, 2012, p.2-3). Figure 1 show the model of four phases of emergency management. For this dissertation, I will mainly focus on the discussions about mitigation and preparedness.

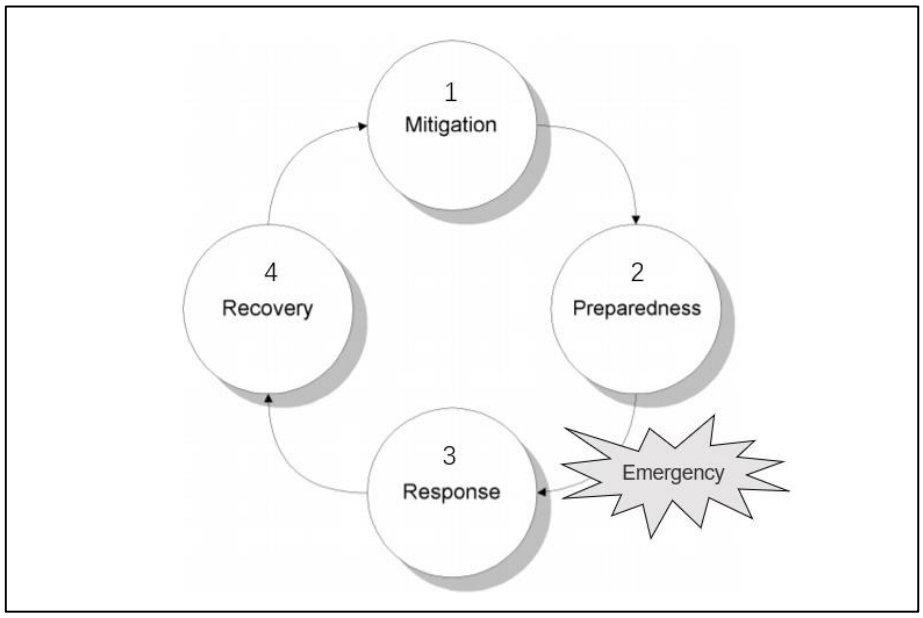

Figure 1: Four stages of emergency management model

Made by author, Dalian

1.3.2 The concept of MRO

As well known, natural disasters, terrorism, human factors and other aspects, are all the reasons that may cause a large number of people in distress. In this situation, the authorities need to carry out effective MRO to save people. In practice, there are many kinds of MRO scenarios, Table 1 shows the different MRO scenarios and their ranking risks (Burgess, 2011, p.39).

Table 1: MRO scenarios ranked by risks

MRO Scenarios Ranked By Risk	
Scenario	**Ranking**
Domestic passenger vessel requires evacuation	1 (tie)
Large vessel sinks, passengers and crew must be located and rescued	1 (tie)
Natural disaster requiring air, land, sea rescue	3
Major casualty aboard cruise ship requires evacuation	4 (tie)
Rescue and interdiction of large number of refugees/illegal immigrants	4 (tie)
Airliner crash requiring passenger extrication and water rescue	6
Rescue of people from collapsed or burning waterfront building or facility	7
Rescue of individuals necessitated by bridge collapse or train derailment	8 (tie)
Small MRO (above local capability)	8 (tie)
Rig sinks; crew must be located and rescued	10
Waterborne evacuation necessitated by large-scale terrorist action, industrial accident, natural disaster, or nuclear/biological incident	11
Rescue of individuals stranded on an ice floe or on a ship beset in ice	12
Rescue of large number of people from flooded (or flooding) tunnel or other need for rescue	13

Source: Burgess (2011). *Mass Rescue Operations.*U.S Coast Guard

Obviously, the risks arising from the evacuation of domestic passenger ships, the SAR after the sinking of large ships, and the large-scale evacuation caused by major incidents of cruise ships rank at the top of this list. Overall, maritime MRO is the highest risk among all the MRO scenarios. And, the MRO on cruise ship is one of the most dangerous situations, so it is valuable and necessary for this dissertation to study how to deal with the cruise ship MRO.

The concept of rescue and MRO is different. The list of abbreviations of IAMSAR Manual (Vol.1) defines 'rescue' as the "*operation to retrieve persons in distress, provide for their initial medical or other needs and deliver them to a place of safety*." While in the same part of IAMSAR Manual, it defines MRO as, "*SAR services characterized by the need for immediate response to large number of persons in distress, such that the capabilities normally available to SAR authorities are inadequate*." (IMO & ICAO, 2016). Therefore, it is necessary for the SAR authority to prepare various SAR facilities to fill the "capacity gap" and make MRO conduct

successfully. In the “Guidance for Mass Rescue Operations (COMSAR.1-Circ.31)”, IMO describes MRO as low likelihood but high consequence event. As the probability of MRO occurrence is relatively rare, the SAR authorities hardly get relevant response experience to deal with the challenges. However, once an MRO happens in the respective SRR, the MRCC is required to make a quick response. They should not only coordinate multiple agencies to do harm reduction, SAR operations, pollution control, on-scene traffic management, but also prepare large-scale logistics work, medical and coroner functions, accident investigation, reply to the public and the media, and so on. If the MRCC couldn’t perform excellent, the consequences of failure could be extremely severe (IMO, 2003).

After understanding the above interpretation of MRO, a new question arises, that is, what is the standard for defining MRO? “A large number of persons in distress” is still too vague, is that good to regulate a specific number for the incident that could be considered as the criteria of MRO? What if the number of persons in distress is one lower than the regulated standard? In practices, I think it’s better to leave some rooms for the SAR authority to judge whether they are going to carry out an MRO. As Button and Gorgol considered, maritime MRO should not only consider the number of people in distress, but also be defined by factors such as time, location, weather and ocean state in a day (Button & Gorgol, 2020, p.357). Therefore, in practice, it doesn’t have a regulated specific number to define if the SAR operation is an MRO.

1.3.3 Similarity and difference of understanding to MRO between China and the US

The US NSARC has carried out relevant research on MRO. According to part 1 of

"United States National SAR Supplement to the International Aeronautical and Maritime SAR Manual Version 2.0", it introduces the Olive SAR model, which divides SAR into three categories, namely Normal SAR operations, MRO and CISAR (US National Search and Rescue Committee, 2018, Part 1). Figure 2 illustrates the classification and definition. It should be noted that there is no clear distinction to distinguish normal SAR from MRO. The determination of MRO should be decided according to the specific scene. CISAR may include an MRO, however, it's independent of the concepts of normal SAR and MRO (Cornillou, 2021a).

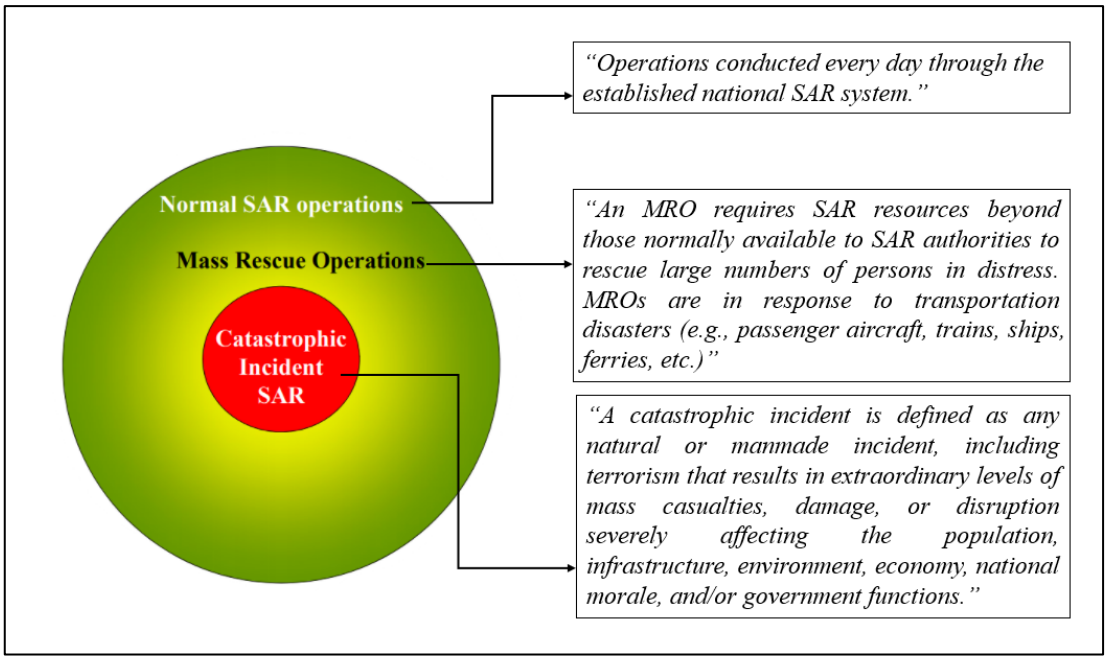

Figure 2: US's classification and definition to MRO

Made by author, Dalian

Source: US National Search and Rescue Committee (2018). *United States National SAR Supplement to the International Aeronautical and Maritime SAR Manual Version 2.0*. US: author

China, on the other hand, has a different definition of an incident from the US. The incident levels are classified into four categories, according to the "National General Emergency Plan for Public Emergencies", they are extraordinary, major, large, and

general incident (State Council, 2006). Table 2 shows the incident classification level regulated in “National Maritime Search and Rescue Emergency Plan”. The MRCC will organize forces and mobilize resources based on the level of incident.

Table 2: China maritime incident classification level

Maritime incident classifaction level	Standards
Extraordinary incident Level Ⅰ response	(1) Maritime emergencies causing more than 30 deaths (including missing); (2) Maritime emergencies that endanger the safety of more than 30 people; (3) Maritime emergencies that seriously endanger the life safety of ships or personnel occur in passenger ships and chemical ships; (4) The civil aircraft with more than 30 passengers has an emergency at sea; (5) Maritime emergencies such as collisions, rocks, fires, etc., which threaten the life safety of ships and personnel; (6) Urgent need for the State Council to coordinate with relevant regions, departments or the military to jointly organize rescue of maritime emergencies; (7) Other maritime emergencies that may cause particularly serious harm and social impact.
Major incident Level Ⅱ response	(1) Maritime emergencies at sea that cause more than 10 people and less than 30 people to die (disappear); (2) Maritime emergencies that endanger the safety of more than 10 people and less than 30 people; (3) Civil aircraft with less than 30 passengers have an emergency at sea; (4) 3,000 ~ 10,000 gross tons (excluding) of non-passenger ships and non-hazardous chemicals ships Maritime emergencies that threaten the life safety of ships and personnel, such as collisions, rocks and fires; (5) Other maritime emergencies that may cause serious harm, social impact and international impact
Large incident Level Ⅲ response	(1) Maritime emergencies at sea that cause more than 3 people and less than 10 people to die (disappear); (2) Maritime emergencies that endanger the safety of more than 3 people and less than 10 people; (3) Maritime emergencies such as collisions, rocks, fires, etc. of non-passenger ships and non-hazardous chemical ships with a gross tonnage of less than 500 ~ 3000 tons, which threaten the life safety of ships and personnel; (4) Chinese seagoing ships or foreign ships with Chinese crew members are missing; (5) Other dangerous situations that cause or may cause great social impact.
General incident Level IV response	(1) Maritime emergencies at sea that cause less than 3 deaths (including missing); (2) Maritime emergencies at sea that endanger the lives of less than 3 people; (3) Maritime emergencies at sea that pose a threat to the life safety of ships and personnel, such as collisions, rocks, fires, etc., of non-passenger ships and non-hazardous chemical ships below 500 gross tons (excluding); (4) Other maritime emergencies at sea that cause or may cause general harmful consequences.

Made by author, Dalian

Source: CMRCC, TianjinMRCC, & DMU (2011). *National Maritime Search and Rescue Manual.* China: author.

In contrast to the US, although there is no regulated definition of MRO or catastrophe in China’s maritime incident classification level, as shown in the table

above. In practice, the understanding of MRO between China and the US is relatively close. The “catastrophe scenario” has been discussed, as mentioned earlier. However, in maritime SAR field, it is more like a conceptual symbol, and there is no relevant SAR documents or specific work related to it at present. In my opinion, the most difficult MRO situation is the catastrophe scenario, which refers to the top maritime incidents in the “MRO scenario ranked by risk mentioned” above, such as “major casualty aboard cruise ship requires evacuation.”

How to response to maritime MRO under current maritime SAR regime in China? As an example, consider the river cruise ship “MV Oriental Star”. The “Oriental Star,” carrying 454 passengers, capsized in the Yangtze River’s Da Mazhou waterway on June 1, 2015. MOTPRC initiated the Level I response for the first time after receiving the distress alarm. The State Council Premier Li Keqiang and Vice Premier Ma Kai then went to the rescue scene to lead the MRO on behalf of the central government (MOT, 2015). Therefore, under the current maritime SAR regime, the response to MRO is covered by level I response. As a result, I created Figure 3 and quoted the data of maritime incidents to depict the position of MRO within the incident classification level (CMRCC, 2021a, p.25).

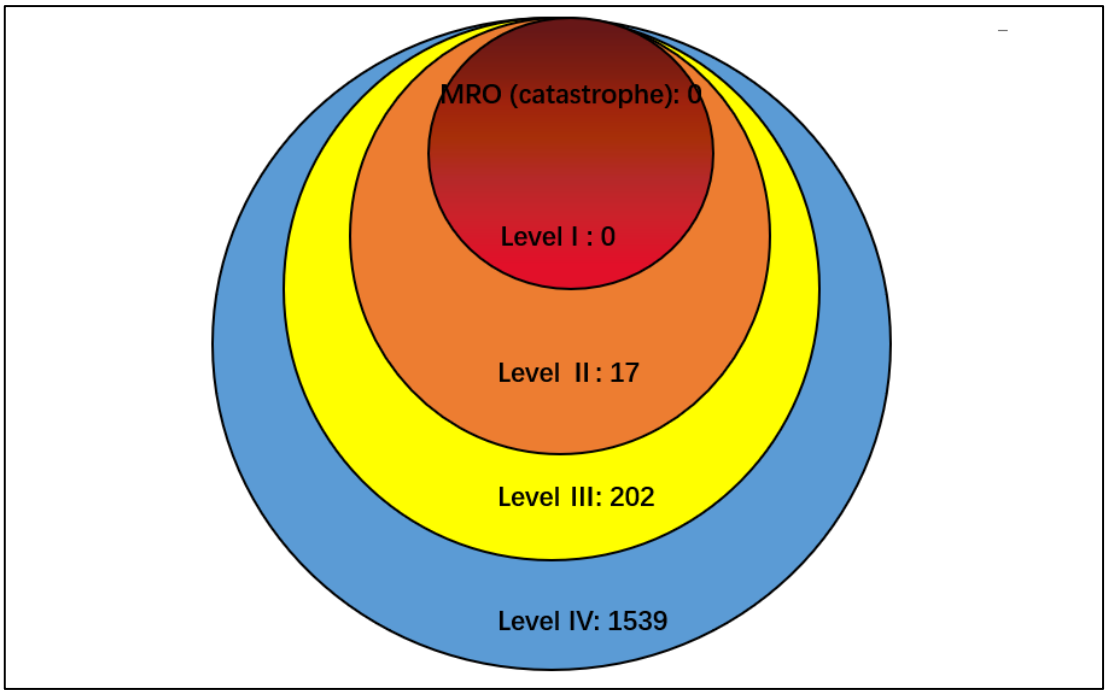

Figure 3: Maritime incident classification level and incidents statistics in 2020

Made by author, Dalian

Source: CMRCC (2021). *China Maritime Search and Rescue Annual Report (2020)*. Beijing: author

As a result, by comparing the Figure 2 and 3 we can summarize that, the similarity of China and the US is the understanding of MRO and catastrophe is close. In terms of the differences between China and the US, one is the concept of MRO and catastrophe has been defined in the US emergency response system, however, China hasn't defined the concept in official SAR documents. The other difference is, the US considered that MRO has no line to normal SAR, but there is a distinction with catastrophe. While China believes that, each level, of course, has a distinct boundary to differentiate it. However, no distinction is made between catastrophe, MRO, and level I.

In order to discuss MRO more accurately, the MRO mentioned in this dissertation are all defined under China maritime incident classification level. Although the

above data shows that there is no MRO or Level I response in 2020, we cannot ignore the extremely serious consequences that an MRO may lead. MRO can occur at any time and any location. Therefore, we must prioritize it, fully prepare for it, and respond as effectively as possible when it occurs.

1.3.4 Difficulties of conducting cruise ship MRO

The Chapter 1 of IAMSAR Manual (eighth Edition) defines a SAR facility as "*any mobile resource, including designated search and rescue units, used to conduct search and rescue operations*." (IMO & ICAO, 2004). Under normal circumstances, the MRCC is unable to immediately mobilize adequate SAR facilities to deal with an MRO. As a result, as IMO emphasizes, it is critical to develop MRO plans tailored to specific SRR. The first step is to identify potential risks that could lead to MRO. IMRF recommends that, in order to meet the challenges of maritime MRO, MRCC should prepare well in terms of thinking, planning, and training before responding. (IMRF, 2019; IMO, 2003).

Similarly, Lindsay introduced the importance of risk analysis in his article "Federal Emergency Management: A Brief Introduction", emphasizing that it should be combined with the work of recognizing the ability to obtain resources (such as SAR facilities, medical resources, and so on), training and emergency exercises, optimizing the MRO plan, and so on (2012, p.2). As a result, it is obvious that risk analysis is the first step in developing countermeasures to potential maritime MRO, particularly for such a complex event involving numerous agencies. Through research, I summarize seven major difficulties of conducting cruise ship MRO:

(1) Collaboration with industry stakeholders. The IMO considers companies that

operate ships capable of transporting a large number of people to be industry stakeholders. When developing MRO plan, these companies should implement preventive measures and accept responsibility for providing technical advice and emergency assistance in SAR operation (IMO, 2003, p.7). To prevent a passenger ship incident, the IMO proposed a SAR cooperation plan between ships, companies, and SAR authorities, with the goal of improving mutual understanding through information exchange, so that each party can cooperate effectively and reduce unnecessary communication (IMO, 2017, p.1). However, there are some shortcomings in practice, such as incomplete contents reported by companies and ships, insufficient understanding by personnel, and unclear recognition on SDP, among other things (ZHOU, 2016, p.47). All of this demonstrates that companies fail to carry out their responsibilities effectively.

(2) Disorganized passengers. According to Regulation 19 of Chapter 3 of SOLAS "*on a ship engaged on a voyage where passengers are scheduled to be on board for more than 24h, musters of newly-embarked passengers shall take place prior to or immediately upon departure*. *Passengers shall be instructed in the use of the lifejackets and the action to take in an emergency.*" (IMO, 2018, p.346). Furthermore, as we all know, cruise ships have relevant emergency plans in place, and the crew has been well trained to organize passengers to carry them out. However, there are far too many cruise passengers on board. In distress situation, passengers frequently experience stress emotions such as fear, pessimism, and despair, which probably will lead to irrational behavior.

Mr. Härstedt, a survivor of ferry "MS Estonia" incident in 1994, described the passenger's reaction in distress like this: "*I heard no instructions to passengers as the situation worsened on board Estonia. I saw a very mixed range of reactions among*

both ship's staff and passengers. Some seemed apathetic, others were injured or trampled underfoot: the scene was chaotic. 'People can hurt other people in such a situation.'" (IMRF, 2010, p.7). When the passengers on board are disorganized and in chaos, the rescue forces on the outside are unable to make direct contact to guide passengers to evacuate, which is a major challenge in MRO practice. As a result, passenger emergency management is central to cruise ship.

(3) Cruise ship's layout is complicated. Cruise ships, as illustrated in Figure 4, typically have tall superstructures (more than ten longitudinal decks), numerous functional areas, and thousands of passenger cabins. The ship as a whole is a maze, resulting in numerous and complicated emergency evacuation routes. In an emergency, passengers are unfamiliar with ship's emergency evacuation routes, resulting in a poor escape from time to time. When the hull's safety performance is compromised due to fire and capsizing, the ship's structure is easily deformed due to the large number of cabins, doors, and windows, and it is difficult for passengers to get out of the cabin on their own when they are trapped inside.

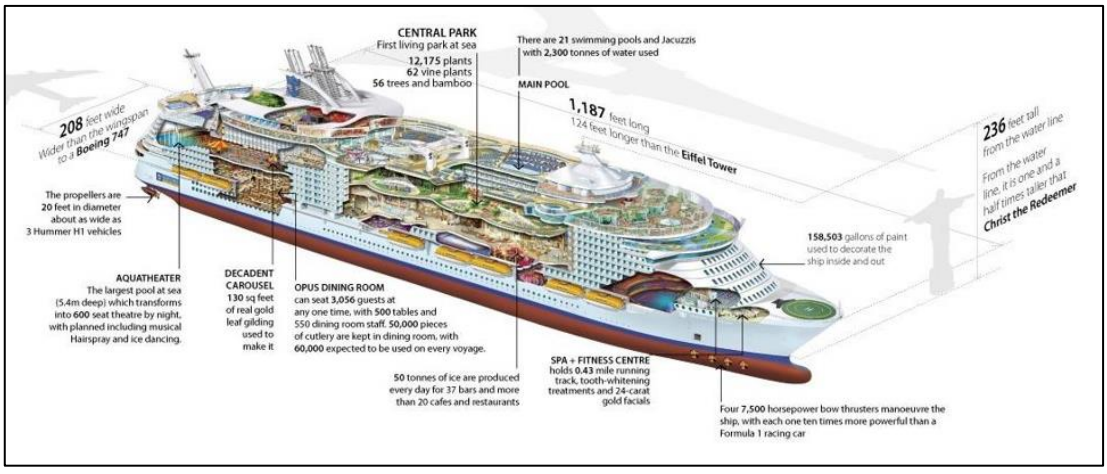

Figure 4: The layout of one of the world's largest cruise ships: Oasis of the Seas

Source：Internet

(4) Numerous older people and kids. Figure 5 shows the average age groups of global passengers. According to CLIA (2020) statistics, from 2016 to 2019, the proportion of passengers traveling by cruise ships changed little in each age group, indicating that the age structure is relatively fixed. From both ends of the table, we can see that approximately 9% of children under the age of 12 and 33% of the elderly over the age of 60 take cruises, accounting for 42% in total. Consider this: if a cruise ship carrying 1000 people is in distress, approximately 420 of them may be elderly or children. These groups are the most vulnerable because of their lack of strength, mobility, and endurance. Rescuers should fully recognize the situation, adjust rescue programme, and make additional preparations for logistics materials, medical first aid resources, and so on.

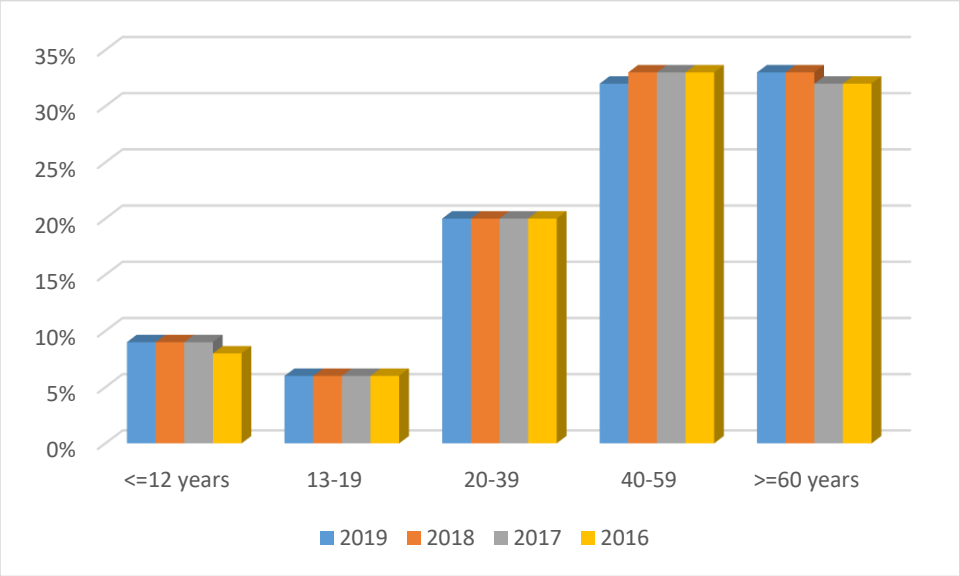

Figure 5: Age structure of global passengers

Made by author, Dalian

Source: CLIA (2020). *2019 Global Market Report.* Author

(5) Complicated rescue situation. In a cruise ship MRO, there could be hundreds or thousands of people waiting to be transferred to a safe location, some of whom require extraneous medical services or first aid. The injured, elderly, women and

children are given priority during the rescue process. Most passengers can escape via the cruise ship's survival craft and side openings. However, a few people may fall into the water unintentionally or become trapped in their cabin. As a result, the MRCC should not only coordinate various agencies to mobilize rescue helicopters, rescue vessels, and diving units, but also prepare medical support, logistic materials, and so on (CNMRCC & TIAN Jin MRCC, 2020, p.26).

(6) Communication problems. Passengers on cruise ships come from all over the world, different languages will cause communication obstacles, so language officials and multilingual signs should be prepared at rescue scene, land support and hospitals for guiding. Furthermore, once an cruise ship incident occurs, it is unavoidably going to garner a lot of attention, both domestically and internationally. Simultaneously, the government, MRCC, rescue units, relevant agencies, on-scene rescuers, media, stakeholders, industry, and families of those in distress are all eager to learn more about the situation. In a short period of time, this will generate a complex information exchange network. Because a large amount of communication may be repetitive and cause communication lines to become congested, an exclusive and dependable communication mechanism must be established (CNMRCC & TIAN Jin MRCC, 2020, p.26). To avoid interfering with the SAR operations from outside, the official information release mechanism should be established as soon as possible. However, there is a time lag between the rescue scene and the official announcement, which may result in incorrect information (Lee & Janelle, 2012, p.29). The complexity of communications in an MRO is depicted in Figure 6.

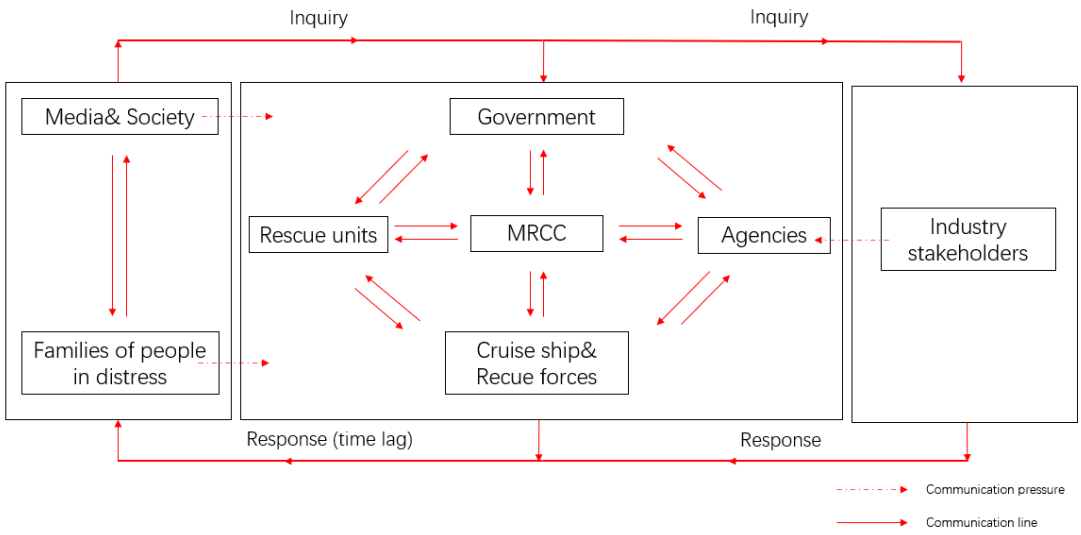

Figure 6: The complexity of communications in an MRO

Made by author, Dalian

(7) Lack of MRO experiences. In "Guidance for Mass Rescue Operations (COMSAR/Circ.31)", IMO reveals that, "*Since the need for MRO is relatively rare, it is difficult to gain practical experience to help deal with them.*" (IMO, 2003, p.1). This is especially noticeable in the cruise industry. Since the cruise ship incidents have a significant negative impact on the business, cruise companies have always placed a high value on cruise safety, investing in advanced navigation equipment and stipulating strict operation regulations to make cruise ships safer than ever. As a result, both the MRCC and SAR forces have little experience with cruise ship MRO, and relevant plans lack practical testing (SHI, 2020, p.22)

1.4 Research content

On the basis of analyzing the research results of maritime MRO at home and abroad, combining with the situation and characteristic of China SAR system and Shanghai MRCC jurisdiction, this dissertation sorts out the risk sources in Shanghai SRR,

analyzes the allocation of SAR facilities, examines relevant existing shortcomings, and puts forward promotion suggestions. The primary research objectives are:

(1) Relevant research results of MRO, maritime MRO concept and cruise MRO difficulties, etc.
(2) The status of international cruise market, regional cruise market, and the development of mainland China's cruise market, etc.
(3) China SAR system, SAR legal system and distress communication system etc.
(4) Status and uncertainty of Shanghai SRR, layout of cruise ships in Shanghai, professional rescue and salvage forces allocation, etc.

CHAPTER 2 ANALYSIS ON STATUS QUO OF CRUISE MARKET

2.1 Development of global cruise market

2.1.1 Overall status of global cruise market

In recent years, the global cruise economy has been improving continuously and is in a period of rapid growth. According to the statistical data of the CLIA, as shown in Figure 7, in terms of the number of passengers taking cruises, the global cruise market had been increased continuously, from 17.8 million passengers in 2009 to 29.7 million in 2019, with an average annual growth rate of 5.3% approximately (CLIA, 2021, p. 21).

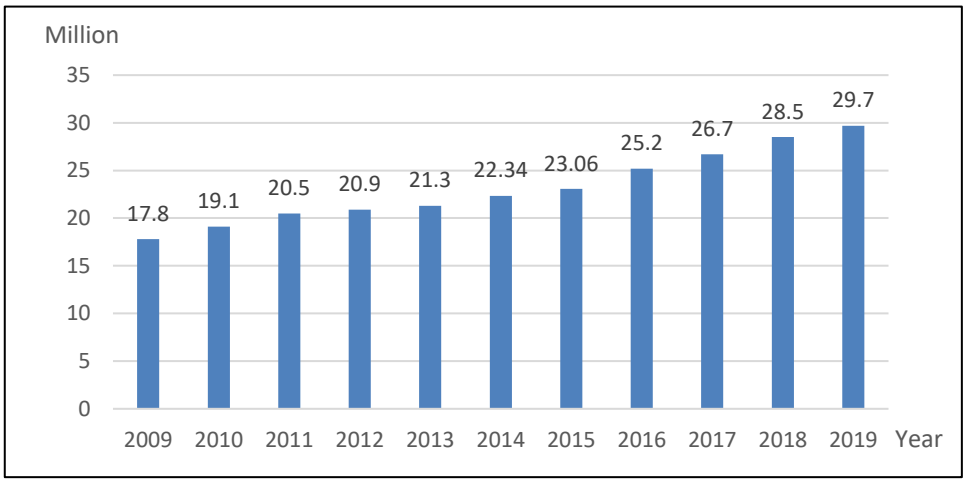

Figure 7: Growth of global cruise passengers

Made by author, Dalian

Source: CLIA (2021). *State of the Cruise Industry Outlook 2021.* Author

At present, there are five major cruise companies in the global cruise market, which are Carnival Corporation, Royal Caribbean International, Norwegian Cruise Line, MSC Crociere and Genting Cruiselines. As shown in Figure 8, the five major cruise companies shared 86.8% of the global market in 2019 (Dias & Lopes, 2020, p.4).

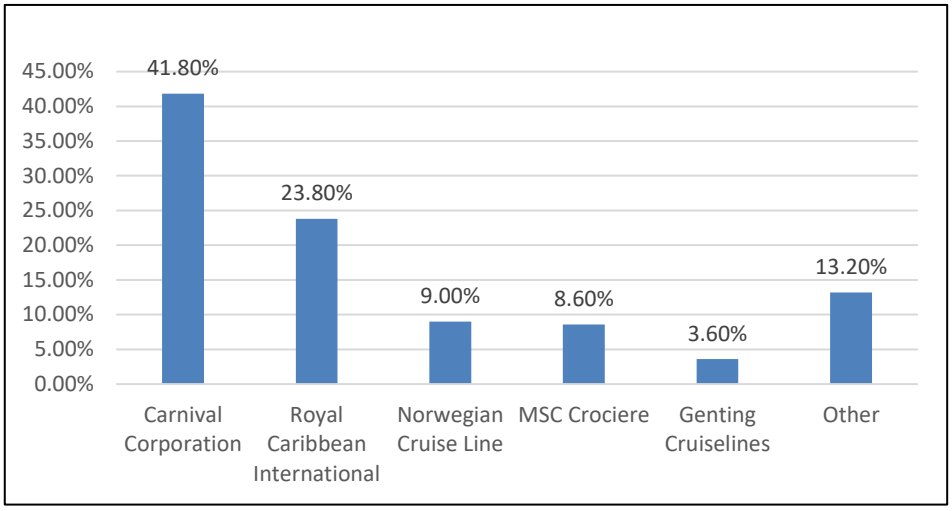

Figure 8: Worldwide major cruise companies market share

Made by author, Dalian

Source: Dias & Lopes (2020). *Case on Cruise Ship Failure Services: Onboard*. Brazil.

In addition, the cruise fleet in the world is expanding. In 2019, 24 new cruise ships were delivered worldwide, with an increase of 42,400 beds, which was a record year in the history of cruise industry. Moreover, the demand for the construction of cruise ship has exceeded supply. The latest delivery time for orders held by the world's three largest cruise shipyards, including the French Atlantic Shipyard, the Italian Fincantieri Group and the German Meyer Shipyard, has been scheduled to 2027.

According to forecast, by 2027, the total number of cruise ships of the top five cruise companies in the world will reach 253, with 677,000 beds and a total reception capacity of 34.29 million passengers. Table 3 depicts the predicted overall reception capacity of the top five cruise companies (WANG, SHI, & MEI, 2020, p.3-17).

Table 3: The predicted scale of worldwide top five cruise companies' fleet by 2027

Cruise company	Number of cruise ships	Total beds (thousand)	Reception capability (million people)
Carnival Corporation	122	319.4	15.77
Royal Caribbean International	60	168.4	8.43
MSC Crociere	24	89.6	4.56
Norwegian Cruise Line	32	72.9	3.53
Genting Cruiselines	15	26.7	2
Total	253	677	34.29

Made by author, Dalian

Source: WANG, SHI, & MEI (2020). *Research on the development of global cruise industry from 2019 to 2020: the downward pressure on the market scale is huge, and the cruise economy is facing severe challenges.* China

2.1.2 Overall status of regional cruise market

According to an analysis to 2018 global cruise market, as shown in Figure 9, the cruise activities are mainly concentrated in the Caribbean, Asia, Mediterranean Sea, West Coast of North America, Northern Europe and Oceania, accounting for approximately 85% of the global cruise market share. Out of these, 40% of the passengers are concentrated in the Caribbean market, which is the largest cruise market worldwide. Due to the rise of the Chinese cruise market, the Asia market grew rapidly and ranked the second largest market with a global share of 15% (Real, 2019).

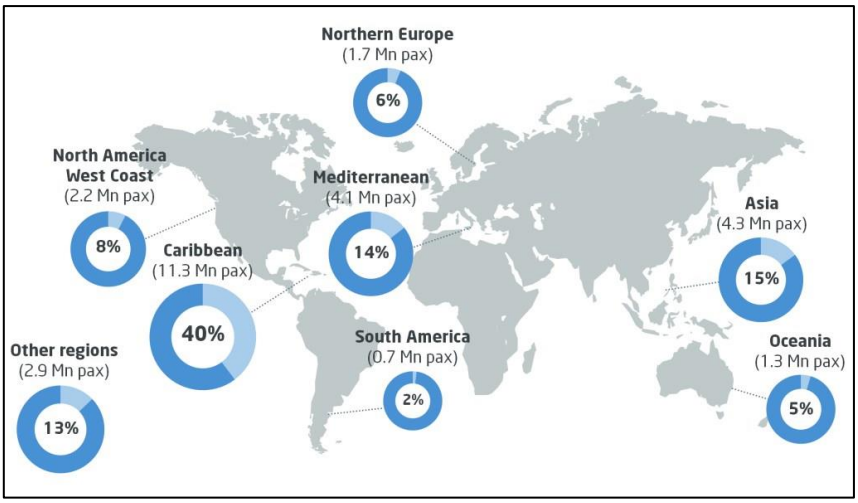

Figure 9: Worldwide cruise market share per region

Source: Real (2019). *Caribbean cruise market: Opportunities in a growing industry.*

2.1.3 Cruise market under the COVID-19 pandemic

According to CLIA's forecast, the cruise market will have a good development prospect and market potential in 2020. If the development is normal, the worldwide cruise passengers will reach 32 million. However, the growth of the market scale is halted by the Covid-19 pandemic (Cheerleading, 2020, p. 1).

From January 29, 2020, all cruise schedules are cancelled in China. Since then, the three major cruise markets, Asia, North America and Europe have also closed down one after another. This global suspension is the first time in 200 years that the cruise industry was shut down in peacetime. The cruise ports lost revenue from cruise berthing services, and the cruise shipyards were forced to stop working. This pandemic has brought huge economic losses to the development of the global cruise industry, and it is a crisis with the longest impact, the widest coverage and the most serious losses in the history of cruise industry. Despite this, the global cruise industry generally believes that the impact of the pandemic is only periodic, which is not enough to change the long-term trend of the global cruise market. In the future, with the improvement of COVID-19 prevention and control situation, the cruise industry will gradually recover (Wang, SHI, Mei, 2020, p.25-32).

2.2 Development of mainland China's cruise market

2.2.1 Overall status of mainland China's cruise market

The growth of Chinese cruise market began in 2006. With the support of national and local policies such as "Guiding Opinions of the Ministry of Transport on Promoting

the Sustainable and Healthy Development of China's Cruise Transport Industry" and "Several Opinions on Promoting the Deepening Development of Shanghai Cruise Economy", the Chinese cruise market has ushered in a golden development period of ten years. Figure 10 describes the total number of cruise ships received in China from 2009 to 2019. In the period of 2006 to 2011, the cruise market grew at an average of 36.74% annually; From 2012 to 2016, the average annual growth rate was 72.84%. In 2017, the growth rate of the cruise market slowed down for the first time, with an annual growth rate of 8%. This marked a strategic adjustment period in which Chinese cruise market changes from "high-speed growth" to "high-quality development" (WANG, JIANG, & MEI, 2019).

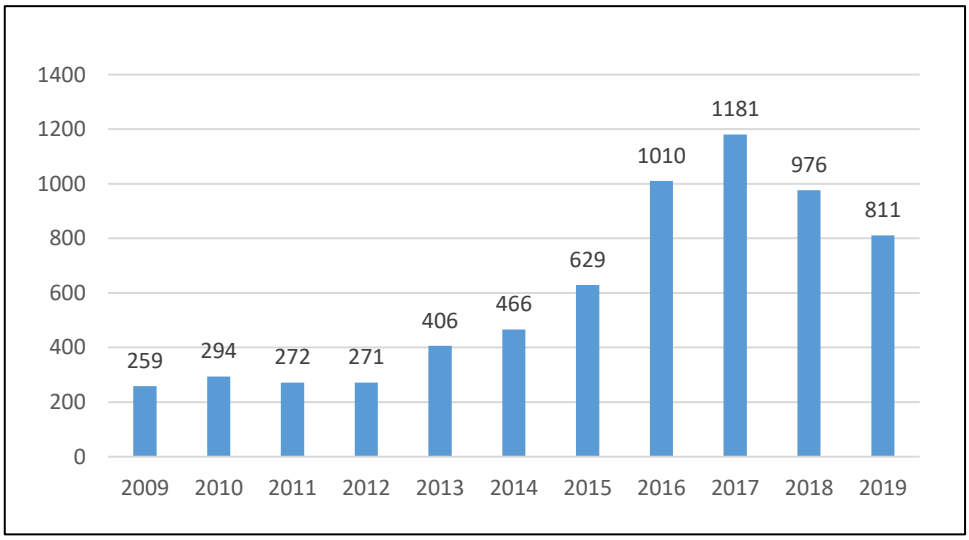

Figure 10: Total number of cruise ships received in China from 2009 to 2019

Made by author, Dalian

Source: Prospective Industry Research Institute (2021). *Global and Chinese cruise industry market status, competitive landscape and development prospect forecast in 2021.* China: author

At present, China is the world's largest emerging cruise market and the world's second largest source of cruise passengers. By the end of 2019, China's cruise ports had received a total of 7,594 cruise ships, with 27.19 million inbound and outbound

passengers. Among them, the departure ports received 5,353 cruise ships and 23.53 million cruise passengers in total (WANG, YE, & MEI, 2019).

As shown in Figure 11, from 2013 to 2019, the number of passengers received by departure ports has greatly increased in China, but the number of passengers received by ports of call has changed little. For example, in 2019, the departure ports received 3.99 million passengers, which is 22 times more than ports of call. As a result, I think the status of departure ports can basically reflect the overall situation of mainland China's cruise market.

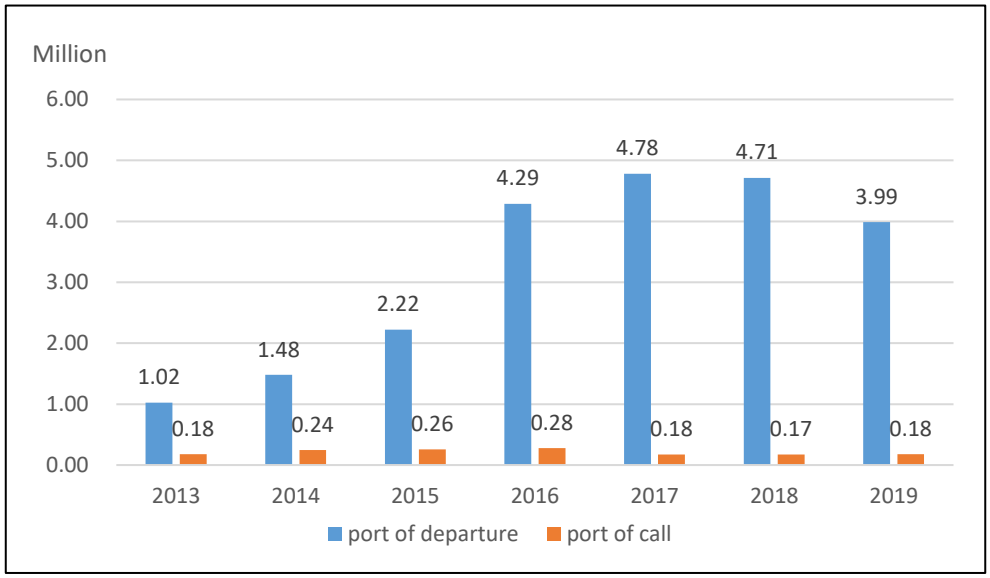

Figure 11: The data of received passengers by port of departure and call from 2013 to 2019 in China

Made by author, Dalian

Source: Prospective Industry Research Institute (2021). *Global and Chinese cruise industry market status, competitive landscape and development prospect forecast in 2021*. China: author

2.2.2 Status of mainland China's cruise ports

According to the "National Coastal Cruise Port Layout Plan", before 2030, China will form a port layout with 2 ~ 3 cruise home ports as the leading factor, the departure

ports as the main body and the ports of call as the supplement, and build a cruise port system with sufficient capacity, perfect functions, high-quality service, safety and convenience, and build a batch of internationally renowned boutique cruise routes suitable for the characteristics of Chinese residents' tourism consumption, thus becoming one of the three major cruise markets in the world. In the layout plan, as Figure 12 shows, Dalian Port, Tianjin Port, Qingdao and other ports will be constructed as departure port (MOTPRC, 2015b).

Figure 12: Layout of cruise ports in mainland China

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At present, there are 14 cruise ports in operation in mainland China. However, these ports have different operating situations. There are some ports without cruise ships calls all year round. On the other hand, some cruise ports are very busy, for instance, the Shanghai Wusongkou International Cruise Terminal. The detailed operation data of the 14 cruise ports are highlighted in Table 4.

Table 4: The operation data of mainland China's cruise ports in 2018-2019

No	Port Name	Cruise ships received			Cruise passengers		
		Number of ships		Year-on-year growth (%)	Number(thousand)		Year-on-year growth (%)
		Year of 2018	Year of 2019		Year of 2018	Year of 2019	
1	Shanghai Wusongkou International Cruise Terminal	375	240	-36	2715	1871.4	-31
2	Xiamen International Cruise Center	96	136	42	324.8	413.7	27
3	Tianjin International Cruise Home Port	116	121	4	683	725.5	6
4	Shenzhen China Merchants Shekou Cruise Home Port	89	97	9	364.6	373	2
5	Guangzhou Port International Cruise Home Port	97	89	-8	481.2	434.4	-10
6	Qingdao Cruise Home Port	44	51	16	109.9	176.2	60
7	Dalian International Cruise Center	37	39	5	84.4	88.5	5
8	Shanghai Port International Passenger Transport Center	28	18	-36	37.2	22	-41
9	Zhoushan Islands International Cruise Port	1	5		0.3	16	
10	Guangzhou Nansha Cruise Home Port	0	4		0	7.48	
11	Sanya Fenghuang Island International Cruise Port	20	4	-80	20	6.4	-68
12	Haikou Xiuying Port	0	0		0	0	
13	Wenzhou Interational Cruise Port	5	0		14	0	
14	Lianyungang International Passenger Transport Center	20	0		13	0	

Made by author, Dalian

Source: SHI, YE, & MEI (2020). *Research on the Development of China's Cruise Industry from 2019 to 2020: New Situation, New Challenge and New Path.* China

2.2.3 Deployment of cruise ships in mainland China

In 2020, mainland China planned to deploy 13 international and local cruise ships, according to data. They are "Spectrum of the Seas," "Costa Venezia," "MSC Meraviglia," "World Dream," "Piano Land," and so on. Astro Ocean Cruise and Bohai Ferry Group are Chinese enterprises, while the rest are international (Zhang, 2020, p. 94). I sorted all the cruise ships operating in China in detail using the websites of the cruise firms and created Table 5.

Table 5: 2019 departure port cruises in the mainland China

Cruise company	Brand	Cruise ship	Maximum passengers capacity	Gross tons	Length& Width
Royal Caribbean International	Royal Caribbean	Spectrum of the Seas	5,549	168,000	347& 41
		Quantum of the Seas	4,905	168,000	347& 41
		Voyager of the Seas	3,974	138,000	311&48
Carnival Corporation	Costa	Costa Venezia	5,260	135,500	323& 37
		Costa Serena	3,780	114,500	290& 36
		Costa Atlantica	2,680	86,000	292& 32
		Costa neoRomantica	1,800	57,150	220& 31
MSC Cruises	MSC Cruises	MSC Meraviglia	5,700	167,600	345& 43
Genting Cruiselines	Dream Cruises	World Dream	3,376	150,695	335& 40
		Explorer Dream	1,856	75,338	268& 32
	Star Cruises	Superstar Gemini	1,530	50,764	230& 29
Astro Ocean Cruise	Astro Ocean Cruise	Piano Land	1,800	70,000	261& 32
Bohai Ferry Group	Bohai Cruise	Chinese Taishan	900	24,500	180& 26

Made by author, Dalian

Source: Zhang (2020). *Research on the Strategic Path of China Cruise Economy Development under the New Situation*. China

It is worth noting that Royal Caribbean International's "Wonders of the Seas," the world's biggest cruise ship, is scheduled to arrive in Shanghai in March 2022. It measures 362 meters long, 47 meters broad, and has a gross tonnage of 228,000 tons. The most individuals on board are 8,764, which includes 6,370 passengers and 2,394 crew members (Shanghai Municipal People's Government, 2021).

2.3 Status of Shanghai cruise home port

Shanghai is a municipality directly under the People's Republic of China's Central Government, as well as the heart of China's economy, banking, commerce, and shipping, a world-famous port city, and the country's second biggest populous metropolis. Shanghai is situated in the center of eastern China's curving coastline, at the easternmost point of the Yangtze River Delta, bordering the East China Sea in the east, Hangzhou Bay in the south, Jiangsu and Zhejiang provinces in the west, Chongming Island in the north, and the Yangtze River estuary (State Council, 2009).

As shown in Figure 13, Shanghai cruise home port is composed by two cruise ports, namely Shanghai Wusongkou International Cruise Terminal and Shanghai Port International Passenger Transport Center. The cruise activities in Shanghai are extremely frequent. From the perspective of the calls of cruise ships, Shanghai wusongkou International Cruise Terminal had ranked first in Asia (Lau & Yip, 2020, p.4). From 2018 to 2019, the total volume of two Shanghai cruise ports accounted for 43.4% and 32.1% of received cruise ships, as well as 56.8% and 45.8% of inbound and outbound passengers of the mainland China.

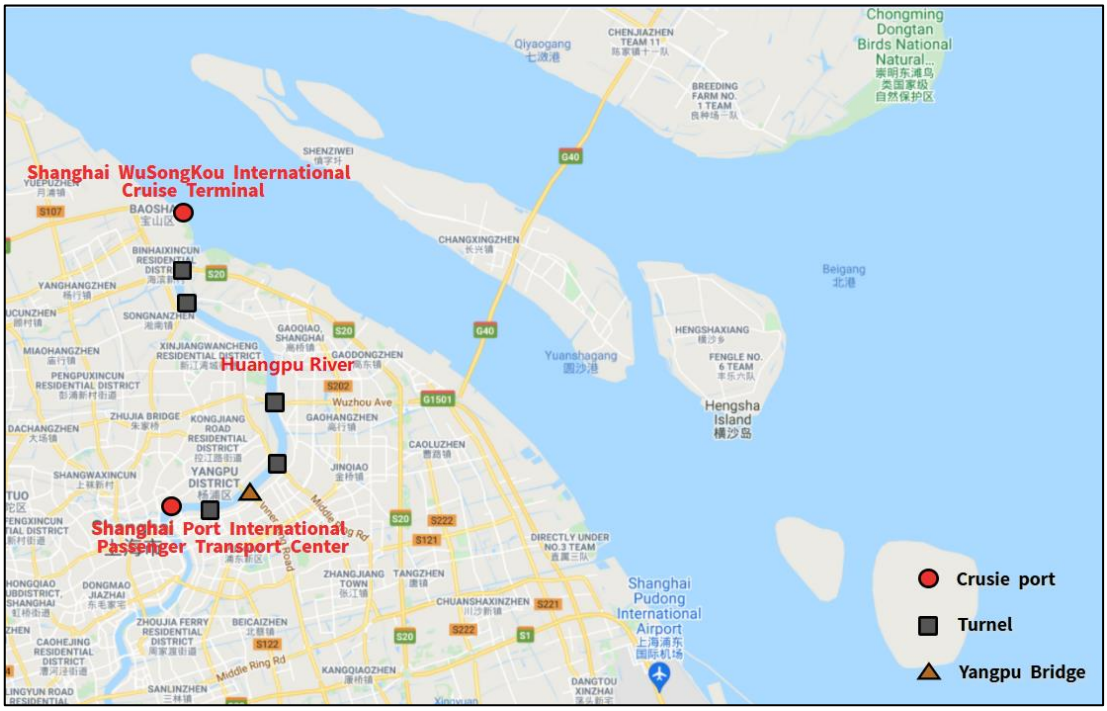

Figure 13: The locations of two cruise ports in Shanghai

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The prosperity of the Shanghai cruise market benefits from the positioning of its economic center, a good geographical position and high-quality port construction. According to China Transport Yearbook (2019), Shanghai started to build Shanghai Port International Passenger Transport Center in 2004 and put into operation in 2008. Shanghai Port International Passenger Transport Center is located on the west bank of

Huangpu River, close to the core area “the Bund”, with a coastline as long as 880 m, facing the “Oriental Pearl” TV Tower across the river, and can berth three 70,000-ton cruise ships at the same time (2020).

With the development of large-scale cruise ships, as the navigation route must pass through Yangpu Bridge with a limited height (marked in Figure 13), it is impossible for giant cruise ships to pass through. In order to further improve the reception capacity of cruise ports, in 2008, Shanghai chose to start construction of Shanghai Wusongkou International Cruise Terminal in Paotai waters along the Yangtze River coastline in Baoshan District. The new cruise port is located 1-2 km away from the main waterway of the Yangtze River, which is one of the busiest waterways in the world. After the construction of the second phase in 2018, the total length of the port wharf will reach 1,600 m, with two 150,000-ton bumper wharfs and two 225,000-ton wharfs, which can dock four ships at the same time. Table 6 summarizes the data of wharves of these two cruise ports (MOTPRC, 2020).

Table 6: The reception capacity of Shanghai home port

Port city	Port name	Maximum berthing (ships)	Length of berth (meter)	Water depth of berth (meter)	Tonnage of dockable cruise ships (tons)	Opening year
Shanghai	Shanghai Port International Passenger Transport Center	3	294	9-10	70,000	2008
			294	9-10	70,000	2008
			294	9-10	70,000	2008
	Shanghai Wusongkou International Cruise Terminal	4	420	11	150,000	2011
			354	11	225,000	2011
			380	11	225,000	2018
			446	11	150,000	2018

Made by author, Dalian

Source: MOTPRC (2020). *China Transport Yearbook (2019).* Beijing: author

2.4 Chapter summary

Prior to the Covid-19 pandemic, the global cruise market showed a consistent and positive growth trend. Although the Covid-19 pandemic has temporarily halted the cruise activities, the cruise industry as a whole believes that the pandemic will have no long-term impact on the cruise market's long-term development trend. With the rapid development of Chinese cruise market, Asia has risen to become the world's second largest cruise market. Shanghai home port leads the country in terms of cruise ships and passengers received, which has two cruise ports. The number of passengers carried by cruise ships is enormous as a sea carrier of large-scale tourism products, and the safety red line cannot be crossed. It is critical to study the potential MRO of cruise ships, which is not only a powerful guarantee for the healthy development of the China's cruise industry, but also responsible for the safety of people's lives and property. The reasons why select Shanghai as the research subject are:

Firstly, Shanghai is a notable cruise home port. Shanghai Wusongkou International Cruise Terminal is Asia's largest cruise port, with the most active and intensive cruise activities.

Secondly, the Yangtze River estuary, where the cruise port is located, is one of the world's busiest waterways, with numerous unknown risks.

Finally, the Shanghai home port will deploy one of the world's largest cruise ship in the future, which will put more pressure on the maritime safety in this region.

CHAPTER 3 CHINA MARITIME SEARCH AND RESCUE REGIME

3.1 Evolution of CMRCC and the inter-ministerial joint meeting mechanism

3.1.1 Establishment of CMRCC

In August 1973, the Greek cargo ship “Baltic Cliff” (chartered by the Ministry of Foreign Trade of China) was hit by Typhoon No.15 in the southern part of Taiwan Strait, 40 nautical miles east of Xiamen, Fujian Province. The captain appealed to the Chinese government for help. However, due to the backward equipment and huge waves, the Baltic Cliff failed to get effective rescue and the ship sank, 14 crew members missed. This incident caused great political influence and attracted the attention of the central leadership.

For this reason, Zhou Enlai, then Premier of China, instructed that the national maritime rescue work should be strengthened. In December of the same year, the State Council held a national maritime safety work conference in coastal provinces and cities, and decided to set up a national maritime safety command, which is composed of the Ministry of Transport, the Ministry of Foreign Trade, the Ministry of Agriculture and Forestry, the General Staff, the Navy, the Air Force and other units.
The head of the Ministry of Transport is the commander, and each unit dispatches personnel to work in the Ministry of Transport, which is responsible for unified deployment and command of typhoon prevention, ship pollution prevention, anti-freezing and maritime SAR.

At the same time, a national professional maritime SAR forces is set up, and the military and local governments jointly undertake the maritime rescue task. Coastal

provinces, autonomous regions and municipalities directly under the Central Government have successively set up maritime safety command organizations to lead the work of "three defenses and one rescue[1]" in their respective jurisdictions (Compilation Committee of Shanghai Salvage Records, 1997).

In July 1989, in order to better fulfill the "International Convention on Maritime Search and Rescue", the State Council and the Central Military Commission approved the establishment of CMRCC in the Ministry of Transport, which is responsible for the unified organization and coordination of the national maritime SAR. The daily work is undertaken by the Safety Supervision Bureau of the Ministry of Transport, relevant departments of the State Council and the military should cooperate to conduct maritime SAR operations. The use of SAR facilities is mainly based on the professional rescue and salvage forces of the Ministry of Transport. In case of insufficient SAR forces in some sea areas, the local garrison can be contacted and the troops will give support. It is agreed that the maritime safety headquarters of coastal provinces, autonomous regions and municipalities directly under the Central Government should be changed into MRCC with the same responsibilities and be guided by CMRCC. On June 22, 1990, the Ministry of Transport issued a notice to establish the CMRCC (SUN, 2014, p.20).

3.1.2 Construction of inter-ministerial joint meeting mechanism

In May 2005, in order to strengthen the organization and leadership of the national maritime SAR and emergency response to ship pollution incidents, coordinate and integrate all forces, and form a working pattern of unified command by the government, rapid response, and combination of prevention and rescue, the State

[1] It means: typhoon prevention, sea pollution prevention, anti-freezing and icebreaking, and maritime SAR.

Council approved the establishment of the "National inter-ministerial joint meeting of maritime SAR," as Figure 14 depicts, it is led by the Ministry of Transport with 13 attended member units. Make overall plans to study the national maritime SAR and emergency response to ship pollution work, organize and coordinate major maritime SAR and ship pollution emergency response, guide and supervise the maritime SAR work of relevant provinces, autonomous regions and municipalities directly under the Central Government, and clarify that CMRCC is the office to undertake daily work of the joint meeting (State Council, 2005).

Figure 14: The organization of National inter-ministerial joint meeting of maritime SAR in 2005[2]

Source: Cornillou (2021b). *SAR_organization_China [handouts]*. France

[2] The Army mentioned here includes not only Navy, Air force, Armed police, but also the General Staff.

In October, 2012, according to the needs of national major oil spill emergency response, the State Council approved the establishment of the "National inter-ministerial joint meeting of emergency response to major maritime oil spills". Under the leadership of the State Council, the inter-ministerial joint meeting study and solve major problems in oil spills, organize and command major oil spill emergency response, guide and supervise the emergency response work of coastal governments and related enterprises. The Ministry of Transport is the lead unit, CMRCC undertakes the daily work under the name of "China maritime oil spill emergency center" (BEI, 2013, p.61-62).

Afterwards, come with the background of new requirements of maritime SAR work, and the reform of state institutions that pushed some institutions were merged and adjusted, the organization of the "National inter-ministerial joint meeting of maritime SAR" had changed. The changes are:

Firstly, according to the approvals of the State Council, in 2006, the Ministry of Information Industry (predecessor of Ministry of Industry and Information Technology), Ministry of civil affairs, China Earthquake Administration joined the inter-ministerial joint meeting. In 2014, the Ministry of Foreign Affairs, National Defense Science and Technology Bureau joined the inter-ministerial joint meeting (CMRCC, 2021b). In 2016, China Coast Guard is newly added to the "National inter-ministerial joint meeting of maritime SAR" (CMRCC, 2021a, p.3).

Secondly, according to the "Deepening the Reform Plan of Party and State Institutions" issued by the CCCPC in 2018, the public security fire and rescue department was placed under the newly formed Ministry of Emergency Management, and became a comprehensive and permanent emergency backbone of national

emergency response. In addition, the public security fire and rescue department was no longer included in the Armed Police Force (CCCPC, 2018). As a result, according to the responsibility of the Ministry of Emergency Management, it joined in the inter-ministerial joint meeting and has power to dispatch the fire and rescue forces.

Thirdly, due to institutional reform in 2018, the State Oceanic Administration has ceased to exist, and most of its responsibilities have been incorporated into the newly established Ministry of Natural Resources. The Ministry of Natural Resources retains the brand of State Oceanic Administration to the outside (CCCPC, 2018). As a result, the Ministry of Natural Resources joined in while the State Oceanic Administration seceded from the inter-ministerial joint meeting.

Finally, as the requirement of institutional reform in 2018, China Coast Guard, which was led and managed by the State Oceanic Administration, was handed over to the Armed Police Force (CCCPC, 2018). In 2020, after approval, the Joint General Staff of the Central Military Commission replaced the navy, air force and armed police to join the inter-ministerial joint meeting (CMRCC, 2021a, p.3).

In addition, although some member units are renamed according to relevant regulations, their duties basically remain unchanged. Accordingly, after the adjustment above, there are 15 members of in the updated “National inter-ministerial joint meeting of maritime SAR” which is updated in Figure 15.

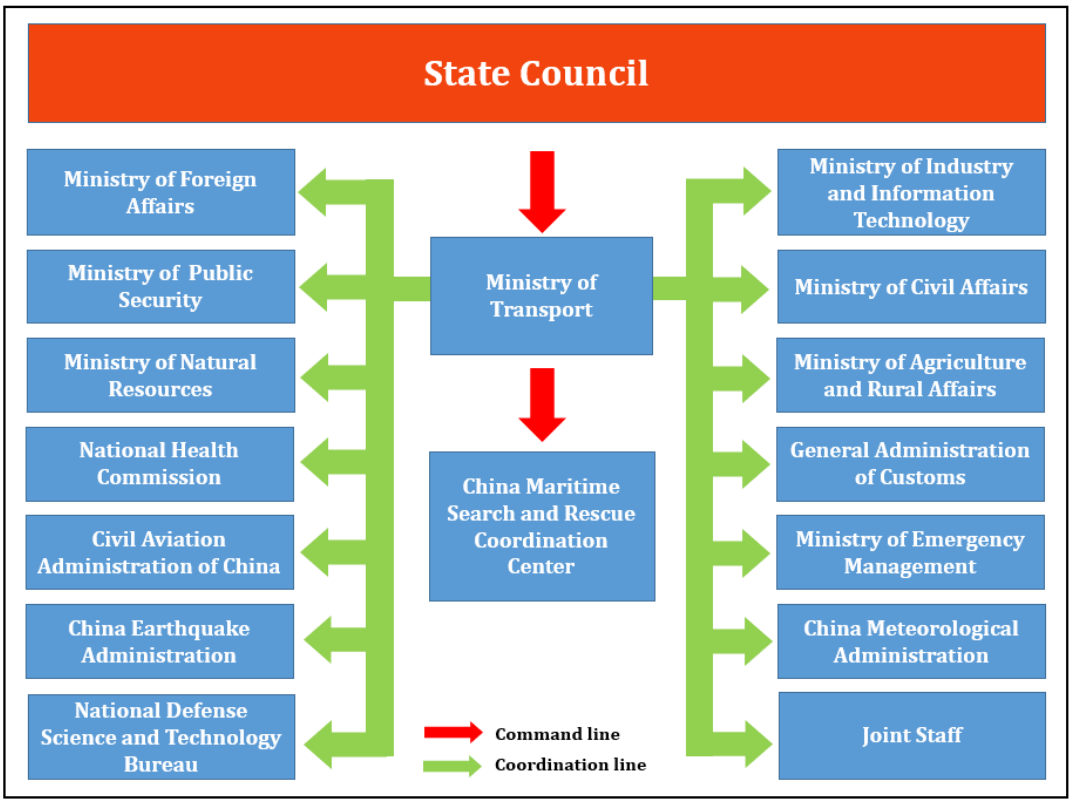

Figure 15: The organization of National inter-ministerial joint meeting of maritime SAR at present

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3.2 China maritime SAR organizational system

According to the "National Maritime Search and Rescue Manual", China maritime SAR organizational system is composed of emergency leading body, operation management body, technical advisory body, emergency command body, on-scene coordinator and emergency rescue forces (CMRCC, TianjinMRCC, & DMU, 2011). Their roles and duties are as follows.

3.2.1 Emergency leading body

Under the leadership of the State Council, the national inter-ministerial joint meeting

of maritime SAR is the emergency leading body, which is responsible for studying and negotiating important issues of maritime SAR, and guiding the national maritime SAR emergency response work. The CMRCC is responsible for the daily work of the national inter-ministerial joint meeting of maritime SAR.

Members of the national inter-ministerial joint meeting of maritime SAR shall, according to their respective duties and responsibilities, combine the actual situation of maritime SAR operations, play a corresponding role, and undertake emergency work such as maritime SAR, disaster relief, aftercare, and so on.

3.2.2 Operation management body

As the office of the national inter-ministerial joint meeting of maritime SAR, CMRCC of MOTPRC is responsible for the daily work of the inter-ministerial joint meeting, and undertakes the operation and management of maritime SAR emergency response work under the leadership of the Ministry of Transport, organizing, coordinating and commanding major maritime SAR operations nationwide.

3.2.3 Technical advisory body

Technical advisory bodies include maritime SAR expert groups and other relevant consulting agencies. The SAR expert group is composed of experts and professions in shipping, maritime safety, aviation, fire protection, medical and health, environmental protection, petrochemical industry, marine engineering, marine geology, meteorology, and so on. The technical advisory body is responsible for providing technical advice on maritime SAR work. Other consulting agencies shall provide relevant support and services for maritime SAR operations at the request of CMRCC.

3.2.4 Emergency command body

Emergency command bodies include: CMRCC, MRCC and MRSC established by governments at all level. The provinces (autonomous regions and municipalities) in the main navigable waters of coastal and inland rivers set up provincial-level MRCC composed of provincial government leaders, relevant departments and local garrisons. According to the needs, the provincial MRCC can set up the branches of MRCC (MRSC).

3.2.5 On-scene coordinator

On-scene coordination is carried by the OSC who shall be appointed by the emergency command body responsible for organizing emergency response to maritime incidents, and undertake on-scene coordination work according to the instructions of the emergency command body. The on-scene SAR facilities shall follow the instructions of OSC.

3.2.6 Emergency rescue forces

Maritime SAR forces mainly include professional forces, military and armed police forces, official forces under government departments, other civil ships, aircraft and social enterprises, institutions, organizations or individuals that can contribute to SAR operations. In particular, China Rescue and Salvage (CRS) is the only national professional forces for maritime rescue and salvage, plays the role of the backbone of China maritime emergency response, an important part of the national emergency rescue support system, and an important force in national defense traffic readiness (XIAO, 2020, p.4).

At present, CRS has more than 10,000 employees, nearly 200 rescue and salvage vessels, such as professional rescue vessels, semi-submersible vessels and lifting vessels. In addition, CRS is equipped with 20 large and medium-sized rescue helicopters. More than 20 rescue bases and 10 flight bases have been set up from the Yalu River estuary in the north to the Xisha Sea area in the south. Now CRS has basically formed a three-dimensional SAR network system with all-round coverage at sea, high sea condition operation, dynamic standby, scientific configuration, rapid response and efficient disposal (ZHANG, LIU, & ZHENG, 2018, p.108).

To sum up, China maritime SAR organizational system is shown in Figure 16.

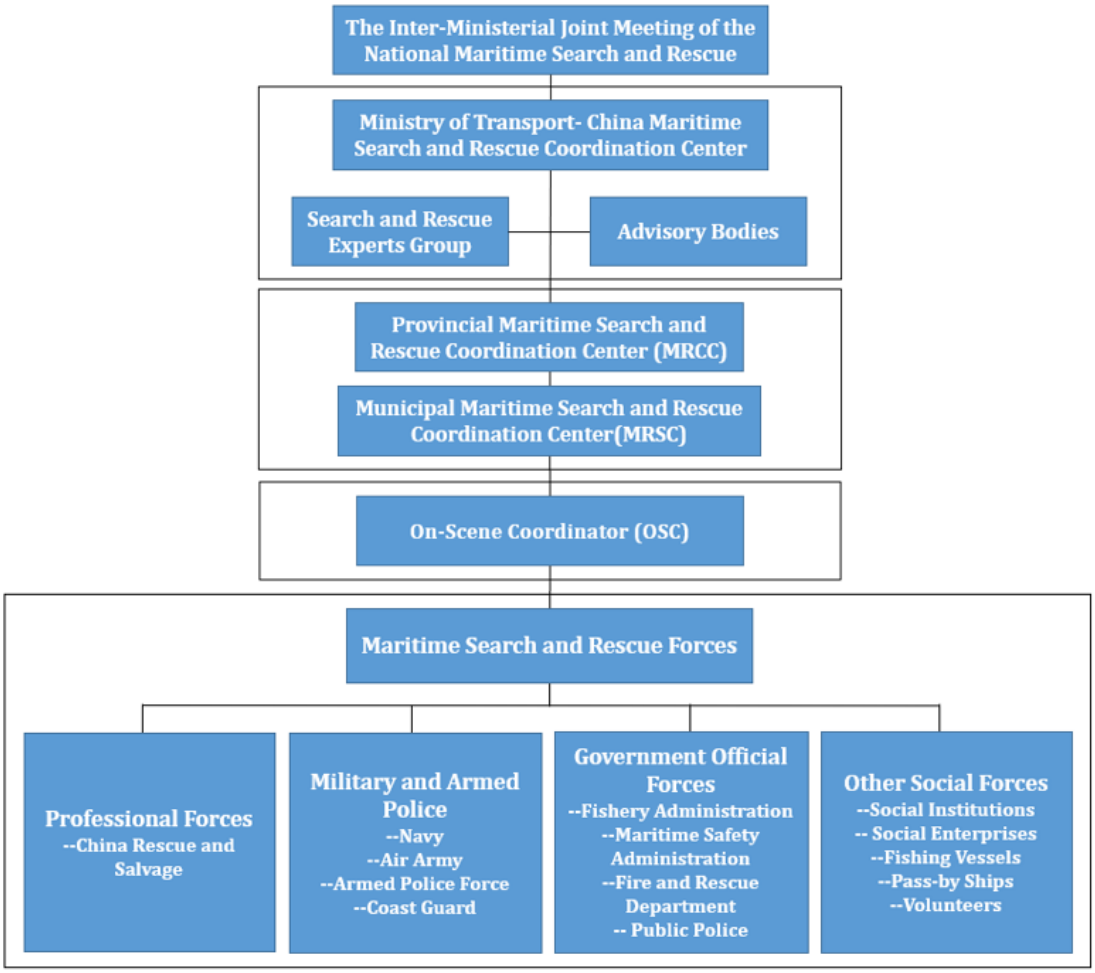

Figure 16: Current maritime SAR organizational system in China

Made by author, Dalian

3.3 China maritime SAR legal system

3.3.1 International Conventions and regional agreements

China is a signatory to the "United Nations Convention on the Law of the Sea", the "1974 SOLAS", the "1979 International Convention on Maritime SAR (1998 Protocol)", and the "Convention on International Civil Aviation" (Ministry of Foreign Affairs, 2021). Under the framework of the Convention, China, as a coastal state, has established national SAR legal system, set up maritime CMRCC, and developed professional search and salvage forces, providing support for ensuring the safety of life, environment and property at sea.

In order to further strengthen regional maritime SAR cooperation, China has successively signed the "China-US Maritime SAR Agreement" "China-North Korea Maritime SAR Agreement" "China-South Korea Maritime SAR Agreement", and the "China-Japanese Maritime SAR Agreement". The signing of these agreements has better promoted information exchanges and mutual trust, technical cooperation and coordination between China and relevant countries on maritime SAR work (CMRCC, TianjinMRCC, DMU, 2011; State Council, 2018).

3.3.2 Domestic laws and regulatory documents

The major domestic laws and rules related to maritime SAR work include the "Maritime Traffic Safety Law of the People's Republic of China" "Safety Production Law of the People's Republic of China" "Emergency Response Law of the People's Republic of China" "Regulation of inland river traffic safety management of the People's Republic of China", and the "Regulation of the People's Republic of China

on radio management", etc. (State Council, 2008)。 In particular, the newly revised "Maritime Traffic Safety Law of the People's Republic of China" was passed by the Standing Committee of the 13th National People's Congress of the People's Republic of China on April 29, 2021 (MOTPRC, 2021). Compared with the old law in 1984, the new law is better adapted to the needs of fulfilling the requirements of relevant international treaties and solving practical SAR problems at sea. Chapter VI of the law is closely related to maritime SAR, which has the following main meanings:

To begin, it specifies that persons in distress at sea have a legal right to life help, and it establishes the fundamental concept that life assistance takes precedence above environmental and property aid.

Second, a maritime SAR coordination mechanism must be established, as well as the construction of maritime SAR forces, the establishment of MRCC to organize, coordinate, and direct work, the establishment of a regular drill and daily training system, and the encouragement of social forces to participate in maritime SAR work.

Finally, it establishes a code of behavior for all parties involved in distress, rescue, and command following the occurrence of dangerous circumstances, in order to ensure the orderly SAR operations (LI, 2021).

3.3.3 Emergency plans and governmental policies

For the purpose of improving the ability to ensure public safety and deal with public emergencies, the State Council has issued the "National Overall Emergency Plan for Public Emergencies". The plan is the general outline of the national emergency plan system, which defines the classification level of various public emergencies, stipulates

the organizational system and working mechanism of the State Council in dealing with particularly serious public emergencies, and is a normative document guiding the prevention and disposal of various public emergencies (State Council, 2006).

The State Council released the "National Overall Emergency Plan for Public Emergencies" to improve the capabilities to maintain public safety and cope with public emergencies. The plan is the general outline of the national emergency plan system, which defines the classification level of various public emergencies, specifies the State Council's organizational system and working mechanism in dealing with particularly serious public emergencies, and is a normative document guiding the prevention and disposal of various public emergencies (State Council, 2006).

After that, the State Council approved and issued the "National Maritime SAR Emergency Plan", which clarified the working principles of maritime SAR, and established an early warning mechanism, a dangerous situation reporting system, emergency response, disposal procedures, and so on (State Council, 2008).

According to the above-mentioned plans, the Ministry of Transport has successively formulated and issued a series of normative documents, such as "Emergency Response Procedure for Maritime Emergencies of the Ministry of Transport" "Emergency Disposal Procedure for Water Transport Bulk Liquid Dangerous Chemicals" "Emergency Plan for Preventing Typhoon and Other Extreme Weather of the Ministry of Transport", and the "Emergency Work Specification for Emergencies of the Ministry of Transport".

Shanghai, Tianjin, Liaoning and other provinces (autonomous regions and municipalities) have successively issued local laws, regulations, and emergency plans

on maritime SAR work. In addition, in 2018, the Ministry of Transport issued and implemented the “National Emergency Response Plan for Major Oil Spills at Sea”, which was reviewed and approved by the national inter-ministerial joint meeting of emergency response to major maritime oil spills (MOTPRC, 2018)

Furthermore, for the sake of promote national SAR operations, the government has also stipulated relevant policies and projects, such as the “Outline for the Construction of Nation with Strong Transportation System” jointly issued by the CCCPC and the State Council, the “Circular of the General Office of the State Council on Strengthening the Water SAR work” “Layout Project of the National Water Traffic Safety Supervision and Rescue System”, approved by the State Council, etc. Table 7 sorts out the main achievements in the construction of maritime SAR legal system in China (MOTPRC, 2007; State Council, 2019a; State Council, 2019b).

Table 7: The main achievements of China’s maritime legal SAR system

Level 1: Major Conventions and Agreements					
No	Conventions	Effective time for China	No	Agreements	Signing time
1	United Nations Convention on the Law of the Sea	7/7/1996	1	China-South Korea Maritime Search and Rescue Agreement	10/4/2007
2	1974 International Convention for the Safety of Life at Sea	1/1/1997	2	China-Japanese Maritime Search and Rescue Agreement	26/10/2018
3	1979 International Convention on Maritime Search and Rescue (1998 Protocol)	1/1/2000			
4	Convention on International Civil Aviation	15/2/1974			
Level 2: Major Domestic laws and regulatory documents					
No	Law name	Enter into force	No	Regulatory documents	Enter into force
1	Maritime Traffic Safety Law of the People's Republic of China	1/9/2021	1	Regulation of inland river traffic safety management of the People's Republic of China	1/8/2002
2	Safety Production Law of the People's Republic of China	1/9/2021	2	Regulation of radio management of the People's Republic of China	1/12/2016
3	Emergency Response Law of the People's Republic of China	1/11/2007			

Level 3: Emergency plans and Govenmental Policies							
No	Emergency plan name	Released by	Enter into force	No	Policy name	Released by	Enter into force
1	National overall emergency plan for public emergencies	State Council	8/1/2006	1	Outline for the Construction of Nation with Strong Transportation System	CCCPC& State Council	19/9/2019
2	National Maritime Search and Rescue Emergency Plan	State Council	22/1/2006	2	Layout project of national water traffic safety supervision and rescue system	State Council	1/7/2007
3	National Emergency Response Plan for Major Oil Spill at Sea	MOT	8/3/2018	3	Circular of the General Office of the State Council on Strengthening Water Search and Rescue Work	General Office of State Council	8/11/2019

Made by author, Dalian

Source: ZHU (2020). *Know and practice, continue with the past and open up the future, improve the high quality development of the national marine SAR capability.* DMU, Dalian;
Relevant government official website

3.4 China maritime distress communication system

From the perspective of infrastructure and communication technology, after years of construction and development, the medium and high frequency maritime distress communication system has been very complete, and achieved a coverage of 100 nm of coastal waters in China. The maritime safety information broadcasting system is capable to cover 250 nm of coastal waters. Through maritime satellite, the entire territorial waters, airspace and a 200 nm EEZ has realized communication without blind zone. In order to provide high-quality vessel traffic services and realize the

“visualization” of ship dynamic supervision, China has developed the largest VTS and AIS in the world. By the end of 2018, there were 44 VTS centers and 597 AIS shore stations in China, and the signals could cover key waters such as “six districts and one line[3]”.

In terms of emergency command and communication system development, the Ministry of Transport’s "Transportation Integrated Emergency Command Center" went into service in March 2016, following a two-year consitruction. The center is capable of real-time video communication with the State Council’s emergency office, provincial transportation authorities, coastal provincial MRCC, MSA and CRS directly under the Ministry of Transport, some patrol vessels of MSA and rescue ships of CRS, and real-time monitoring of highway, waterway, and road transportation industries. Furthermore, the majority of provincial MRCC have developed maritime SAR emergency command platforms, which offer optimal conditions for fast SAR organization, coordination, and command (ZHU, 2020, p.17; MOTPRC, 2016).

3.5 Chapter summary

This chapter summarizes the evolution and status of China maritime SAR regime. There are four main points:

Firstly, introduced the evolution of CMRCC and two national inter-ministerial joint meeting mechanisms. In particular, this dissertation deeply studies the national

[3] According to the definition of “Notice of the Ministry of Transport on Adjusting Key Ships and Key Areas of Water Traffic Safety Supervision”, the “six districts one line” means: The “six districts” are Bohai Sea waters (including Chengshanjiao and its north waters), Changjiang Estuary waters, Zhoushan Archipelago waters, Taiwan Province Strait waters, Pearl River Estuary waters and Qiongzhou Strait waters. The “one line” is: Yangtze River first line waters (including southwest mountain waters).

inter-ministerial joint meeting of maritime SAR, the five major changes of member units since 2005 have been clarified.

Secondly, according to the “National Maritime SAR Emergency Plan”, the six tiers of the national SAR system from top to bottom are introduced, which is the core part for understanding China maritime SAR regime.

Thirdly, the achievements of China maritime SAR in regional agreements, laws and regulations, planning construction, and major support policies are summarized within the framework of international conventions, which may aid in a better understanding of China maritime SAR regime and current situation.

Finally, this dissertation explores the current condition of China maritime distress communication construction, introducing different communication ways and coverage regions that will assist in the development of a more complete knowledge of China maritime SAR regime.

CHAPTER 4 SHANGHAI SEARCH AND RESCUE REGION STATUS

4.1 Location and area of Shanghai SRR

4.1.1 SRR announced by Shanghai Municipal People's Government

According to "Shanghai Maritime SAR Emergency Plan (2017 Edition)", Shanghai Maritime SRR refers to the area undertaken by Shanghai MRCC to handle maritime emergencies, which is shown in Table 8.

Table 8: Shanghai SAR Region

(1) Huangpu River waters
It is connected from Wusongkou Lighthouse, 101 Dengfu, 102 Dengfu and Pudong West Boundary Mark (31 23′ 14″ N/121 31′ 41″ E) to Huangpu River waters within the range between the upstream boundary of Minhang Power Plant and the upper corner connecting line of Punan Canal Port.
(2) Shanghai section of Yangtze River
The north branch waterway downstream of the longitude line of Niupenggang high-voltage line (121 14′30″ E), the water area north of the right mark of the main channel of the Yangtze River near Chongming Island, the Liu Hei House (31 30′52″ N/121 18′54″ E) downstream of the Liuhekou of the Yangtze River trunk line and the letter-applying pole (31 37′34) downstream of Shiqiao River in Chongming
(3) Coastal waters of Shanghai
The coastal waters of Shanghai refer to the waters between the following southern and northern boundaries except the areas of responsibility of Jiangsu and Zhejiang MRCC. Northern boundary line: It extends due north from 31 40′00″ N/121 55′00″ E to 33 00′00″ N/121 55′00″ E, and then extends due east along the latitude line of 33 00′00″ N. Southern boundary line: A: 30°41′32″N/121°16′00″E, B: 30°32′55″N/121°16′00″E C: 30°33′03″N/121°21′30″E, D: 30°28′49″N/121°42′30″E E: 30°32′00″N/122°16′00″E, F: 30°32′00″N/122°20′30″E G: 30°30′40″N/122°27′36″E, H: 30°28′00″N/122°27′36″E I: 30°28′00″N/122°32′48″E, J: 30°31′23″N/122°32′48″E K: 30°35′20″N/122°12′54″E, L: 30°44′20″N/122°16′58″E M: north end of Beiding Sing Tao, N: the northern end of huaniao mountain O: northern end of reef The above points are connected in sequence, and then extend from the northern end of the reef to the east.

Source: Shanghai Municipal People's Government (2017). *Shanghai Maritime Search and Rescue Emergency Plan (2017 Edition)*.Shanghai: author

However, the eastern boundary of SRR has not yet been officially announced by Shanghai Municipal People's Government. If the parallel lines at the north and south ends continue to extend eastward, they will approach South Korea and arrive in Japan. The map shown in Figure 17 is drawn according to the description of SRR in Shanghai.

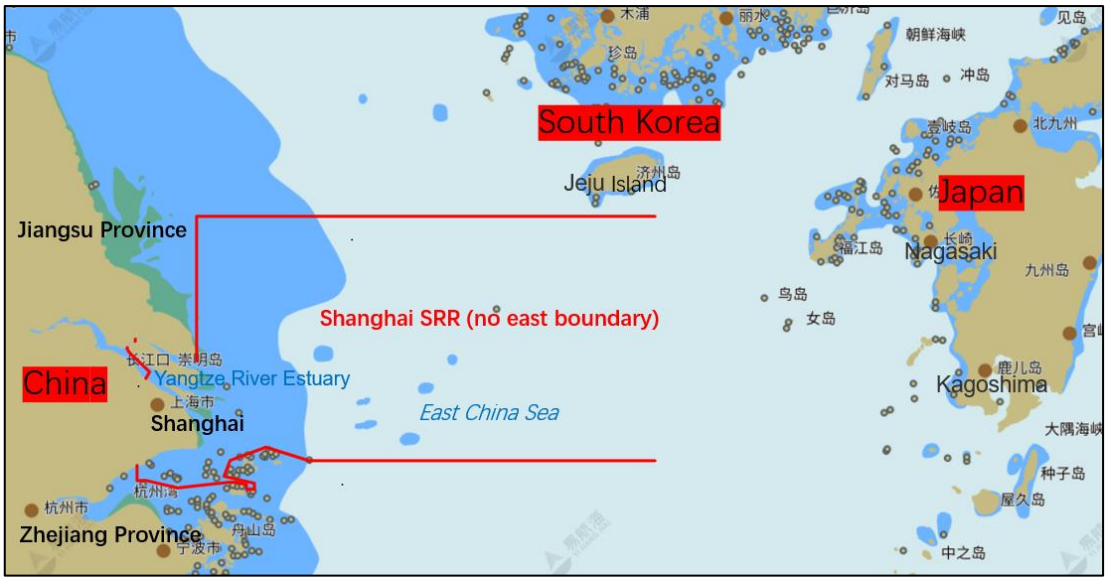

Figure 17: Shanghai SAR announced by Shanghai Municipal People's Government

Made by author, Dalian

4.1.2 Two views on the eastern boundary of Shanghai SRR

Obviously, there should be a dividing line to the east of SRR in Shanghai. However, the disputes between China, Japan and South Korea on the definition of continental shelf and exclusive e`conomic zone in the East China Sea makes the demarcation of SRR complicated (SUN, 2016, p.5-6).

On a global scale, after the entry into force of the "1979 International Convention on Maritime SAR", the Maritime Safety Committee of the IMO divided the world's

ocean into 13 SAR areas, and then each countries decided its own SRR (IMO,2021). During the research, I found two views on the boundary of Shanghai SRR, one comes from Canada, and the other one is from Chinese scholars.

According to the Department of Fisheries and Oceans of Canada and Canadian Coast Guard, they have given the SAR area demarcation line between China and Japan through a website, as shown in Figure 18(Fisheries and Oceans Canada & Canadian Coast Guard,2021).

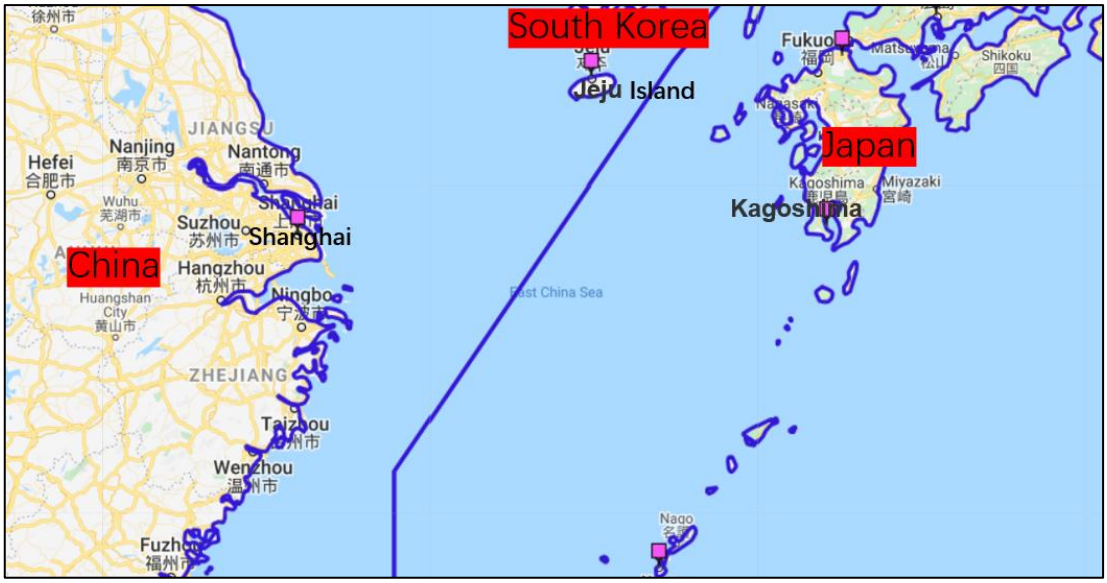

Figure 18 The search and rescue area demarcation between China and Japan

Source: Fisheries and Oceans Canada & Canadian Coast Guard (2021). *Website*

By measuring and positioning the sea map provided by Canada, I get the intersection points of the demarcation line and the eastward extension lines of Shanghai SRR at the north and south, which are 33°0'N/ 127°25'E, 30°44'N/ 125°50'E respectively.

On the other hand, in a jointly published thesis, Chinese scholars pointed out that the eastern boundary of China's SRR is the line of 126°E (WANG, LI, & ZHANG, 2014, p.5). The professors of law school of DMU also hold the same opinion (LI & WANG,

2015, p.98). Accordingly, I combine both the views and draw the Shanghai SRR in the East China Sea in Figure 19. The blue lines at the north and south ends represent the boundary line of SRR of the East China Sea. It should be noted that the eastern boundary of SRR of the East China Sea is not given too. Therefore, the blues lines in Figure 19 is schematic (WANG, LI, & ZHANG, 2014, p.16).

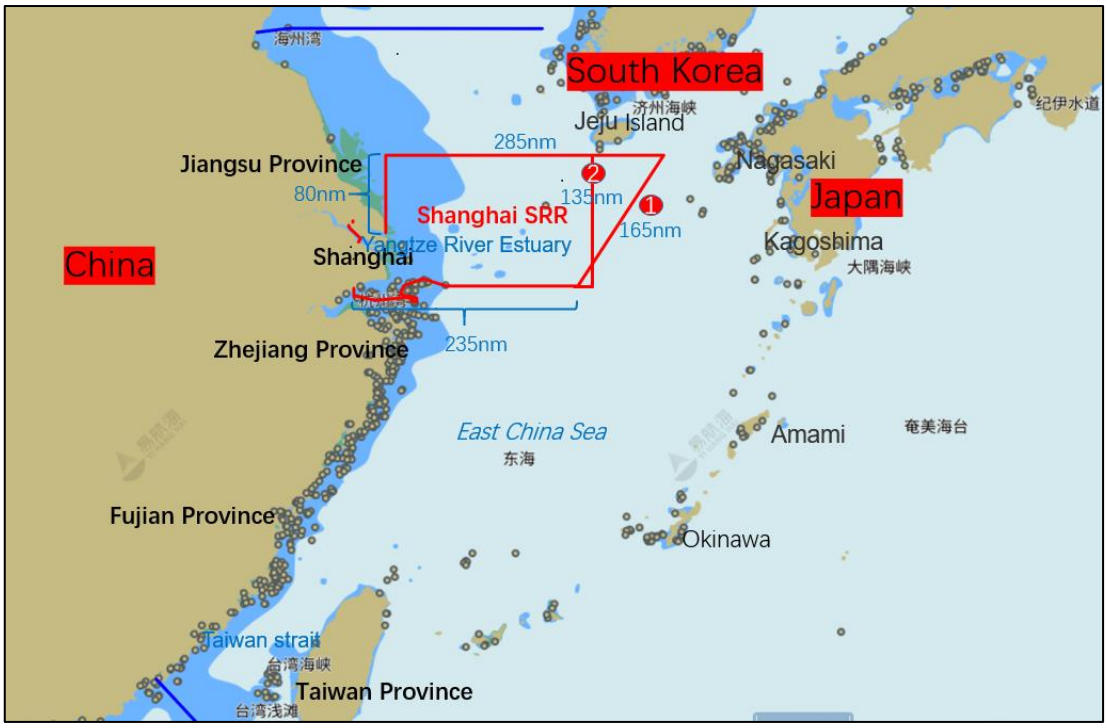

Figure 19: Two views on the eastern boundary of Shanghai SRR

Made by author, Dalian

From my opinion, line 1 reflects the perspectives of Canada's Fisheries and Oceans and the Canadian Coast Guard. The significance of this line is that it limits the farest distance of eastern boundary. In other words, this means that in the SRR formed by line 1, the responsibility of organizing SAR operation should be borne by Shanghai MRCC.

Line 2 represents the views of Chinese scholars, which implies that Shanghai MRCC

will be in charge of organzing SAR operations in the region to the left of line 2, and in the area to the right of line 2, it will be able to collaborate with appropriate nations to carry out SAR operations as a participant.

However, it should be noted that, thus far, Chinese officials have not endorsed or denied these two points of view. In China, the sole official statement is still that of the Shanghai Municipal People's Government. As mentioned earlier, although China had signed SAR agreements with Japan and South Korea respectively, the articles of both agreements only stipulate the working priciple of relevant SAR issues, such as co-coorperation, communication and so on. Most importantly, the agreements didn't refer to the specific area of SRR for each country. Therefore, the SRRs of three countries are still unclear at East China Sea.

4.1.3 A joint MRO organized by Shanghai MRCC

On January 6,2018, an extraordinary incident occurred in the East China Sea about 160 nautical miles east of Shanghai (30°51.1'N/124°57.6'E). The Panamanian oil tanker "MT Sanchi" with 111,510 tons of condensate oil collided with the Hong Kong bulk carrier "CF CRYSTAL". After the collision, 21 crew members of "CF CRYSTAL" abandoned the ship, all of whom were rescued by nearby fishing boats. However, the "MT Sanchi" caught fire immediately and out of control, drifted southeast. The distress situation of 32 crew members is uncertainty.

After receiving the distress alert, Shanghai MRCC immediately launched the emergency plan and start the level I response. It organized professional rescue and salvage force, patrol vessel of MSA, China Coast Guard and Fisheries Department to conduct MRO. In addition, Shanghai MRCC also informed the situation to the

MRCCs of Japan and South Korea, and coordinated Korea Coast Guard and Japan Maritime Self-Defense Force to jointly carry out MRO.

Throughout the 9-day SAR effort, China deployed more than ten ships to assist in the rescue on a daily basis. The rescue forces from Japan and Korean also made their biggest efforts. The fire, however, cannot be extinguished because of the condensate oil that spilled and the hull that burnt constantly. On January 14, the "Sanchi" exploded and sunk, with 3 dead and 29 missing. The sinking occurred at 28°22'N/125°55'E of the East China Sea (Maritime Safety Administration of P.R. China, 2018; MOTPRC, 2018b). Figure 20 depicts the distance between the distress point and the sinking position.

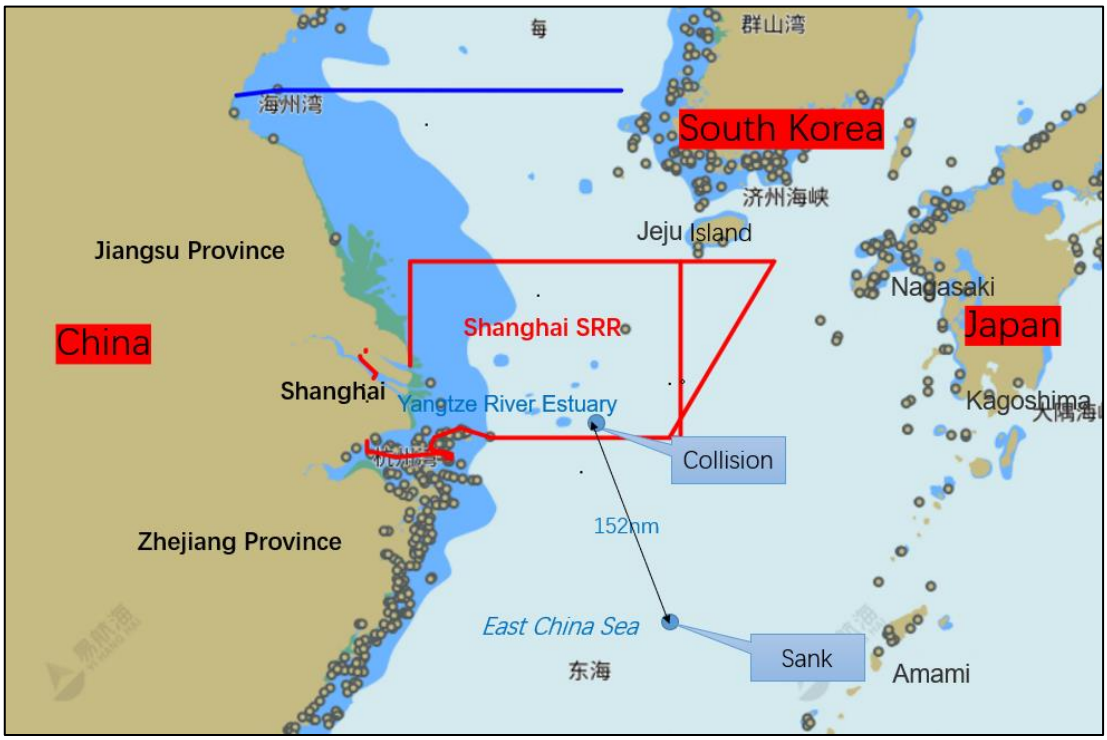

Figure 20: The distance between the distress point and the sinking position of "MT Sanchi"

Made by author, Dalian

Combined with the previous introduction of Shanghai SRR and the “MT Sanchi” MRO case organized by Shanghai MRCC, we can sum up three points:

Firstly, according to the geographical location of Shanghai, the ability of Shanghai MRCC to organize SAR facilities will be fewer and fewer as the rescue scene is more far away from the land.

Secondly, no matter the Shanghai SRR is formed by line 1 or line 2, from the practical work point of view, I think that Shanghai MRCC should prepare to carry out SAR mission in two attitudes, one is completely self-lead, and the other is organized regional joint SAR operations in Shanghai SRR.

Thirdly, Shanghai MRCC organized the SAR operation in the waters where the distress location was 30°51.1’N/124°57.6’E, and coordinated joint rescue operations with Japan and South Korea. This indicates that, in practice, the Shanghai MRCC is in charge of the emergency response in this region. Furthermore, the “MT Sanchi” MRO case also demonstrates that China, Japan, and South Korea have the foundation and desire of collaboration in the Shanghai SRR’s eastern area.

4.2 Cruise activities in Shanghai SRR

4.2.1 Cruise routes deployed in Shanghai SRR

According to emergency management theories, the first step in properly preparing for MRO in Shanghai SRR is to completely comprehend the risk sources in the jurisdiction. Based on this, I classified cruise ship routes with Shanghai as the port of departure or call between the second half of 2021 and the first half of 2023, as shown

in Figure 21 (CruiseCritic, 2021a; CruiseCritic, 2021b).

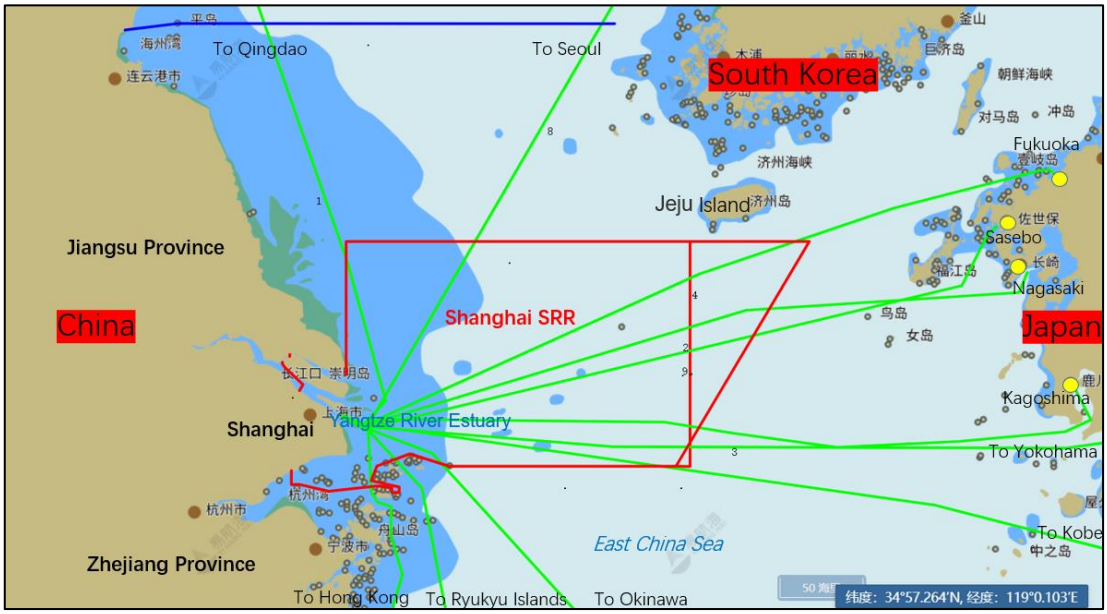

Figure 21: The second half of 2021 to the first half of 2023 cruise routes within Shanghai SRR

Made by author, Dalian

Source: CruiseCritic, 2021a; CruiseCritic, 2021b. *Website*

As shown in the Figure 21, in Shanghai SRR, there are 11 cruise routes (green lines) that connect in the Yangtze River Estuary and then sail to three directions via the East China Sea. There are two northbound routes, one to Qingdao, China, and the other to Seoul, South Korea. The most routes are eastward, with a total of six, all of which sail to main Japanese port cities. Okinawa, the Ryukyu Islands, and Hong Kong are the three southbound destinations.

4.2.2 Cruise ships operated in Shanghai SRR

I sorted out a list of cruise ships when sorting out the routes, and collected the basic information of cruise ships in Table 9 by visiting the websites of relevant cruise firms.

The cruise ship with an asterisk (*) is operated with Shanghai as departure port, others are sailing to Shanghai as port of call.

Table 9: Cruise activity in Shanghai from the second half of 2021 through the first half of 2023

No	Cruise Ship	Cruise Company	Maximum passengers capacity	Crew	Total on board	Gross tons	Length	In service
1	*Wonder of the seas	Royal Caribbean International	6,730	2,394	9,124	228,000	362	2022 (to be deployed)
2	*Spectrum of the seas	Royal Caribbean International	5,549	1,551	7,100	168,000	347	2019
3	*Queen Elizabeth	Cunard Line	2,547	1,005	3,552	90,901	294	2010
4	Norwegian Sun	Norwegian Cruise Line	2,400	906	3,306	78,309	258	2001
5	*AIDAbella	AIDA Cruises	2,500	646	3,146	69,203	251	2008
6	Westerdam	Holland America Line	1,964	800	2,764	81,811	285	2004
7	Noordam	Holland America Line	1,916	800	2,716	82,500	285	2006
8	Zaandam	Holland America Line	1,432	615	2,047	61,396	237	2000
9	Seven Seas Explorer	Regent Seven Seas Cruises	750	552	1,302	55,254	223	2016
10	Nautica	Oceania Cruises	824	386	1,210	30,277	181	2000
11	Seven Seas Mariner	Regent Seven Seas Cruises	700	445	1,145	48,075	216	2001
12	Silver Muse	Silversea Cruises	596	411	1,007	47,791	212	2017
13	Seabourn Odyssey	Seabourn Cruise Line	450	335	785	32,346	198	2009
14	*Seabourn Sojourn	Seabourn Cruise Line	450	335	785	32,346	198	2010
15	Silver Shadow	Silversea Cruises	388	295	683	28,258	186	2000
16	Silver Whisper	Silversea Cruises	382	295	677	28,258	190	2001

Made by author, Dalian

Source: Relevant Cruise companies' website

According to the Table 9, the 16 cruise ships are operated by 9 cruise companies, all of which are international cruise companies. Five of the 16 cruise ships with Shanghai as their departure port, while the remaining cruise ships will call at Shanghai along the way.

According to a cruise ship size classification method, cruise ships can be divided into five categories, which are: mega (above 3,500 passengers), giant (2,500-3,499 passengers), midsized (1,500-2,499 passengers), small-mid (800-1,499 passengers), and small cruise ships (less than 799 passengers) (CruiseCritic, 2020). As a result, I categorized these 16 cruise ships by using the standard and create Table 10.

Table 10: Classification of 16 cruise ships within Shanghai SRR

Classification	Number of ships	Average total people on board	Average gross tons
Mega Ships	2	8,112	198,000
Large Ships	2	3,349	80,052
Midsized Ships	3	2,929	80,873
Small-Mid Ships	2	1,629	45,837
Small Ships	7	912	38,904

Made by author, Dalian

Table 10 shows that regardless of the type of cruise ship, the number of passengers and crew on board is massive. According to data, CMRCC-organized and coordinated SAR operations saved more than 150,000 people in distress between 2011 and 2020, with an average of more than 15,000 lives saved per year. In 2020, the CMRCC successfully saved 10,834 people by organizing and coordinating SAR missions. At the same year, Shanghai MRCC successfully rescued 1,632 people (Huanqiu Net, 2021; CCTV news, 2021; Sohu, 2020).

Therefore, when the entire year's SAR data is compared to the number of people on cruise ships, it is clear that if any single cruise ship is in distress and causes mass casualties or requires evacuation, it would be a catastrophe to local government and a significant challenge to the country.

4.3 Shanghai maritime SAR regulatory system

At present, by retrieving from the website of MOTPRC and Shanghai Municipal People's Government, there are four major official documents on maritime SAR in Shanghai, which are shown in Table 11.

Table 11: Major maritime SAR regulatory documents in Shanghai

Type	Document name	Enter into force (year)
Regional emergency joint mechanism	Water search and rescue cooperation and linkage mechanism in the Yangtze River Delta region	2020
Local regulatory document	Shanghai maritime SAR Management Measures	2013
Governmental policy	Implementation Opinions on Strengthening the Construction of Water SAR system in Shanghai	2018
Emergency plan	Shanghai Maritime SAR Emergency Plan	2017

Made by author, Dalian

Source: CMRCC (2020); Shanghai Municipal People's Government (2021). *Official website*

In the "Shanghai maritime SAR emergency plan", it regulates "*Shanghai MRCC is the emergency commanding body of Shanghai's maritime emergency response work, and its director is the deputy mayor in charge.*" The members of the Shanghai MRCC include 26 units, such as the Donghai Rescue Bureau, the Shanghai Salvage Bureau, and the East China Sea Branch of the China Coast Guard etc.

The plan requires Shanghai MRCC to set up a technical advisory body to provide decision-making advice and technical services for response to maritime incidents. Furthermore, the plan governs the emergency response procedure, the appointment of an OSC, the mobilization of SAR facilities, aftercare, and so on, particularly the emergency support section, which is divided into meteorological and hydrological services, personnel safety, emergency resource allocation, communication support, medical first aid, public safety, financial support, information dissemination, and so on. The framework of Shanghai SAR organizational system is depicted in Figure 22.

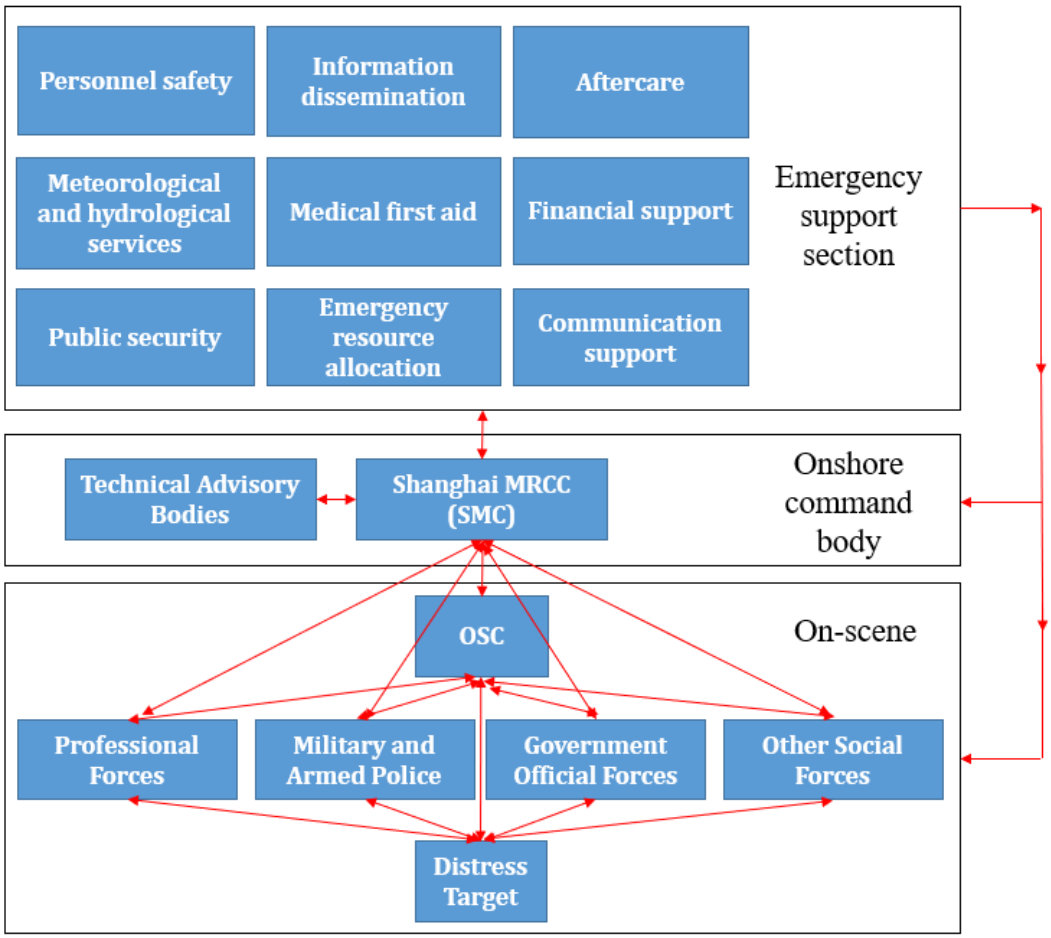

Figure 22: The framework of Shanghai SAR organizational system

Made by author, Dalian

The maritime SAR operation has its own labor division. As seen in Figure 22, the MRCC is in charge of coordinating numerous agencies and playing a critical role in the entire process. SMC, in particular, serves as the SAR mission's communicator, coordinator, and leader, which is one of the most crucial positions for successfully executing maritime SAR missions.

4.4 Professional search and rescue forces in Shanghai SRR

Shanghai's professional search and rescue forces are the subordinate organization of

Rescue and Salvage Bureau of MOT, which are Donghai Rescue Bureau and Shanghai Salvage Bureau, they are both based in Shanghai. The responsible area of the Donghai Rescue Bureau is as same as the area of SRR of the East China Sea (MOTPRC, 2010).

4.4.1 The professional rescue ships of Donghai Rescue Bureau

According to TIAN (2018), the Donghai Rescue Bureau deployed 25 professional rescue ships and 6 diving emergency teams in the East China Sea from north to south, and has established 8 rescue bases in Lianyungang, Shanghai, Zhoushan, Ningbo, Wenzhou, Fuzhou, Putian, and Xiamen. Furthermore, there are 29 rescue ship standby points, 7 of them are important standby points, including Donghai No.1 (off the coast of Lianyungang), Donghai No.2 (Jigujiao in the Yangtze River estuary), Zhoushan No.4 Xiashimen, Wenzhou Dachen Island, Fuzhou Dinghai Bay, Pingtan Caoyu, and Xiamen, and 8000 kW and above marine rescue vessels are deployed all year round.

Figure 23 depicts the Donghai Rescue Bureau’s rescue fleet. The Donghai Rescue Bureau’s main professional rescue ships (two 14000 KW, one 12000 KW, seven 8000 KW, and one 6000 KW) have a maximum speed of 18-22 knots and an endurance of 10000-14000 nm. They can be dispatched in class 9 (wind 12, wave height 14m) and class 6 (wind 12, wave height 14m) sea conditions (wind power level 9, wave height 6m). All of them outfitted with fire monitors, high-speed rescue boats, life-saving hanging baskets, hanging life rafts, photoelectric tracking systems, and other specialized rescue equipment. The helicopter-landing platforms are provided for rescue ships with 8000 kW and above capacity. The marine rescue ships "Donghai jiu 101" and "Donghai jiu 102" in particular not only perform maritime

SAR, but also have a shipborne helicopter hangar that can carry S-76D rescue helicopters to conduct rescue operations.

Figure 23: Professional rescue ships of the Donghai Rescue Bureau

Source: Internet

4.4.2 The professional rescue helicopters of Donghai Rescue Bureau

Donghai Rescue Bureau equipped with ten large and medium-size rescue helicopters, The East China Sea First Rescue Flying team has deployed six rescue helicopters in Shanghai and one in Wenzhou. The East China Sea Second Flying Rescue Team has deployed two rescue helicopters in Fuzhou and one in Xiamen. The Zhoushan Archipelago is a new landing base with rescue helicopter deployment, and only serves as a transfer flight to the East China Sea First Rescue Flying Team. Rescue

helicopters have the speed (144-155 knots) and flexible route characteristics when carrying out SAR missions, but the rescue range is relatively limited. Figure 24 shows the status of professional rescue helicopter.

Figure 24: Professional rescue helicopters of Donghai Rescue Bureau

Source: Internet

Figure 25 depicts the configuration of Donghai Rescue Bureau SAR facilities, as described in the preceding introduction. The yellow region with a radius of 110 nm, centered on the flight rescue base, represents the rescue helicopter's rescue range (State Council, 2010).

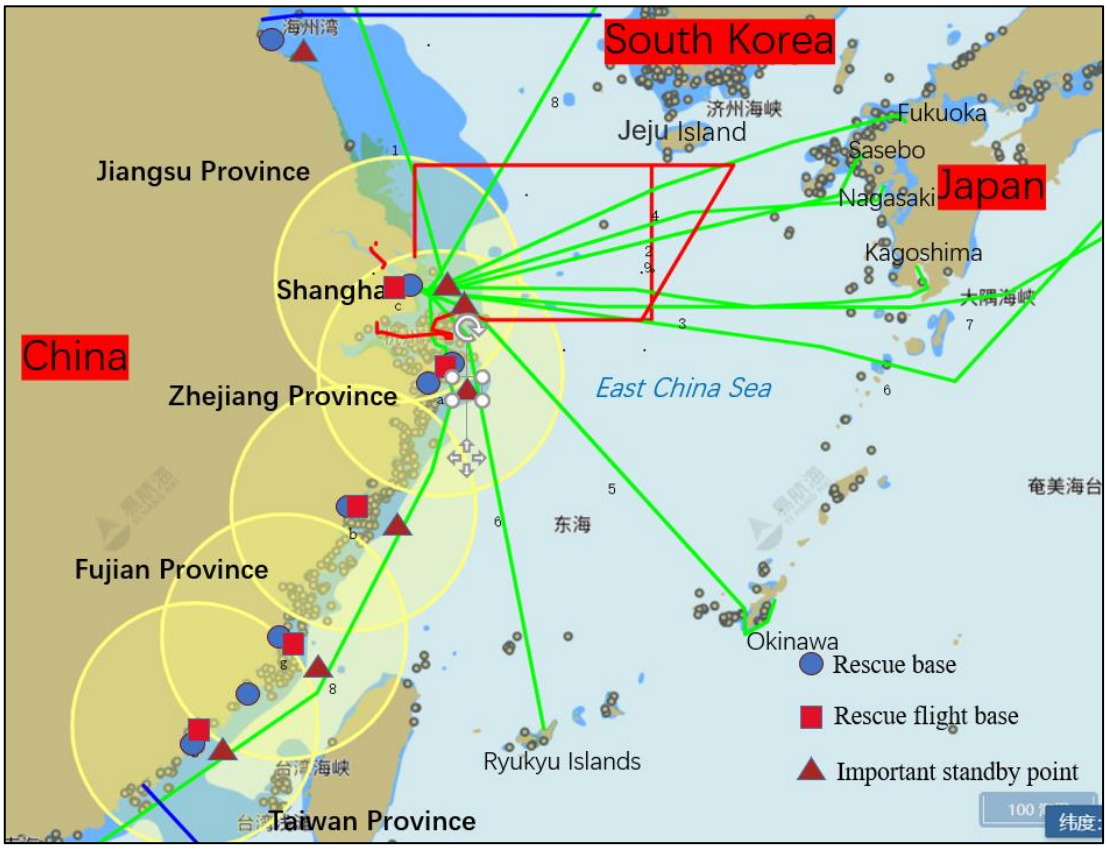

Figure 25: The layout of rescue facilities of Donghai Rescue Bureau at East China sea

Made by author, Dalian

4.4.3 The professional salvage forces of Shanghai Salvage Bureau

Shanghai Salvage Bureau has 48 large lifting boats, diving support boats, high-power tugboats, and a wide range of engineering divers. Figure 26 depicts the main ships of the Shanghai Salvage Bureau. According to the requirements of the "Implementation Opinions on Rescue Linkage of the Salvage Bureau of the Ministry of Transport," in order to fully exploit the overall advantages of the rescue and salvage forces, salvage units should assist and cooperate with professional rescue forces to execute rescue missions if necessary (TIAN, 2018, p.22).

Figure 26: Main vessels of Shanghai Salvage Bureau

Source: Internet

4.4.4 Capability assessment of professional rescue forces in Shanghai SRR

The Donghai Rescue Bureau has deployed a rescue base (with a diving emergency team on standby), a rescue flight base, and two important rescue ship standby points (Donghai No.1 and Donghai No.2) in Shanghai SRR, giving Shanghai SRR trinity rescue capacity on the air, water surface, and underwater. In addition, near the north and south ends of Shanghai SRR, several rescue bases and important ship standby points have been stationed, which may be dispatched to support SAR operations in Shanghai SRR if necessary. Figure 27 depicts the deployment of professional rescue forces in Shanghai SRR.

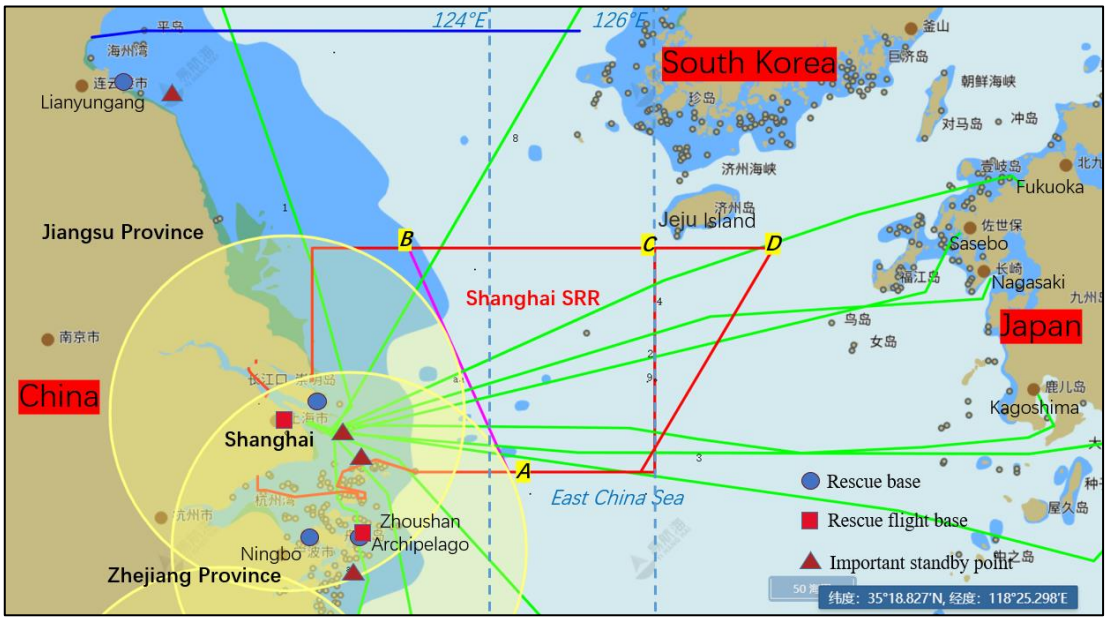

Figure 27: The deployment of Donghai Rescue Bureau forces in Shanghai SRR

Made by author, Dalian

As shown in the Figure 27, the yellow area represents the area that can be covered by rescue helicopters. The line segment AB is tangent to the two areas, and the rescue area to the west of AB connection line is almost fully covered by rescue helicopters. In this area, not only the trinity rescue can be realized, but also the timeliness is better because it is close to the deployment position of rescue forces. If the rescue helicopter's speed is calculated at a speed of 144Kt and the rescue ships is 18Kt, it will only take rescue helicopter 45 minutes to reach any position of the yellow area. For the nearest rescue ships, it will take about 4-6 hours to reach any point on AB connection line. Therefore, the area to the west AB connection of Shanghai SRR is the strong side of rescue capability.

On the other hand, only surface rescue and underwater rescue can be dispatched to the eastern area of AB connection line, and with the eastward extension, the rescue ship will have a longer voyage, which will cost more time to arrive the rescue scene.

Through calculation, it will take 12 hours for the nearest rescue ship to reach point C and 16 hours to point D. In addition, as shown in Figure 28, the difficulty and efficiency of underwater operation will be further reduced due to the increasing depth of sea (from 30-110 m). Therefore, the professional rescue ability in the area to the east of AB connection line will be weakened with the eastward movement.

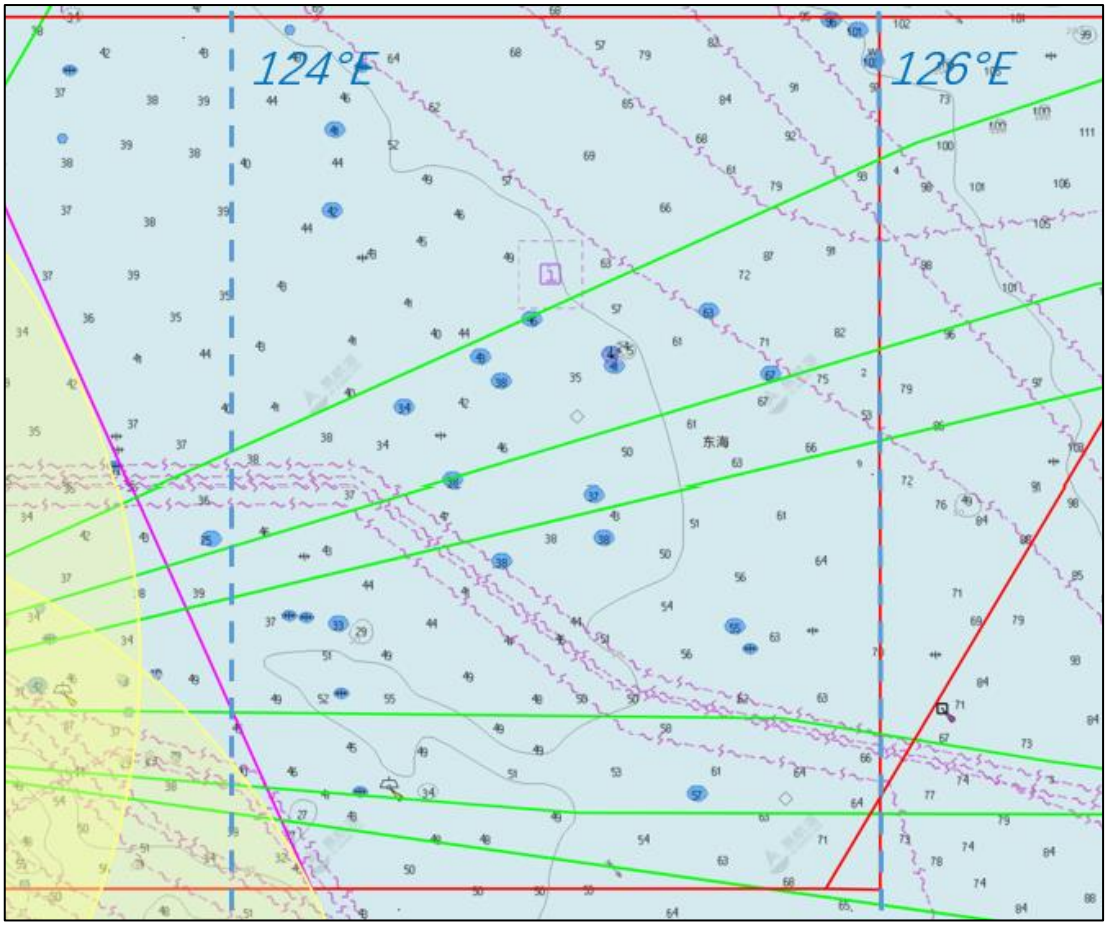

Figure 28: Variation of water depth in east part of Shanghai SRR

Made by author, Dalian

4.5 Chapter summary

This chapter discusses the relevant situation of the Shanghai SRR, which is divided into four aspects:

Firstly, it introduces the Shanghai SRR area, compares two different views on the eastern boundary of Shanghai SRR. And, demonstrates the characteristics of Shanghai SRR by discussing the “MT Sanchi” MRO case in 2018.

Secondly, it analyzes the risk sources in the Shanghai SRR, sorts out the deployment of cruise routes and cruise ships, and emphasizes the difficulty and potential serious consequences of cruise ship MRO.

Thirdly, it collects the Shanghai Municipal People’s Government’s regulatory documents on SAR work and describes the framework of Shanghai SAR organizational system.

Finally, it introduces the deployment of professional rescue and salvage forces in Shanghai SRR. Furthermore, comparing, analyzing, and evaluating the rescue capabilities in the air, water, and underwater.

CHAPTER 5 ADVICES FOR MASS RESCUE OPERATION

5.1 Enhance the communication and cooperation mechanism

5.1.1 Develop international communication with major countries

During my research, I discovered that there is a significant gap in the depth and width of MRO research between Chinese officials, scholars and internationals. At the government level, the USCG places a high value on MRO's readiness and response. The USCG has treated MRO as a distinct subject and conducted extensive research on it. In 2004, the USCG published the "Mass Rescue Operations Planning Guidance". After that, it developed the "Coast Guard Mass Rescue Operations (MRO) program" in 2010. (USCG, 2004; USCG, 2010). In addition, the NSARC published the "United States national search and rescue supplement to the international aeronautical and maritime search and rescue manual version 2.0" in 2018, which included extensive discussion of MRO (US NSARC, 2018).

At the academic research level, a large number of high-quality articles about MRO were published in the USCG's "journal of safety and security at sea" as early as 2011. Some scholars have even discussed MRO in greater detail, such as the topic of thermal requirements for survival in MRO or the importance of developing an MRO culture, and so on (Renee, B, Stephen, & Mak, 2010; Gorgol, 2012). However, the only official research result on maritime MRO in China is the "Manual of mass rescue operation on cruise ships". In terms of the academic research, as far as I know, it's very few. CHEN held the same view on this (2017, p.12-14).

As a result, I believe the government should focus more on MRO. Make active use of the IMO, IMFR, and other international forums to improve exchanges and

collaboration with major countries. Collaborate with the United States and European countries in particular. Because their cruise business is highly active, they have greater experience with cruise ship MRO mitigation and preparedness.

5.1.2 Promote regional cooperation with Japan and South Korea

According to the preceding chapter's research, the eastern border of Shanghai SRR has not been defined owing to disputes in this sea area between China, Japan, and South Korea. Given the relatively limited coordinated SAR facilities of the eastern Shanghai SRR, as well as the precedent that China, Japan, and South Korea collaborated to carry out MRO of "Sanchi" in this region in 2018, I propose that, on the basis of the China-South Korea Maritime SAR Agreement and the China-Japanese Maritime SAR Agreement, China could explore ways and means to further strengthen cooperation with these two states.

From my opinion, there are three motivations to doing so. One is consistent with the objective fact of the disputed seas in the East China Sea. The other is that via collaboration, Japan and South Korea's search and rescue capabilities may be helpful to compensate for the inadequacy of SAR capability in Shanghai's eastern SRR. Third, eliminate any mechanism obstacles that may impede SAR operations in the Shanghai SRR's eastern sea zone, allowing SAR to function more efficiently and protect lives at sea.

5.1.3 Optimize trans-provincial emergency joint response mechanism

Since it is closer to the land, the western area of Shanghai SRR will have more adequate SAR resources, quicker response, and stronger SAR mission competence. However, execute the MRO into action in the case of a cruise ship incident remains

exceedingly difficult and challenging. As an example, consider the “Oriental Star”. At the time, State Council Premier LI Keqiang and Vice Premier MA Kai personally went to the scene to command the rescue operations and coordinate various resources from the central and local governments.

Since Shanghai’s cruise activities are so busy, in my opinion, Shanghai should have a stronger incentive to take the initiative to strengthen the mitigation and preparedness of cruise ship MRO. The “Water SAR cooperation and linkage mechanism in the Yangtze River Delta region” was recently announced and put into action. It is regulated that Shanghai will participate in joint maritime SAR operations with bordering provinces Jiangsu and Zhejiang under this framework (CMRCC, 2020).

As a result, in order to increase the capacity reserve for carrying out MRO operations on cruise ship incidents, I suggest that Shanghai should strengthen cooperation with neighboring provinces in SAR notification, emergency resource allocation, SAR facilities sharing, and other areas based on the cooperation framework.

5.2 Reinforce professional air rescue capability

5.2.1 Current deficiency of rescue helicopter

At the moment, there are two main aspects for rescue helicopter to reinforce: one is the ability to respond to emergencies at all time, and the other is to improve the rescue coverage range. According to TIAN (2018, p.21), “*rescue helicopter can implement effective life rescue under complex weather conditions in the daytime*,” but that does not include night. CRS has recently actively promoted helicopter night flight training and has formed a specific night flight capability. However, compared to daytime rescue capability, the nighttime rescue performance of rescue helicopters

needs to be further improved through training and actual practice.

The other aspect is to improve the range of rescue coverage. As previously stated, helicopters are unable to cover the eastern of SRR in Shanghai. According to information released by the Donghai Rescue Bureau, in order to improve the rescue capacity of the distant sea, the Donghai Rescue Bureau has planned to promote the training task of ship-borne helicopters and has achieved preliminary results (Donghai Rescue Bureau, 2020). However, until now, ship-borne helicopter rescue has not been a common rescue method. The main reason for this is that the ship-borne rescue helicopter has strict requirements for getting in and out of the hangar, taking off, mooring, and refueling at sea, one of which is the requirement of the ship's motion state. Table 12 shows the requirements for ship motion state under various helicopter operating conditions (XIE & ZHOU, 2016, p.44).

Table 12: The requirements for ship motion state under different operating conditions of rescue helicopter

Rescue helicopter operation contents	Ship motion state		
	Heel	Trim	Wind speed (m/s)
Take-off and landing	<±5°	<±2°	<20 (Upper limit of Gale)
Hovering and hoisting operation	<±8°	<±2°	<20 (Upper limit of Gale)
Safety mooring	<±15°	<±4°	<25 (Lower limit of Storm)
Safe parking of hangar	Under the wind speed of Hurricane (37m/s) , the helicopter is safely tethered and stored in the hangar		

Made by author, Dalian

Source: XIE & ZHOU (2016). *Discussion on shipboard work of rescue helicopter.* Yantai

Obviously, at sea, the meteorological and sea conditions are highly uncertain, and the ship's motion state cannot guarantee that the conditions for rescue helicopters to take off and land are suitable at all time. As a result, the development of ship-borne rescue

helicopters as a reliable distant sea rescue mode is hampered by current technical and equipment constraints.

5.2.2 Suggestions on reinforcing the air rescue capability

To improve night flight rescue capability, the government, in my opinion, should continue to increase financial support to enhance the intensity and frequency of night flight training, eventually achieving the goal of rescue helicopters performing SAR missions all time.

In terms of distant sea rescue, we can learn from Japan by developing amphibious aircraft while maintaining the existing mode of ship-borne aircraft. The Japan Coast Self-Defense Force currently equips US-2 short take-off and landing (STOL) SAR Amphibians. According to the manufacturer's introduction, the maximum range of the aircraft is over 2,500 nm, and the speed is 315Kt. It can perform tasks such as SAR, material transportation, and wounded transfer on land or water. This type of aircraft, when equipped, can effectively supplement the distant sea rescue capability (Naval Technology, 2021; ShinMaywa Industries, 2021). The SAR process of US-2 STOL SAR Amphibians is depicted in Figure 29.

Figure 29: The SAR process of US-2 STOL SAR Amphibians

Source: ShinMaywa Industries, Ltd (2021). *Website.* Japan, author

Furthermore, local MRCC can consider coordinating fixed offshore facilities (such as oil platforms) as temporary take-off, landing and refueling points for helicopters, which can broaden the scope of rescue by allowing rescue helicopters to fly secondary missions. This proposal has some universality, but it is also dependent on the specific conditions in each SRR and the needs of the MRCC. Unfortunately, I couldn't find any fixed offshore facilities in the East China Sea that could meet the needs of Shanghai SRR until now.

5.3 Strengthen the construction of regulations and plans

5.3.1 Formulate regulations to enhance mitigation

In the Chapter 1 of MRO learning materials in library of IMRF, it quoted Kenneth Watt's views to depicts the importance of preparedness: "*It is worth taking action in advance to deal with disasters,*" "*The costs of doing so are typically inconsequential, measured against the losses that would ensue if no such action were taken. The magnitude of disasters decreases to the extent that people believe that they are possible, and plan to prevent them or to minimize their effects.*" (IMRF, 2021).

As previously mentioned, the first stage in emergency management is mitigation. In accordance with the working principle of "mitigation is better than rescue," the government and stakeholders should strengthen risk control and management through safety early warning, risk identification, material guarantee, emergency plans, and drills in order to avoid passenger ship accidents through prevention.

5.3.2 Stipulate MRO emergency plan

At the moment, China implements MRO by the existing maritime SAR regime and treats it as the level I response, without a set of MRO-specific emergency plans. Looking back, China has successfully completed many maritime MRO cases. However, Lee and Janelle pointed out, one of the MRO realities is "past success does not guarantee future results." (2011, p. 33). We can't help but ask, is it still good to continue to operate according to the existing SAR regime?

It must be noted that, current ships are becoming larger in size and stronger in carrying capacity. The SAR challenges posed by maritime incidents are becoming bigger than ever. Given that the "National Maritime SAR Emergency Plan" was

developed in 2006, it might be necessary to upgrade some specific aspects, to optimize the mitigation and preparedness for the newer and greater challenges under the framework of China maritime SAR regime, such as maritime MRO.

The good news is that the CMRCC has taken a significant step forward in publishing the "Manual of mass rescue operation on cruise ships" in 2020. As a result, based on the characteristics of their respective SRR jurisdictions, I believe the provincial MRCCs should also develop relevant emergency plans and make thorough emergency preparedness. Shanghai, in particular, a port city with a thriving cruise industry, should prioritize the cruise ship MRO challenge.

5.4 Promote the cultivation of SMC profession

According to the definition of Article 1.2 in Chapter 1 of the IAMSAR Manual Volume 2, "*SMC is a temporary official assigned to coordinate the response to an actual or obvious distress situation.*" (IMO & ICAO, 2016) As the complexities of SAR operations, SMC must have extensive professional knowledge and be able to deal with complex information in a calm and rational manner. However, according to a survey of 196 employees from 13 provincial MRCC, it reveals some shortcomings: Firstly, SMC is mostly made up of part-time employees, the majority of whom work as VTS attendants. This is in contrast to the Manual's recommendation that SMC be professionals who can make the correct professional response at once. Secondly, SMC lacks a systematic training program, a training plan, and a system for teacher selection and training. Finally, 92 percent of the staff has been with SMC for less than ten years, which indicating that the SMC team is not stable enough (TANG & LI, 2016, p.28).

Therefore, for the purpose of better construction of SMC talents, from my standpoint, the MRCC can further refine job division or responsibilities, and set up full-time SMC posts, with appropriate personnel serving as full-time SMC for an extended period of time. Also, the MRCC should organize the development of SMC competency standards and the establishment of a SMC training system, theoretical teaching, case analysis, practical operation, and evaluation should all be used to improve training. Furthermore, relevant departments should develop or revise policies to clarify the administrative or professional title level of SMC and make beneficial policies to ensure the stability of SMC team.

5.5 Chapter summary

This chapter primarily makes four recommendations for improving maritime MRO work:

Firstly, for improve MRO's coping capability, government should pay more attention to MRO. The international, regional and trans-provincial exchanges and cooperation mechanism need to be established and optimized.

Secondly, it is suggested that air rescue capability be improved. This dissertation examines the shortcomings of current air rescue capability at all time and distant sea rescue, and proposes suggestions on training, equipment, and cooperation mechanism.

Thirdly, it is suggested that MRO rules and regulations be strengthened. In light of the current trend of large-scale ships, it is proposed that SAR authorities update relevant rules and regulations, and that provincial MRCCs prioritize and strengthen the development of MRO emergency plans.

Finally, the training of SMC professionals should be strengthened. In conjunction with the current SMC situation and the IAMSAR Manual requirements, it is suggested that the optimization measures from post-establishment, training and support policy be stipulated.

CHAPTER 6 CONCLUSION

At the moment, the global cruise market is thriving, and China's cruise market, represented by Shanghai, is expanding rapidly. With the growing popularity of large-scale cruise ships and intense cruise activity, the risk of maritime cruise ship incidents rises sharply, necessitating new and higher requirements for maritime SAR work and SAR capability.

Although MRO is a low-probability, high-consequence event, this dissertation emphasizes the need of mitigation and preparedness of cruise ship MRO incident. This dissertation introduces the framework of maritime SAR regime in China and Shanghai in detail. Combined with the activities of cruise ships, it evaluates the professional rescue capability, identifies shortcomings, and proposes some countermeasures for Shanghai SAR work, such as strengthening international, reginal, trans-provincial exchanges and cooperation, and strengthening the top-level design of MRO on the basis of fully analyzing the characteristics of SRR.

The highlights of this dissertation are the in-depth discussion of the concept of MRO, clarifying clearly all five organizational adjustments since the establishment of the National inter-joint meeting of maritime SAR, fully analyzes the current situation and characteristics of Shanghai SRR, and demonstrates it more intuitively and accurately with the help of cases and charts. I hope this dissertation can contribute some valuable research results to the mitigation and preparedness of maritime MRO in China, and that the government will pay more attention to responding to potential cruise ship MRO, so that the marine economy and people's leisure tourism can take place in a safer environment and with a more solid guarantee.

REFERENCE

BEI, S. (2013). The capacity of the country for emergency response to major maritime oil spills greatly promoted-The First National Joint-Ministry Meeting for Emergency Response to Major Maritime Oil Spills held. *China Maritime Safety*, 61-62.

Burgess, C. (2011). Mass Rescue Operations. *The Coast Gurads Journal of Safety& Security at sea*, 68 (3), 34-39.

Button, R., & Gorgol, T. (2020). Understanding the challenge: Mass Rescue Operations at Sea. In M. H. Norquist, J. N. Moore, & R. Long, *Cooperation and Engagement in the Asia-Pacific Region*, 356-390.

CCCPC. (2018). *Deepening the Reform Plan of the Party and State Institutions.* Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/gongbao/content/2005/content_64263.htm

CCCPC, & State Council. (2019). *Outline for the Construction of Nation with Strong Transportation System*. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/zhengce/2019-09/19/content_5431432.htm

CCTV news. (2021). *Ministry of Transport: Last year, China successfully rescued 10,834 people in distress at home and abroad.* Retrieved from Baidu: https://baijiahao.baidu.com/s?id=1700878984691968834&wfr=spider&for=pc

Cheer, J. (2020). Not drowning, waving: Where to for cruise tourism post-COVID-19? *Monash Lens, 21*, 1-9.

CHEN, Y. (2017). *Research on maritime Mass Rescue Operation(MRO) in China*. Unpublished master's thesis, World Maritime University, Malmö, Sweden.

Embassy of the People's Republic of China. (2021). *Land and resources*. Retrieved from chinaembassy: http://www.chinaembassy.se/chn/ljzg/t98558.htm

CLIA. (2020). *2019 Global Market Report.* Retrieved from Cruise Lines International Association: https://cruising.org/-/media/research-updates/research/2019-year-end/updated/2019-global-market-report.ashx

CLIA. (2021). *State of the Cruise Industry Outlook 2021.* Retrieved from Cruise Lines

International Association: https://cruising.org/-/media/research-updates/research/2021-state-of-the-cruise-industry_optimized.ashx

CMRCC. (2020). *Water search and rescue cooperation and linkage mechanism in the Yangtze River Delta region was issued and implemented*. Retrieved from MOT: https://zizhan.mot.gov.cn/sj2019/soujiuzx/gongzuodt_sjzx/202011/t20201103_3483693.html

CMRCC. (2021a). *China Maritime Search and Rescue Annual Report (2020)*. Beijing.

CMRCC. (2021b). *Member units of the national inter-ministerial joint meeting of maritime SAR*. Beijing.

CMRCC, TianjinMRCC, & DMU. (2011). *National Maritime Search and Rescue Manual.* Dalian Maritime University Press.

CNMRCC, & TIAN Jin MRCC. (2020). *The Manual of mass rescue operation on cruise ships.* Beijing.

Compilation Committee of Shanghai Salvage Records. (1997). The shipwreck of the Baltic Sea Cliff. In Compilation Committee of Shanghai Salvage Records, *Shanghai Salvage Records.* Retrieved from Shanghai chorography office: http://www.shtong.gov.cn/Newsite/node2/node2245/node70962/node70977/node71005/userobject1ai75019.html

Cornillou, Jean-Charles. (2021a). *CMC2021_Introduction [handouts]*. France.

Cornillou, Jean-Charles. (2021b). *SAR_organization_China [handouts]*. France.

CruiseCritic. (2020). *What's the Best Cruise Ship Size for You?* Retrieved from CruiseCritic: https://www.cruisecritic.com/articles.cfm?ID=360

CruiseCritic. (2021a). *Cruises from Shanghai to Shanghai*. Retrieved from CruiseCritic: https://www.cruisecritic.com/cruiseto/cruiseitineraries.cfm?portofcall=582&depcity=208

CruiseCritic. (2021b). *Cruises to Shanghai*. Retrieved from CruiseCritic: https://www.cruisecritic.com/cruiseto/cruiseitineraries.cfm?portofcall=582&page=1

Dias, M. O., & Lopes, R. O. (2020). Case on Cruise Ship Failure Services: Onboard. *Arabian Journal of Business and Management Review (Kuwait Chapter), 9 (1)*, 10-19.

Donghai Rescue Bureau. (2020). *The Donghai Rescue Bureau successfully completed the second maritime training mission of ship-borne helicopters in 2020*. Retrieved from The Paper: https://www.thepaper.cn/newsDetail_forward_9584018

Dosta, J. M., Kim, H.-j., & Ringstad, A. (2015). A Historical-Institutionalist Analysis of the MV Sewol and MS Estonia Tragedies: Policy Lessons from Sweden for South Korea. *The Korean Journal of Policy Studies*, 31(1), 35-71.

Fisheries and Oceans Canada, & Canadian Coast Guard. (2021). *Search and Rescue Contacts (Find Rescue Coordination Centres Worldwide)*. Retrieved from sarcontacts: https://sarcontacts.info/

Gorgol, T. (2012). *Building a MRO Organizational Culture.* Retrieved from United States Coast Guard: https://www.dco.uscg.mil/Portals/9/CG-5R/MassRescueOps/MROOrganizationalCulture.pdf

Huanqiu Net. (2021). *Ministry of Transport: China Maritime Search and Rescue Center has rescued 150,000 people in the past 10 years.* Retrieved from Huanqiu Net: https://baijiahao.baidu.com/s?id=1700882263971234414&wfr=spider&for=pc

IMO. (2003). *Guidance for Mass Rescue Operations.* Retrieved from IMO: https://wwwcdn.imo.org/localresources/en/OurWork/Safety/Documents/COMSAR.1-Circ.31%20-%20Guidance%20For%20Mass%20Rescue%20Operations.pdf

IMO. (2017). *Guidelines for preparing plans for cooperation between search and rescue services* . Retrieved from IMO: https://wwwcdn.imo.org/localresources/en/OurWork/Safety/Documents/Documents%20relevant%20to%20SAR/MSC.1-Circ.1079-Rev.1%20Guidelines%20for%20preparing%20plans%20for%20co-operation%20between%20sar%20services%20and%20passenger%20ship.pdf

IMO. (2018). *The International Convention for the Safety of Life at Sea (2018 consolidated edition).* Retrieved from samgongustofa: https://www.samgongustofa.is/media/english/SOLAS-Consolidated-Edition-2018.docx.pdfhttps://www.samgongustofa.is/media/english/SOLAS-Consolidated-Edition-2018.docx.pdf

IMO. (2021). *International Convention on Maritime Search and Rescue*. Retrieved from International Maritime Organization: https://www.imo.org/en/OurWork/Safety/Pages/SARConvention.aspx

IMO, & ICAO. (2016). *IAMSAR Manual.* London.

IMRF. (2010). International Maritme Rescue Federation Conference on Mass Rescue at Sea, Gothenburg 7-8 June 2010: Conference Report. p.1-32. Guthenburg: IMRF.

IMRF. (2019). *Chapter 3: Complex incident planning: risk analysis.* Retrieved from International Maritime Rescue Federation: https://www.international-maritime-rescue.org/chapter-3-complex-incident-planning-risk-analysis

IMRF. (2021). *Chapter 1: The Challenge: Acknowledging the problem, and mass rescue incident types.* Retrieved from International Maritime Rescue Federation: https://www.international-maritime-rescue.org/chapter-1-the-challenge-acknowledging-the-problem-and-mass-rescue-incident-types

Lau, Y.-y., & Yip, T. (2020). The Asia cruise tourism industry: Current trend and future outlook. *The Asian Journal of Shipping and Logistics, 36*, 190-201.

Lee, G. R., & Janelle, R. (2011). 10 Mass Rescue Opeartions Realities. *The Coast Gurads Journal of Safety& Security at sea*, 68 (3), 28-34.

LI, X. (2021). *Explanation on Maritime Traffic Safety Law of the People's Republic of China (Revised Draft).* Retrieved from The national People's Congress of the people's Republic of China: http://www.npc.gov.cn/npc/c30834/202104/5d166543bd0b456bb25254f01442919c.shtml

LI, Z., & WANG, C. (2015). Legal issues related to the delineation of responsibility areas in search and rescue of disputed sea areas. *Academic Exchange, (12)*, 97-101.

Lindsay, B. R. (2012). *Federal Emergency Management: A Brief Introduction.* Retrieved from Federation of American Scienists: https://fas.org/sgp/crs/homesec/R42845.pdf

Lutgens, F. K., Edward, T. J., & Tasa, D. G. (1992). *Essentials of Geology.* New York: MacMillan.

Maritime Safety Administration of P.R. China. (2018). *Maritime Safety Administration of P R China .Report on the Investigation of the Collision Between M.T SANCHI and M. V CF CRYSTAL in East China Sea on 6 January 2018.* Retrieved from https://safety4sea.com/wp-content/uploads/2019/09/MARDEP-Report-on-the-Investigation-of-the-Collision-between-M.T.-Sanchi-and-M.V.-CF-Crystal-in-East-China-Sea-on-6-January-2018-2018_05.pdf?__cf_chl_jschl_tk__=7745676681f7a97d070e36dec03321bb3d5c5baa-1624

Ministry of Foreign Affairs. (2021). *List of China's participation in international conventions*. Retrieved from Official website of Ministry of Foreign Affairs: https://www.fmprc.gov.cn/web/ziliao_674904/tytj_674911/tyfg_674913/t4985.shtml

MOTPRC. (2007). *Layout project of national water traffic safety supervision and rescue system*. Retrieved from MOT: https://www.mot.gov.cn/zhengcejiedu/hangdaozhengzhi/xiangguanzhengce/201510/t20151015_1902622.html

MOTPRC. (2010). *Notice of the Ministry of Transport on Issuing the Measures for the Administration of Dispatching and Command of Professional Rescue Ships.* Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/gongbao/content/2010/content_1653857.htm

MOTPRC. (2014). *Notice of the Ministry of Transport on Adjusting Key Ships and Key Areas of Water Traffic Safety Supervision.* Retrieved from China shipping trading network: https://www.cn-eship.com/news/newsinfo.jsp?id=219345

MOTPRC. (2015a). *Ministry of Transport: Start the first-level emergency response to save people*. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/xinwen/2015-06/03/content_2872481.htm

MOTPRC. (2015b). *National Coastal Cruise Port Layout Planning Scheme.* Retrieved from Ministry of Transport of the People's Republic of China: https://xxgk.mot.gov.cn/2020/jigou/zhghs/202006/t20200630_3319575.html

MOTPRC. (2016). *The Transportation Integrated Emergency Command Center of the Ministry of Transport was put into trial operation*. Retrieved from The State Council Information Office of the People's Republic of China: http://www.gov.cn/xinwen/2016-03/30/content_5059698.htm

MOTPRC. (2018a). *Interpretation of National Emergency Response Plan for Major Oil Spills at*

Sea. Retrieved from MOT: https://www.mot.gov.cn/zhengcejiedu/guojiazdhsyyyjczya/

MOTPRC. (2018b). *The Ministry of Transport held a special conference on the collision and explosion accident of the "Sangji"*. Retrieved from The State Council Information Office of the People's Republic of China: http://www.scio.gov.cn/xwfbh/gbwxwfbh/xwfbh/jtysb/document/1617663/1617663.htm

MOTPRC. (2020). *China Transport Yearbook (2019).*

MOTPRC. (2021). *Maritime Traffic Safety Law of the People's Republic of China.* Retrieved from Official website of Ministry of Transport: https://zizhan.mot.gov.cn/sj2019/soujiuzx/faguizc_sjzx/202105/t20210517_3593465.html

Naval Technology. (2021). *ShinMaywa US-2 STOL Search and Rescue Amphibian.* Retrieved from Naval Technology: https://www.naval-technology.com/projects/shinmaywa-us-2-stol-search-and-rescue-amphibian/

Prospective Industry Research Institute. (2021). *Global and Chinese cruise industry market status, competitive landscape and development prospect forecast in 2021.* Retrieved from eastmoney: http://finance.eastmoney.com/a/202103191851059642.html

Real, P. (2019). *Caribbean cruise market: Opportunities in a growing industry.* Retrieved from SHAPING FUTURE: https://algnewsletter.com/maritime/caribbean-cruise-market-opportunities-in-a-growing-industry/

Renee, B., B, D. M., Stephen, C., & Mak, L. (2010). *Thermal requirements for surviving a mass rescue incident in the Arctic: project update.* Paper presented at The American Society of Mechanical EngineersCanada. 2011 30th International Conference on Ocean. Offshore and Arctic Engineering, America.

Shanghai Municipal People's Government. (2017). *Shanghai Maritime Search and Rescue Emergency Plan (2017 Edition).* Retrieved from Shanghai Municipal People's Government: https://www.shanghai.gov.cn/nw32024/20210106/cd96f8bc6d1f41bbb2e998bc9654748d.html

Shanghai Municipal People's Government. (2021). *The largest luxury cruise ship sets sail in China*

next year. Retrieved from Shanghai Municipal People's Government: https://www.shanghai.gov.cn/nw4411/20210421/90c5a809d56947498e3c2ff279bb7c90.html

SHI, J., YE, X., & MEI, J. (2020). Research on the Development of China's Cruise Industry from 2019 to 2020: New Situation, New Challenge and New Path. In n.d., *Annual Report on China's Cruise Industry (2020)* , 37-67.

SHI, X. (2020). Research on massive emergency rescue of international cruise. *China Maritime Safety*, (3), 21-24.

ShinMaywa Industries. (2021). *Rescue Operations.* Retrieved from ShinMaywa Industries,Ltd: https://www.shinmaywa.co.jp/aircraft/english/us2/us2_rescue.html

Sohu. (2020). *Shanghai will build a world-class water search and rescue system during the 14 th Five-Year Plan period.* Retrieved from Sohu: https://www.sohu.com/a/419932192_100019407

State Council. (2005). *Reply of the State Council on agreeing to establish a national maritime search and rescue inter-ministerial joint conference system.* Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/zhengce/content/2008-03/28/content_3606.htm

State Council. (2006). *National General Emergency Plan for Public Emergencies.* Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/yjgl/2006-01/08/content_21048.htm

State Council. (2008). *National Maritime Search and Rescue Emergency Plan*. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/ztzl/2008tffy/content_1117159.htm

State Council. (2009). *China's administrative divisions-cities.* Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/test/2009-04/17/content_1288060.htm

State Council. (2010). *Shantou Flight Base of Nanhai First Rescue Flying Team of Ministry of Transport was opened*. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/gzdt/2010-11/12/content_1743890.htm

State Council. (2018). *Chinese and Japanese governments sign maritime search and rescue*

cooperation agreement. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/xinwen/2018-10/27/content_5334951.htm

State Council. (2019). *Circular of the General Office of the State Council on Strengthening Water Search and Rescue Work*. Retrieved from The Central People's Government of the People's Republic of China: http://www.gov.cn/zhengce/content/2019-11/08/content_5450144.htm

SUN, J. (2014). Historic evolution of the Marine SAR function in the Ministry of Communication(continue). *China Maritime Safety,* (4), 8-21.

SUN, W. (2016). *Legal Basis in China's Maritime Delimitation Disputes with Neignboring Countries*. Unpublished master's thesis, Shenyang university of technology, Shenyang, Liaoning Province, China.

TANG, W., & LI, M. (2016). Problems and Suggestions for the Chinese Team of Maritime Search and Rescue Task Coordinators. *Navigation*, 25-29.

TIAN, H. (2018). *Research on the Development and Allocation of China Maritime Search and Rescue Forces.* Unpublished master's thesis, Dalian Maritime University, Dalian, China.

US National Search and Rescue Committee. (2018). *United States national search and rescue supplement to the international aeronautical and maritime search and rescue manual version 2.0.* Retrieved from United States Coast Guard:https://www.dco.uscg.mil/Portals/9/CG-5R/nsarc/NSS_2018_Version/National%20SAR%20Plan%202018.pdf

USCG. (2004). *Mass Rescue Operations.* Retrieved from United States Coast Guard: https://www.dco.uscg.mil/Portals/9/CG-5R/MassRescueOps/MROPlanningGuidance(PVS).pdf

USCG. (2010). *Coast Guard Mass Rescue Operations (MRO) program.* Retrieved from United States Coast Guard: https://www.d5srcgauxem.org/wp-content/uploads/2020/02/AMROSCOMMINSTRUCTION2010.pdf

WANG, H., JIANG, r., & MEI, J. (2019). A Strategic Research on the Whole Industry Chain of China's Cruise Economy in the New Era. In n.d., *Annual Report on China's Cruise Industry（2019）*, 116-126.

WANG, H., SHI, J., & MEI, J. (2020). Research on the development of global cruise industry from

2019 to 2020: the downward pressure on the market scale is huge, and the cruise economy is facing severe challenges. In n.d., *Annual Report on China's Cruise Industry (2020)* , 1-36.

WANG, H., YE, X., & MEI, J. (2019). Research on the Development of China's Cruise Industry from 2018 to 2019: Substantial Start of the Cruise Industry's Whole Industry Chain. In n.d., *Annual Report oN China's Cruise Industry（2019）*, 43-83.

WANG, J., LI, R., & ZHANG, H. (2014). Research on China's Search and Rescue Area in the Vision of East Asia. *Northeast Asia Forum*, (4), 15-24.

WANG, L. (2021). Taking high-quality development as a good start for China Rescue and Salvage in the 14 th Five-Year Plan and comprehensively promoting the construction of modern professional rescue and salvage system. *China Transport News*. Beijing, China.

XIAO, K. (2020). The construction of a service transportation power needs to fill the shortcomings of the development of China's salvage system. *Shipping Management, 43 (4)*, 4-13.

XIE, L., & ZHOU, Y. (2016). Discussion on shipboard work of rescue helicopter. *World Shipping*, 39-44.

ZHANG, P., LIU, X., & ZHENG, Y. (2018). Views on the construction of emergency handling capacity of salvage system from the collision and explosion accident of Sangji ship. *Pearl River Water Transport*, 107-109.

ZHANG, Y. (2020). Research on the Strategic Path of China Cruise Economy Development under the New Situation. In n.d., *Annual Report on China's Cruise Industry (2020)* , 87-99.

ZHOU, J. (2016). Problems related to search and rescue cooperation between international passenger ships and search and rescue centers. *Tianjin Navigation*, (1), 46-47.

ZHU, Y. (2020). Know and practice, continue with the past and open up the future, improve the high quality development of the national marine SAR capability . *China Maritime Safety*, (3), 16-20.