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The application of international conventions by Chinese inland-river vessels under special routes : taking the air pollution prevention as example

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The application of international conventions by Chinese inland-river vessels under special routes ----taking the air pollution prevention as example.

By

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DECLARATION

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

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

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ABSTRACT

The Pearl River Delta, which is the most economically developed area, also has very developed and busy water transport. There are international routes, domestic coastal routes, and inland routes. The types of ships sailing in this area are varied. Different routes require different legal systems, international conventions and domestic regulations.

The Hong Kong and Macao route is a special route. The division of the route belongs to the inland river A-level shipping area. But because it includes Hong Kong and Macao, it also has the nature of international routes. If inland-river ships want to cross the route, they must meet the requirements of this route. Taking the issue of air prevention pollution certificate as an example, this paper explains the particularity of this route, and puts forward the way to solve the contradiction in response.

Key words: the Hong Kong and Macao route, inland-river ships, air prevention pollution, international conventions, domestic rules.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

H/MR	Hong Kong and Macao route
MSA	Maritime Safety Administration
MARPOL	the International Convention for the Prevention of Pollution From Ships
DECAs	the Domestic Emission Control Areas
CCNR	Central Commission for the Navigation of the Rhine
MDWT	the Management of Domestic Water Transportation

LIST OF FIGURES & TABLES

Chapter 1 Introduction

Over the past few years, the economic cooperation between the mainland and Hong Kong and Macao has become more connected, and the volume of economic trade has been increasing year by year. At the same time, the cooperation and development of a number of huge projects would promote the economy to continue to be better, for example, Hong Kong-Zhuhai-Macao Bridge, one of the century projects of China. This super large project greatly stimulates domestic demand, especially on Building materials such as sand and stone. These projects have attracted a large number of ships registered in Guangdong to go to the construction. Most of these ships are inland-river vessels and can navigate the A-level navigation area of inland rivers. But the waters of Hong Kong and Macao are very important, which makes the voyage between the mainland and Hong Kong and Macao become a very special international route.

1.1 Research background

1.1.1 Background of the Pearl River shipping

In a vast territory of China, there is a natural water network, connecting with rivers, lakes, and seas. According to statistics, there are more than 50,000 rivers over 100 km^2, with a total length of about 430,000 km. Our country inland waterways navigation mileage is up to 1.33 million kilometers, accounting for about 32 percent of the overall length of rivers. At present, the inland river shipping system with the Yangtze River, the Pearl River, Heilongjiang and the Beijing Hangzhou canal as the backbone has been initially formed.

Among them, the Pearl River is the largest water system and the main artery of water transport in Southern China, with Guangzhou as its center. Its navigable value is only next to the Yangtze River. At present, the navigable mileage is only 1/3 of the river length, implying that there is great potential for development. It is important to note that the largest navigation density is in the Pearl River Estuary Area. The Pearl River Delta urban agglomeration is formed at the mouth of the Pearl River, which is now also known as Guangdong-Hong Kong-Macao Greater Bay Area. About 70% of inland river vessels are sailing in this area.

Firstly, it needs to be clear about the division of the inland river A-level navigation area in this area. A-level navigation area - the waters of the Pearl River from Humen (Sha Jiao) to the beacon joint line of the beacon Island , the beacon of the king horn of Qiao Island, as well as to the waters of Hong Kong and Macao, not more than 5 kilometers away from the shore; from the Hongwan waterway to the Macao navigation area.

From then on, we can see that Hong Kong and Macao in the Pearl River Delta region are also divided into A-level navigation area of inland-river. That is to say that, from the angle of seaworthiness of ships，inland water vessels of A-class holding an approved ship inspection certificate can sail to Hong Kong and Macao.

However, as we all know, due to historical reasons, Hong Kong and Macao now belong to highly autonomous special administrative regions. Therefore, their waters need to be applied to relevant international conventions，which has formed a special route for Hong Kong and Macao.

1.1.2 Definition.

In this paper, we define inland-river ships sailing Hong Kong and Macao routes as follows: according to the relevant documents of the Ministry of Communications, the route specifically refers to inland-river vessels navigating through Hong Kong and Macao, registered in mainland China (such as Guangdong province), get certificates of A-level navigation area of inland-river, and must be on record and approved by the Provincial Department of Communications and managed by companies with the management qualifications of this route.

1.1.3 Current situation of inland ships

In recent years, with the rapid and continuous growth of the demand for inland river transportation, ship types have also changed greatly. For many years, the conditions of long ship age, small tonnage, type of ship type, technical backwardness and obsolete transportation are changing. (Wang, Q.J, 2010)

Through the research and application of special techniques such as bulbous bow, double-tail, flap rudder, guide tube, reversing rudder, large diameter depth ratio and so on, inland river ships are developing towards standardization, large-scale, specialization and diversified transportation.

1.2 The contradiction to be solved

As the total number, total tonnage and deadweight capacity of ships have been increasing sharply in recent years, the shipping market in the Pearl River Delta region has been growing slowly, which has caused fierce market competition among ships. Some ships are facing the risk of outage. At the same time, the construction of the Hong Kong Zhuhai Macao Bridge and the expansion project of the Hong Kong airport have made some ships expect business opportunities and actively participate in them.

But, the waters of Hong Kong and Macao are very special. Because of their high degree of autonomy, the waters are applicable to the international convention, although they are divided into A-level navigation area of inland-river. The ships that sail in these waters must meet the relevant requirements of international conventions. Inland vessels do not always meet the requirements of international conventions. They mainly meet the requirements of inland river laws. (Hu, D. H, 2007)

Here comes the contradiction. Ships which do not meet the requirements of Hong Kong and Macao maritime regulations can no longer operate in Hong Kong and Macao waters. If these ships want to, they have to find ways to meet the requirements of the relevant conventions. That is to say: they should be restructured or carry out the relevant experiment required by the international conventions, so as to achieve the requirements of the Hong Kong and Macao maritime departments under the existing regulatory framework. If they did, they would get certificates of ship inspection, to prove that they are qualified.

This article will focus on the issue of air pollution prevention certificates and related experimental procedures. Through showing how such vessels meet the requirements of

international conventions and obtain ship certificates, it will provide references for the ships to meet the requirements of H/MR.

In addition, it is part of the overall planning of Tai Wan District. Shipping in the Pearl River waters is bound to develop in a more international direction, such as the previous policies on clean energy for ships, the policy of ship dismantling, and so on. The implementation of these policies will surely develop towards a more environmentally friendly and more consistent direction to the requirements of the international conventions. The paper also provides them with some degree of reference.

1.3 Related research status

At present, most of the research on Hong Kong and Macao routes is at the level of laws and regulations, and there are relatively few discussions and implementation in specific conventions. The combination of the two studies are much less.

The paper from Wu zhijian (Guangdong MSA), named *survey management on prevention of air pollution for inland-river ships entering into Hong Kong*, has introduced some requirements of HK's regulation, domestic laws and regulations on statutory surveys, and supplied suggestions. Apart from that, there was a paper in 1995 "*on the succession of state to international treaties especially about HK's after 1997*", talking about How Hong Kong continued to apply the original international treaties after China resumed the exercise of sovereignty over Hong Kong.

1.4 Main contents and methodology

This article, from the view of the inland ships that must carry out the international conventions, discusses the special requirements on the special routes, and how to implement a specific annex, and recommends an effective foreign example. In the end, a proposal to resolve the contradiction was formed.

Chapter 2 introduces the background of H/MR, from the process of historical development, and explains the reasons why this route is so particular.

Chapter 3 analyzes the differences and similarities of the MARPOL and domestic regulations on requirements of preventing air pollution of ships. In this way, we can probably understand the current situations of enforcement of these requirements at home and abroad.

Chapter 4 shows completely the process of issuing air pollution prevention certificates for inland river vessels.

Chapter 5 provides a similar management on international river- the Rhine River Road, which has been a successful example in the world. We can get some useful lessons from it.

Chapter 6 summarizes the conclusions of all chapters and provides suggestions to inland-river vessels who want to navigate to Hong Kong and Macao.

This paper uses a variety of methodologies, including comparative method, example analysis method, summary method, chart method and so on. With the help of these methods, we can understand the relevant views much better. And most of them are based on the experiences when working as a surveyor in Huizhou MSA.

Chapter 2 Formation and requirements of H/MR.

It is necessary to explain the history and formation of Hong Kong and Macao Routes (H/MR), demarcating the year of the return of Hong Kong in 1997 (Macao's return year is 1999).The background and requirements of H/MR are displayed on the basis of relevant documents issued by the state authorities. (Chen, H, 1995)

2.1 Before the return of sovereignty: special international shipping.

Before the return of the sovereignty of Hong Kong and Macao, H/MR was identified as special international shipping routes. Before 1997, they did not return to the motherland. The waterway transportation between Guangdong and Hong Kong and Macao was managed according to international shipping. All of the laws and regulations of the international maritime transport in China were applicable to the transportation of Hong Kong and Macao.

In 1984, China implemented the policy of reform and opening to international shipping. Next, according to this policy, in 1985, the Ministry of Communications established the interim administration of the Ministry of Communications on International Maritime Shipping Co. The thirteenth clause stated: "the water transport between our regions and Hong Kong and Macao is currently treated as international maritime transport; this approach applies to this route." It could be seen that this route was first defined as an international maritime transport.

In 1985, the Ministry of Communications , Fujian and Guangxi to approve the vessels whose GWT was under 1000t of every single ship and the management of shipping Co, which navigated H/MR. Later, the authorization was extended to the whole country.

However, it is a little different from the policies above. In 1992, Guangdong Province formulated the management measures for water transportation service in Guangdong, which incorporated the auxiliary industry of Hong Kong and Macao transportation into the category of water transportation service industry, and established a management system similar to the domestic water transportation for shipping agent and freight forwarder. But the policy involved in changes to the requirements of the ship.

These policies were implemented until the return of sovereignty in Hong Kong and Macao. During this period, the "special international routes" in Hong Kong and Macao can be understood in this way: on the political level, Hong Kong and Macao belonged to the British and Portuguese colonies, and the sovereignty had not returned. The shipping routes from Guangdong to Hong Kong and Macao are naturally characterized as international routes in nature. On the management level, the management of Hong Kong and Macao routes was

different from the usual international shipping based on the historical practice and the actual characteristics of Hong Kong and Macao transportation with regional transportation.

To sum up, we can conclude that the inland vessels of H/MR should belong to the category of special international routes before the return of sovereignty. That is to say that they need to meet all the international conventions required by the government of Hong Kong and Macao.

2.2 After the return of sovereignty: special domestic shipping.

After the return of the sovereignty of Hong Kong and Macao, the Ministry of Transportation issued two notices respectively in 1997 and 1999. They were the notice on the shipping management of the mainland and the HK routes after the return of Hong Kong and the notice on the shipping management of the mainland and the Macao and Hong Kong routes after the return of Macao. Both of these notices made clear the purpose and main theme from the very beginning that: the sea transportation routes between Hong Kong, Macao and the mainland were special domestic routes. The transportation management part of Hong Kong and Macao belonged to the domestic shipping management system, part of which belonged to the international shipping management system. Therefore, the H/MR was identified as "special management domestic route".

Its particularity is mainly manifested in the following aspects:

Firstly, A high degree of autonomy in the applicability of the law. In addition to the entry of a foreign military vessel to Hong Kong and Macau, the special administrative license of the Central People's government is required, and other ships may enter the port in accordance with the laws of Hong Kong and Macau. In accordance with the laws of the Hong Kong Special Administrative Region and the law of the Macao Special Administrative Region, the documents of them must be issued in the name of “China Hong Kong” and the name of "China Macao". What’s more, after the return of sovereignty of Hong Kong and Macao, the original shipping operation and management system, including the management system of seafarers, could be maintained.

Secondly, there are different ways of management for companies with different attributes. It is this way of categorization that embodies the particularities.

Shipping companies and ships were registered in the mainland and have approved the qualification of international shipping of H/MR. The passenger and cargo liner that has been approved to operate the route may continue to operate the passenger and freight transport business between Hong Kong and Macao and the opening-up ports in the mainland.

Shipping companies and ships registered in Hong Kong and Macao can operate the maritime transport between Hong Kong and Macao and the opening-up ports of the mainland. The shipping of passenger and cargo liner on the route shall be approved by the Ministry of Communications of China according to the regulations on international liner transportation management.

Foreign vessels mustn't engage in passenger and freight business between Hong Kong and Macao and the mainland's opening-up ports without the approval of the Ministry of Communications of China.

At last, we can see clearly the particularity of this kind of water transport qualification in relevant laws and regulations.

The transport part of Hong Kong and Macao belongs to the international shipping management system. Because, at present, domestic laws and regulations concerning that are part of separate regulations, and partly in the international maritime management laws and regulations. That is to say that regulations that should be applied to H/MR should appear in the laws and regulations of domestic waterway transport management, but in fact they do not exist.

In 2008, the fifty-fourth item on the Management of Domestic Water Transportation (revised in 2016)(short for MDWT), published by the Ministry of Communication, pointed out that "the water transportation between the mainland and Hong Kong and Macau, and between the mainland and Taiwan areas is not applicable to the provisions of this regulation." This shows that its nature is not entirely within the scope of domestic waterway transportation business.

Furthermore, the fifty-sixth item on the People's Republic of China International Shipping Regulations (revised in 2016), implemented in 2002, pointed out that "the maritime transport between the mainland and Hong Kong and Macau shall be carried out by the Department of transportation under the State Council in accordance with the regulations." It can be seen from these regulations that the transport of Hong Kong and Macao is part of the international shipping management in the specific management and operation.

2.3 Understanding the particularity of this route from the following levels

Hong Kong and Macao routes are indeed a very special route, which is unique in the world. It might be helpful for us to understand from the political, legal and managerial levels. (Huang, M.J., 2014)

2.3.1 Political level

Our country is a "one country, two systems" one. The mainland is a socialism, while Hong Kong and Macau are capitalism. Under two different systems, the transportation of waterways should of course be subject to special management. First, the "one country" decided that the waterway transportation of Guangdong, Hong Kong and Macao was a "domestic route", and after the return of the sovereignty of Hong Kong and Macao, they were an integral part of People's Republic of China.

Secondly, the "two systems" determines that Hong Kong and Macao enjoy a high degree of autonomy under the premise of "one country", including administrative power, legislative power, independent judicial power and the right of final adjudication, and can carry out the economic, social and legal systems different from the mainland of China. It also means that after the return of the sovereignty they can still retain their original and different shipping management system. Therefore, the "special management" must be carried out in this navigational route.

2.3.2 Legal levels

After the return of Hong Kong and Macao, their original legal systems are basically unchanged, and the laws of the two regions belong to the Anglo American law system and the continental law system respectively, and the mainland of China is a relatively independent legal system. This leads to the existence of three jurisdictions with unique legal systems in Guangdong, Hong Kong and Macao, so that the interregional conflict of laws is inevitable.

The characteristics of this interregional conflict of laws mainly include: firstly, this kind of conflict between Guangdong, Hong Kong and Macao is an interregional conflict of laws in a single state. Concretely, it is the legal conflict between the central law and the local law of the Special Administrative Region, which belongs to the equal status in a certain period.

Secondly, there are not only legal conflicts between the jurisdictions that belong to the same social system, such as that between Hong Kong and Macao, but also between the jurisdictions of different social systems, such as that between Guangdong and Hong Kong & Macao.

Finally, all jurisdictions have their own courts of final appeal, and there is no supreme judicial organ above all jurisdictions, so there is no coordination between the supreme judiciary in resolving interregional conflicts of law.

Therefore, based on the reality of the inter regional conflict of laws between Guangdong and Hong Kong & Macao, the laws and regulations are the basic basis for the effective management of water transportation, which requires us to consider both the laws and regulations of the mainland and those of Hong Kong and Macao in the management of the water transportation in Guangdong, Hong Kong and Macao.

It is problem-solving that should focus on the future, seek common ground while reserving differences, strengthen communication, and strive to achieve the organic integration of the legal system between the three sides.

2.3.3 Managerial level

The division of some special areas will turn Hong Kong and Macao into unified management, such as "Implementation Plan on Domestic Emission Control Areas in Waters of the Pearl River Delta, the Yangtze River Delta and Bohai Rim , (Beijing, Tianjin, Hebei)", which divided and managed the emission control area as a whole.

According to the Regulation of Waterway Transport Management 2013, Hong Kong and Macao transport should belong to inter provincial transportation. The "domestic route under special management" is the quality of transportation defined by the Department of Transportation of the State Council from the perspective of administrative management from the mainland, and also as the starting point and cornerstone for the establishment of the relevant management system.

However, this qualitative constraint on HK and Macao waterway transport management is limited. In fact, the Hong Kong and Macao regions have carried out the basic free and open ship registration system in the shipping policy, which is equal to opening to all countries of the world the coastal transport rights between Hong Kong, Macao and the mainland, which is not conducive to the healthy development of national security and domestic water transportation.

In addition, the waterway transportation between mainland and Hong Kong & Macao includes direct cargo transportation, waterway passenger transport, and transportation of import and export goods through Hong Kong. Therefore, from the management level, in order to manage the water transportation of Guangdong, Hong Kong and Macao more efficiently and improve the administrative system of the water transportation, we should make a clear definition of the property of "domestic route under special management ".

2.4 Summary of this chapter

All in all, the H/MR has to and should be a special transporting route, which is better for the three sides. While providing good business opportunities for practitioners engaged in this route, it also puts forward stricter laws and regulations. It is very necessary to carefully study the relevant ship conventions about this line.

Chapter 3 Similarities and differences on regulations for the prevention of air pollution from ships between inland ships and international navigation.

According to the preceding description, we know the particularity of H/MR route.

In order to further explore its particularity, we should concretely analyze its requirements through real events. Here will be used as an example of the prevention of air pollution from ships. One is an international regulation from MARPOL Annex VI, and the other is a domestic regulation (Technical rules for statutory inspection of inland ships 2011 & 2016). By comparing their similarities and differences, we can find out the problems and possible solutions when carrying out this requirement.

MARPOL Annex VI, in addition to the provisions of the annexes 3rd, 5th, 13th, 15th , 18th and 19th, the provisions applicable to all ships' supplementary provisions of Annex VI are applicable to all ships. This annex stipulates the limit of SO_x and NO_x content in the exhausting gas of ships and the prohibition of intentional emission of ozone depleting substances. These are the control targets, including: ozone depleting substances, SO_x, NO_x, volatile organic compounds and marine incineration devices. (Hou, 2017)

While, the domestic rules applies to all inland river ships sailing in china, unless otherwise specified. Furthermore, the requirements for pollution prevention of vessels when navigating inland waterways with special requirements shall comply with the decrees and relevant regulations of the Chinese government (including local governments). The control targets are as same as MARPOL.

3.1 Similarities between international and domestic regulations

3.1.1 A similar birthplace.

The basis of the two rules is similar.

MARPOL Annex VI, has been modified by the Protocol of 1978 relating thereto and the Protocol of 1997, and amended by IMO, which is a mature regulation. Although the inland river rules are not clearly expressed as to which meeting or document is based on. However, on the whole, the formulation of the air pollution prevention rules is a reference to the content of MARPOL, and the provisions are appropriately added or deleted according to the specific national conditions of China. So we can say that the source of these regulations is consistent. In addition, when the terms come into force, they will come into force in China. The same basis is more effective for inland vessels to implement.

3.1.2 Definitions are same

From the previous common point, we can infer that the definition is consistent. The core content of the definition is exactly the same. There are some important ones as follows.

Installations mean the installation of systems, equipment, including portable fire-extinguishing units, insulation, or other material on a ship, but excludes the repair or recharge of previously installed systems, equipment, insulation or other material, or the recharge of portable fire-extinguishing units.

Ozone-depleting substances that may be found on board ship include, but not limited to: Halon 1211, Halon 1301, Halon 2402, CFC-11, CFC-12, CFC-113, CFC-114, CFC-115.

Major conversion of engine: .1 the engine is replaced by a marine diesel engine or an additional marine is installed, or; .2 any substantial modification, as defined in the revised NO_x Technical Code 2008, is made to the engine, or; .3 the maximum continuous rating of the engine is increased by more than 10% compared to the maximum continuous rating of the original certification of the engine.

There are more definitions in MARPOL, and the definitions are much more detailed. Because this regulation should apply to vessels sailing all over the world. Compared with this, domestic

regulations only need to be redefined for inland vessels in China. So, some of definitions that are in MARPOL are not included in the domestic rules, such as shipboard incinerator, continuous feeding and so on.

3.1.3 NO_x Technical Code are totally the same.

Both MARPOL and the domestic rules regulate that the revised NO_x Technical Code 2008 shall be applied in the certification, testing and measurement procedures for the standards set forth in regulations. Besides, the procedures for determining NO_x emission set out in this code are intended to be representative of the normal operation of the engine. The advantage of this is that the inspection standards of inland ships directly conform to international standards. That is to say that the detection of NO_x emission is still done just once, and it can meet both domestic and international standards at the same time. For all inland vessels, especial vessels sailing H/MR, that means saving a lot of time and money. If there were two different standards for the domestic and international separately, the owners would pay more time and money on meeting the requirements. Therefore, it is highly efficient to directly quote international standards. The inspection process and results of a ship will be tackled in detail later in this article.

3.2 Differences between international and domestic regulations

3.2.1 Some devices are not required in domestic regulations

The ships required by MARPOL are relatively large, high cost of building and sailing an international voyage. While inland vessels are less tonnage ships with low cost of construction sailing in inland waters. These differences are embodied in the requirements for marine equipment. For example, shipboard incineration and reception facilities, which are required in MARPOL, are not required in inland vessels. (Wu, Z.J, 2009).

A> Incinerators

Inland ships are not necessary to be equipped with incinerators. There are lots of reasons by analyzing its function. Incinerator is a special equipment for burning waste oil from main engine,

auxiliaries, oil-water separator and oil pan, and most solid waste. Because the power of the main engine and auxiliary engine of inland vessels is very small, so that the waste oil produced can basically be disposed by the oil separator. And inland vessels produce very little solid waste, which can basically be put into shore to receive equipment for waste.

B> Reception facilities

According to MARPOL, we know that reception facilities are used to meet: .1 the needs of ships using its repair ports for the reception of ozone-depleting substances and equipment containing such substances when removed from ships; .2 the needs of ships using its ports, terminals or repair ports for the reception of exhaust gas cleaning residues from an exhaust gas-cleaning system; without causing undue delay to ships, and .3 the needs in ship-breaking facilities for the reception of ozone-depleting substances and equipment containing such substances when removed from ships.

After knowing its specific role, we could make sure that those facilities are not necessary for the inland shipping in China, according to the characteristics of inland river ships. First of all, there are relatively few living facilities and mechanical equipment on inland ships. Basically, no ozone depleting substances are produced except for refrigerators and air conditioners. Secondly, the power of main engine and auxiliary machine is relatively low, generally not more than 1000kW. And realistically, vessels are not equipped with the exhaust gas cleaning system, so they would not produce exhaust gas cleaning residues. Finally, in China, shipyards building inland ships are small in size, as well as capital investment strength. They basically do not invest money in purchasing such reception facilities at all.

To sum up, some of the equipment that MARPOL seeks is ahead of the domestic shipping development. Inland vessels do not need these facilities at present. This makes the difference between international regulations and domestic regulations.

3.2.2 Requirements within emission control areas

In order to control the emissions of SOx, NOx and particulate matter from vessels and to improve the air quality of coastal areas and regions along the rivers, and in particular, of port cities in China, a plan called Implementation Plan on Domestic Emission Control Areas in Waters of the Pearl River Delta, the Yangtze River Delta and Bohai Rim , (Beijing, Tianjin, Hebei), was launched on December 2, 2015.

The Domestic Emission Control Areas (hereinafter referred to as DECAs) are stipulated in this document. The document is also quoted in the 2016 rule of inland ships. Like MARPOL, the document delineated DECAs in the Pearl River Delta shown as follows.

The Pearl River Delta DECA includes：

(a) the seas enclosed by geodesic line connecting the 6 points of A, B, C, D, E, F(excluding waters under the jurisdiction of Hong Kong and waters administered by Macao)；

A： The joining point of coastlines of Huizhou and Shanwei

B： The point where the seaward extension of 12 nautical miles from Zhentouyan terminates

C：The point where the seaward extension of 12 nautical miles from Jiapengliedao terminates

D：The point where the seaward extension of 12 nautical miles from Weijiadao terminates

E： The point where the seaward extension of 12 nautical miles from Dafanshi terminates

F： The joining point of coastlines of Jiangmen and Yangjiang

(b) Navigable waters of the rivers under the jurisdiction of 9 cities, including Guangzhou, Dongguan, Huizhou, Shenzhen, Zhuhai, Zhongshan, Foshan, Jiangmen, and Zhaoqing.

The core ports within this DECA are Shenzhen, Guangzhou and Zhuhai.

Figure 1: Pearl River Delta DECA

However, some emission limits in this DECA are different from those defined by MARPOL. shown as follow:

Table 1: differences of some emission limits.

DECAs of MARPOL		**DECAs of Pearl River Delta**	
The sulphur content of fuel oil	**Execution time**	**The sulphur content of fuel oil**	**Execution time**
Not exceed 1.50%m/m	Prior to July 1, 2010	not exceed 0.5% m/m (at the core ports)	On and after 1 January 2017.
Not exceed 1.00%m/m	On and after July 1, 2015; and	not exceed 0.5% m/m (at the all ports)	On and after 1 January 2018

<table>
<tr><td rowspan="2">Not exceed 0.10%m/m</td><td rowspan="2">On and after January 1, 2015</td><td>not exceed 0.5% m/m (entering the DECAs)</td><td>On and after 1 January 2019.</td></tr>
<tr><td colspan="2">An assessment on the effect of the aforementioned control measures will be conducted before 31 December 2019 to decide whether: to introduce the requirement of 0.1% m/m sulphur content in the DECAs.</td></tr>
<tr><td colspan="2">The emission of nitrogen oxides</td><td colspan="2">The emission of nitrogen oxides</td></tr>
<tr><td colspan="2">When the ship is operating in DECAs, it should meet the standards of Tier III. The specific values are as follows

1. 3.4g/kwh when n is less than 130 rpm;
2. $9*n^{(-0.2)}$kwh when n is 130 or more but less than 2000 rpm;
3. 2.0kwh when n is 2000 rpm or more</td><td colspan="2">Inland vessel regulations do not specify the use of Tier III, so in the current situation, the standard of Tier II is still used.

1. 14.4g/kwh when n is less than 130 rpm;
2. $44*n^{(-0.2)}$kwh when n is 130 or more but less than 2000 rpm;
3. 7.7kwh when n is 2000 rpm or more</td></tr>
</table>

3.3 Brief summary

Through a specific analysis and comparison in preventing air pollution of ships on international conventions and domestic regulations, we can draw a conclusion that requirements for preventing air pollution from inland ships are generally formulated and revised in reference to international conventions, but at the same time the actual situation of them is also taken into account. The overall requirements and technical inspection rules, such as NOx Technical Code 2008, meet the international conventions. And in accordance with the specific division of implementation plan on domestic DECAs and requirements of the domestic regulations, the certificate on Prevention of Air Pollution for Inland-River Ships could be issued, which is one of necessary legal certificates for sailing H/MR.

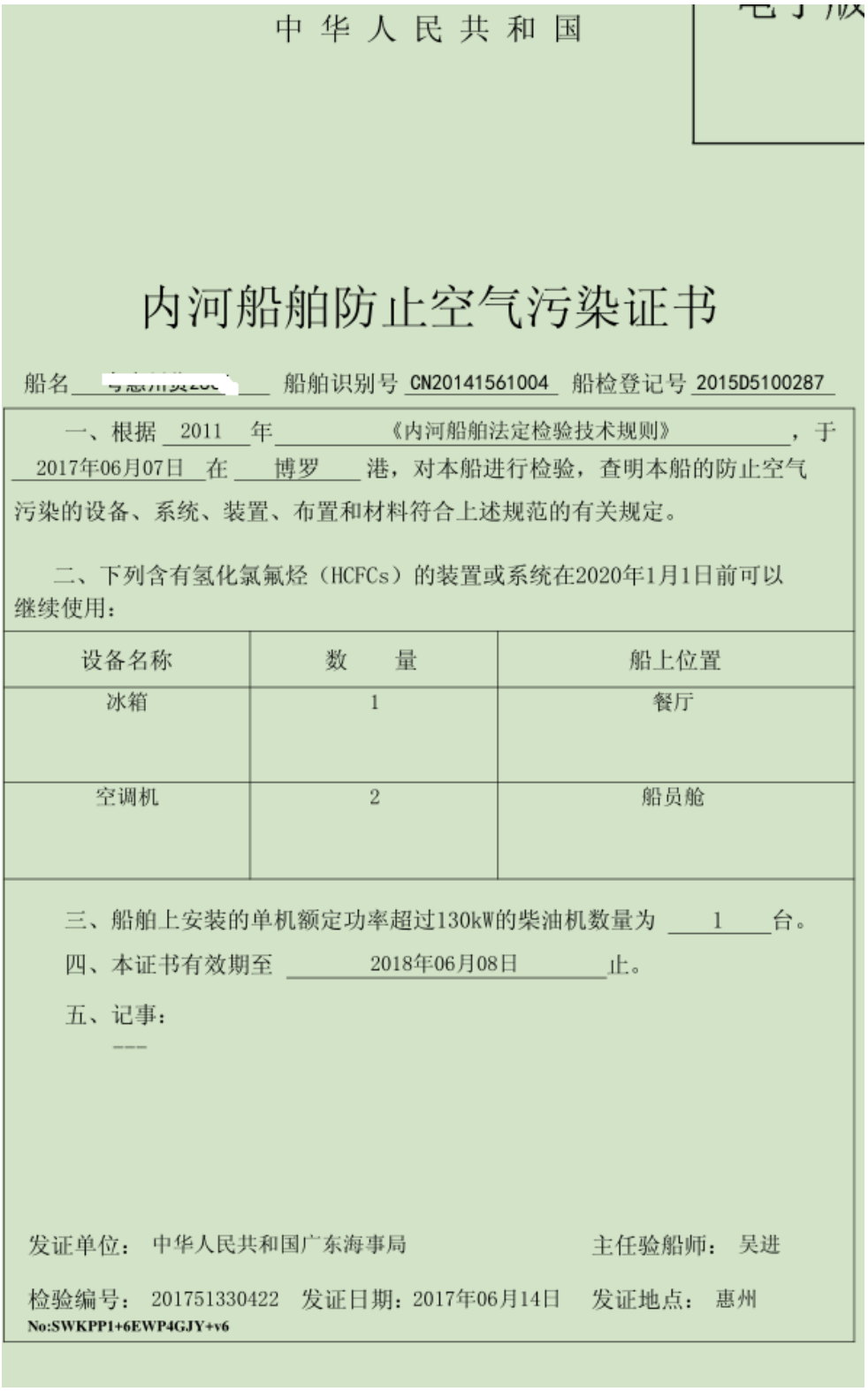
Chapter 4 Process of issuing air pollution prevention certificates for inland-river vessels

With the analysis and comparison above, we can see that the inland river regulations have been in accordance with the international conventions, although it is not completely implemented completely.

In this chapter, there would be a procedure showing how the certificate on Prevention of Air Pollution for Inland-River Ships could be issued, from which we can see the situation of the execution of inland ship regulations, as well as in the detection of NO_x Technical Code 2008.

4.1 The certificate on Prevention of Air Pollution for Inland-River Ships in China

The following figure shows a certificate on air pollution prevention for a common inland river vessel. This certificate is also the main basis for maritime supervision. (Zhang, 2010). Through the certificate, we see the most basic information required to hold the certificate. The first is ozone depleting substances, and the second is nitrogen emissions. If these two points meet the requirements of inland river regulations, the certificate can be issued.



中 华 人 民 共 和 国

内河船舶防止空气污染证书

船名 [redacted] 船舶识别号 CN20141561004 船检登记号 2015D5100287

一、根据 2011 年 《内河船舶法定检验技术规则》，于 2017年06月07日 在 博罗 港，对本船进行检验，查明本船的防止空气污染的设备、系统、装置、布置和材料符合上述规范的有关规定。

二、下列含有氢化氯氟烃（HCFCs）的装置或系统在2020年1月1日前可以继续使用：

设备名称	数 量	船上位置
冰箱	1	餐厅
空调机	2	船员舱

三、船舶上安装的单机额定功率超过130kW的柴油机数量为 1 台。

四、本证书有效期至 2018年06月08日 止。

五、记事：

发证单位： 中华人民共和国广东海事局 主任验船师： 吴进

检验编号： 201751330422 发证日期：2017年06月14日 发证地点： 惠州

No:SWKPP1+6EWP4GJY+v6

Figure 2: a sample of a certificate on air pollution prevention for inland-river ships

This certificate is issued in China. The information it displays from beginning to end is in turn:

Title: The People's Republic of China

The certificate on Prevention of Air Pollution for Inland-River Ships

Text:

Firstly: Basic information: ship name, ship inspection number, ship identification number. Applicable laws and regulations, time and place of inspection, etc.

Secondly: Substances containing HCFCs, mainly refrigerators and air conditioners, are installed in kitchens and crew rooms. They can be used before January 1, 2020.

Thirdly: The number of single engine power over 130kW on board is one.

Fourthly: The validity of this certificate

Fifthly: Note (none)

At the bottom of the certificate is the issuing body, surveyor and other information.

From the specific content of the certificate, we can see that there are two specific testing factors that affect the issuance of the certificate: one is HCFCs material, and the other is nitrogen oxide. As mentioned above, there are basically no other ozone-depleting substances on inland ships except for refrigerators and air conditioners, which can be exempted before 2020. So, the focus is nitrogen oxide emissions. (Qi, 2013).

4.2 An example of the whole process of nitrogen emission detection

Since both domestic and international regulations require the test of nitrogen oxides to conform to the 2008 Rule, I would fully demonstrate the whole process of the nitrogen emission test of an inland-river vessel in the jurisdiction of the Huizhou MSA, and then combine this test to discuss the situation in which inland ships meet the international public agreement. (Xia, 2010)

4.2.1 Contamination detection scheme for a diesel engine on board

4.2.1.1 Objective

In order to ensure the efficient and orderly completion of the pollutant emission test of the diesel engine, the test plan is formulated. Diesel engines for main propulsion are not suitable for this test scheme.

4.2.1.2 Parameters of the Diesel Engine

Table 2: Engine parameters

Engine	
Manufacturer	Chongqing Cummins Engine Company Ltd.
Engine type	KTA38-G
Engine Family or Engine Group identification	Family K
Serial number	HFNXSJ-01
Rated speed	1200r/min
Rated power	720kw
Injection control	19 ℃AC BTDC
Electronic injection control	☐yes ☑No
Variable injection timing	☐yes ☑No
Variable turbocharger geometry	☐yes ☑No
Cylinder. Bore	159mm
Stroke	159mm
Nominal Compression ratio	14.5:1
Cylinder number and configuration	Number: 6 ☑V ☐ in-line
Auxiliaries	
Remarks	The nameplate of the conveyer belt power diesel engine has lost the missing nameplate. The serial number of the ship unloader is the number of the addition of the inspection company.

4.2.1.3 Components affecting NOx emission

Since the diesel engine has no technical files and related technical data, this parameter check is the actual inspection of the current condition, and the case of the inspection would be formed. Components are affected by the NO_x emission as shown in Table.

Table 3: Components affected by NO_x emission.

Serial number	Inspection content	Serial number	Inspection content
1	piston	5	Fuel injection pump
2	Camshaft	6	Adders
3	Injector	7	Intercooler
4	The cylinder cover		

4.2.1.4 Criterion of detection

The detection is mainly based on RESOLUTION MEPC.177 (58), Amendments to the technical code on control of emission of nitrogen oxides from marine diesel engines (NO x Technical Code 2008). The chapters involved are Chapter 3 – Nitrogen oxides emission standards, Chapter 5 – Procedures for NOx emission measurement on test bed, Chapter 6 – Procedures for demonstrating compliance with NOx emission limits on board, and Chapter 7 – Certification of an existing engine.

According to the third chapter requirements of NOx emission limits, the test cycle for diesel engine is C1 cycle, the specific requirements of the cycle are as follows:

Table 4: Test cycle for "Variable-speed, variable-load auxiliary engine" application

Test cycle type C1	Speed	Rated				Intermediate			Idle
	Torque	100%	75%	50%	10%	100%	75%	50%	0%
	Weighting factor	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15

4.2.1.5 Test conditions

a> The opening of the sampling point:

The sampling probes for the gaseous emissions shall be fitted at least 10 pipe diameters after the outlet of the engine, turbocharger, or last after-treatment device, whichever is furthest downstream, but also at least 0.5 m or 3 pipe diameters upstream of the exit of the exhaust gas system, whichever is greater.

The sampling probe is opened at the selected location, and connected by flange joint, and the joint flange is required as follows:

Table 5: size of joint flange.

Specifications	Size
external diameter	160mm
internal diameter	35mm
Flange thickness	9mm
Diameter of bolted ring 1	130
Diameter of bolted ring 2	65
Flange slot	4 holes in diameter 12mm, equidistant in the diameter of the bolt ring. Slot wide 12mm
Bolts and nuts	4 sets
The flange should be made of steel and the surface must be smooth.	

b> Test condition parameters and test validity:

The test is carried out on board, and the test condition parameters are affected by natural conditions. So, it is possible that the test condition parameters do not meet the requirements of the test standard. Therefore, the validity of the test condition parameters should be confirmed before the test. (Wang, X.H, 2014)

The method is to test the absolute temperature Ta and relative humidity R_a of the engine inhalation air with a ventilated dry and wet bulb thermometer, test the total atmospheric pressure P_b with the empty box barometer, and then calculate the test condition parameter f_a. This engine is a turbocharged engine, and the calculation formula of f_a is as follows:

$$f_a = (\frac{99}{p_s})^{0.7} \bullet (\frac{T_a}{298})^{1.5}; \qquad p_s = p_b - 0.01 R_a p_a$$

According to solution MEPC.177(58), This test is approved by the single type machine. Only the test condition parameter f_a should be calculated.

c> An engine with pressurized air cooling:

Because the engine has been installed on the ship, it is impossible to detect the temperature of the pressurized air. Therefore, this test only records the temperature of cooling water. According to the available data, the temperature of the engine cooling circulating water should be more than 40 degrees before the loading operation is allowed.

d> Power

The power we test is the power of the engine output shaft. And the required power consumption of auxiliary auxiliaries, such as pumps, has been deducted. So the measured power is net power.

e> Air intake system for engine

The test is carried out on board the ship. The engine has been equipped with a whole air intake system, which is completely applied to the test. Referring to the relevant data of KT50-G2, the rated power is carried out under atmospheric pressure 100kpa. According to the standard, the air pressure of this test should be within 100±0.3kpa range. When the tail gas is measured, the intake air pressure is monitored synchronously.

f> oil supply system

The test is carried out on board, and the diesel engine has a complete overall fuel supply system. The fuel supply system adopts Z type integral plunger fuel injection system and pump tube injector type fuel injection pump.

g> Engine exhaust system and sampling location

The test was carried out on board, and the engine was equipped with an overall exhaust system. Every row of cylinders of the engine is fitted with an exhaust cylinder, and two exhaust cylinders are remitted into a large exhaust cylinder above the engine and directly into the atmosphere through the deck. The length of the exhaust pipe below the deck is about 3 meters, the height of the exhaust pipe above the deck is about 2 meters, and the diameter of the pipe is about 20 centimeters. The sampling port is positioned 1.5 meters above the deck.

h> Test fuel

The fuel used in this experiment is GB-DMA class marine fuel oil (Chinese standard). Therefore, the test fuel can meet the requirements for the experimental fuel (MEPC.177 (58) resolution) for the experimental fuel (ISO 8217:2005 for DM grade marine fuel for engine type).

Ship-owners also need to provide fuel test report.

(1) fuel density (kg/m3); (2) the hydrogen content of fuel (%m/m); (3) carbon content of fuel (%m/m); (4) nitrogen content of fuel (%m/m);(5) oxygen content of fuel (%m/m);

4.2.1.6 measurement system：

The detection includes three parts: detection of engine parameters, detection of environmental parameters and detection of exhaust pollutants. All of them are carried out at the same time.

Firstly: Detection of engine parameters:

The testing cycle is C1 cycle, and the speed (rated speed, intermediate speed) and torque need to be tested. The intermediate speed for test cycle C1 shall be declared by the manufacturer, taking into account the following requirements:

.1 For engines which are designed to operate over a speed range on a full load torque curve, the intermediate speed shall be the declared maximum torque speed if it occurs between 60% and 75% of rated speed.

.2 If the declared maximum torque speed is less than 60% of rated speed, then the intermediate speed shall be 60% of the rated speed.

.3 If the declared maximum torque speed is greater than 75% of the rated speed, then the intermediate speed shall be 75% of rated speed.

.4 For engines which are not designed to operate over a speed range on the full load torque curve at steady state conditions, the intermediate speed will typically be between 60% and 70% of the maximum rated speed.

The maximum torque speed of the ship's engine is 900r/min, 75% of the rated speed, According to the standard, the transition speed of this test is the maximum torque speed declared, that is, 900r/min.

Because of the technical difficulties in the engine torque test on board, the torque measured by the wireless torque telemetry system is the shaft torque after the deceleration of the reducer (the speed of the reducer decreases and the torque increases). Therefore, the torque test is changed to: first calculate the power of the torque corresponding to each test point, and then use the wireless torque telemetry system to measure the power of each test point to confirm the torque. The power corresponding to the torque at each test point is shown in Table 3.

When the torque is tested, the result is related to the material of the test shaft. It is verified by the ship-owner that the shaft material is No. 35 steel. The Poisson ratio of it is 0.291, and the modulus of elasticity (Young's modulus) is 212GPa.

Confirmation of stable state: during each of the test cycles after the initial transition, the specified speed should be maintained within + 1% of the rated speed or + 3min^{-1} (the larger) (except for the low speed turning within the manufacturer's declared deviation). The torque should be maintained within 2% of the total torque of the whole process at rated speed of the engine.

Table 6: The torque and the speed

Maximum torque	6590N▪m			Rated torque			5730N▪m
allowable deviation of speed	±12r/min			allowable deviation of torque			±115N▪m
Speed	rated（1200r/min）				Intermediate（900r/min）			Idle
Test point	1	2	3	4	5	6	7	8
Torque	100%	75%	50%	10%	100%	75%	50%	0%
power range(kw)	828±14	621±14	414±14	83±14	621±14	466±14	311±14	/

Secondly: Detection of fuel consumption

When the testing engine is running stably at the test point, the fuel flow of the 3 intake pipes and the fuel flow rate of the return pipe are read at the same time. The arithmetic mean of the three time is the final fuel consumption

Thirdly: Detection of environmental parameters

The test contents include atmospheric pressure, intake humidity, intake temperature, and environmental parameters must be measured at every test point.

Fourthly: Detection of exhaust pollutants

The detection of the exhaust pollutants includes the content of the main components of the exhaust gas (nitrogen oxides, carbon monoxide, carbon dioxide, hydrocarbons, 0_2), the discharge flow and the exhaust temperature.

4.2.1.7 Detection method:

Putting the sampling probe of the automatic smoke detector and the diesel exhaust analyzer into the exhaust pipe through the sampling port. The sampling probe should be in the 10%~90% area of the flue diameter, as close as possible to the central point of the pipeline, and the temperature of the flue gas at the sampling point should not be less than 190 C^0. Then the soft cloth is used to block the sampling port to prevent the ambient air from entering the flue.

The exhaust gas recording time should not be less than 10min, and the sampling frequency should be no less than 3 times per minute. The average value of the last 60s recorded in each

model is used as the concentration of exhaust pollutants (CO, CO_2, HC, NO_x and O_2) under this mode. The measured concentrations of CO, HC, and NOx are recorded by ppm and accurate to the nearest whole number; the measured CO_2 and O_2 concentrations should be recorded in% and to the two decimal places.

The method of measuring exhaust gas flow is calculated by carbon balance method.

4.2.1.8 Measuring instrument

Instruments required for testing and their accuracy are shown in the table below.

Table 7: Instruments required for testing and their accuracy

Detection category	detection item	detection equipment	equipment type	instrument accuracy
Detection environment	Ambient humidity	Ventilated dry and wet bulb thermometer	TYPE:DHM2	humidity：1% temperature:0.2℃
	Intake humidity			
	ambient temperature			
	Intake temperature			
	Pressure	Air box barometer	DYM3	100pa
engine performance	Power	Wireless torque telemetry system	TQ201H	0.02 με（应变电桥）
	speed			1r/min
Engine exhaust parameters	Exhaust temperature	Automatic smoke and smoke tester	3012H	0.1℃
	/	Multifunction sampling tube for flue gas	1085A	/
Engine fuel consumption	weight	Electronic balance	DTF-A1000	0.01g
	Detection time	Stopwatch	PC2000A	0.1s
	Fuel flow velocity	Automobile oil consumption tester	VH4	0.1mL/min
Engine exhaust pollutants	NOx	Diesel engine exhaust analyzer	ELD	1ppm
	CO			1ppm
	CO_2			0.01%
	CHx			1ppm
	oxygen content			0.01%
Description	1085A, the sampling tube, is used in conjunction with the automatic smoke detector, which is widely used for smoke detection and smoke detection of organized (exhaust).			

4.2.1.9 Test contents and procedures

a> Preparation of the measurement system

Firstly, Preheating: Start the diesel exhaust analyzer, pretest the instrument, and the preheating time is at least 30 minutes.

Secondly, leaking detection of diesel engine exhaust analyzer: Leakage test device is used to leak test instrument for diesel exhaust analyzer. In the test, all the readings of the diesel exhaust analyzer should be nonexistent. If there is a reading record of a component, the pipeline should be inspected and the defect should be removed before repeating the above test. If it cannot be ruled out, the instrument shall not be used.

Thirdly: Calibration of diesel engine exhaust analyzer: Nitrogen is used for zero calibration of diesel exhaust analyzer and full range calibration with other standard gases. The calibration process is 3 minutes for each standard gas, and the result should not exceed the allowable deviation range of standard gas. The types and specifications of the standard gas are as follows:

Table 8: The types and specifications of the standard gas

NO.	standard gases	standard value	Use
1	N_2	/	zero calibration of diesel exhaust analyzer
2	NO	4870±97ppm	Calibration of nitrogen oxide detector in diesel exhaust analyzer
	NO_2	501±10ppm	
3	CO	2020±40ppm	Calibration of CO in diesel exhaust analyzer
4	CO_2	20.8±0.42%	Calibration of CO_2 in diesel exhaust analyzer
5	Propane	2500±50ppm	Calibration of Hydrocarbon in diesel exhaust analyzer
6	Pure air	21±0.42%	Calibration of O_2 in diesel exhaust analyzer

Fourthly, Installation of wireless torque telemetry system: The full bridge induction piece is mounted on the shaft between the gearbox and the machine. The installation of wireless torque telemetry system and the detection and calibration of exhaust pollutants are synchronized by different inspectors.

Fifthly, Adjustment of oil road: An automobile fuel consumption detector is installed on the total intake pipe and the total return pipe. In order to prevent accidents, the oil circuit adjustment should be installed after the strain gauge is installed, and the fire extinguisher should be installed at the scene.

Sixthly: Warm-operation

When the temperature of the engine cooling circulating water is more than or equal to 40 degrees Celsius, the warm-operation is completed, and then next test operation begins.

Seventhly: Test

There are eight test points, shown as follows. They are all carried out in accordance with the following procedures.

Table 9: Test procedures

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8
Speed	1200r/m	1200r/m	1200r/m	1200r/m	900r/m	900r/m	900r/m	Idle
Power	max	621	414	NONE	621	466	311	/

Step 1: The load and throttle of the engine are adjusted by the ship operator, and the state of the engine is monitored by the inspector. Since the wireless torque telemetry system has measured the rotation speed after the deceleration, when the engine speed is monitored, the measured speed should be multiplied by the reduction ratio, and the engine power under the load will be recorded in real time.

Step 2: When the speed and load reach the required value, the monitoring personnel should put the probe into the exhaust pipe from the sampling port, and the probe should be as close as possible to the center point of the pipe. The sampling port must be blocked by soft cloth, in order to prevent air from flowing into the exhaust pipe.

Step 3: When the speed and load reach the required value, the fuel consumption inspector can begin to monitor the engine fuel of the test point, and record the fuel flow of the oil pipe and the fuel flow rate of the oil pipe. They need to record three times (the data of the inlet pipe and the back oil pipe have to be recorded at the same time). The engine fuel consumption monitoring arranges another group of inspectors to synchronize with engine exhaust monitoring.

Step 4: After the closure is completed, the detection time (accurate to minute) can be recorded. The test points are detected for 10 minutes, and the last 60 seconds of the diesel engine exhaust analyzer are recorded (CO, CO_2, HC, NO_x and O_2, read every 20 seconds). These, engine exhaust flow, temperature, environmental parameters (atmospheric pressure, intake humidity, intake temperature) and cooling water temperature, should synchronously be recorded.

Step 5: After this test, the automatic smoke detector and the probe of the exhaust analyzer can be taken out, and ambient air must be absorbed by them for at least two minutes. After absorbing, the next test can be carried out.

These five steps are a complete detection program.

4.3 testing report

4.3.1 Basic Information:

Table 10: Basic Information

Testing Type	Commissioned Detection	Testing Category	Marine Engine Emission
Approval	Single model engine	Test Date	January, 2018
Application	Conveyor Belt Power	Surveyors	
Test address	Shenzhen		
Equipment	Section 1.Infralyt ELD Section 2.Wireless Torque Node TQ201H		

	Section 3. gas-pressure meter DYM3 Section 4. Flowmeter VH4 Section 5 katathermometer DHM2 型 Section 6. Stopwatch PC2000A
Basis	Section 1. Technical Code on Control of Emission of Nitrogen Oxides form Marine Diesel Engines(2008) Chapter 5 Section 2. Technical Code on Control of Emission of Nitrogen Oxides form Marine Diesel Engines(2008) Chapter 3

4.3.2 Test condition description

a> The description of the intake pressure

This test is carried out on board，atmospheric pressure range over standard requirements. Consider the whole test system as an open system. Atmospheric pressure can not be effectively controlled, this test only records actual atmospheric pressure, and participates in the calculation of the results.

b> The explanation of the test condition parameter fa

This test is recognized as a single type machine, and only the test condition parameter FA can be calculated.

c> The description of the transition speed

The maximum torque speed of the ship's engine is 900r/min, for 75% of the rated speed; According to the standard, the transition speed of this test is 75% of the rated speed, that is, 900r/min.

d> Description of 100% torque test point at rated speed.

The power required by the test point 1 (rated speed, torque 100%) is also unable to reach the maximum load of the belt, and the following adjustments are made to the test point 1:

In the case of the engine at the rated speed, the load of the belt is added to the maximum, the power of the measured power as the test point 1.

e〉 Description of 10% torque test point at rated speed.

Because of the larger friction force of the sand relief belt， the power consumed by the engine in driving the sand relief belt is already greater than the power of the test point 4 (rated speed, torque 10%).The following adjustments are made to the test point 4:

In the case of the engine at the rated speed, belt no-load (no weight), the actual work power is measured as the power 4 of the test point.

4.3.3 Test data

Table 11: Test data.

Engine Serial Number		HFNXSJ-01		Test cycle			C1
Density	838kg/m^3	Carbon		85.72%		Hydrogen	12.86%
Oxygen	0.82%	Nitrogen		0.02%		/	/
Mode	P1	P2	P3	P4	P5	P6	P7	P8
Time at beginning	11:14	11:25	11:42	10:47	12:43	12:19	12:00	12:53
Atmospheric pressure	101.7	101.7	101.7	101.7	101.7	101.7	101.7	101.7
Intake air temperature	27.5	27.8	28.1	27.0	28.6	28.4	28.3	28.7
Intake air humidity	16.27	16.99	18.02	15.96	18.79	18.71	18.26	19.09
Relative humidity(RH)of intake air %	71.6	72.5	74.1	70.3	75.0	75.6	74.2	75.7
Test condition parameter (fa)	1.156	1.164	1.174	1.145	1.186	1.184	1.178	1.190
Speed/ rmp	1179	1183	1217	1199	894	890	863	/
Power / kW	670	624	412	150	618	463	292	5
Fuel flow, kg/h	67.3	55.3	49.8	32.9	54.6	47.4	35.2	19

Exhaust flow (qmew)kg/h	2096	2162	1966	1465	1829	1881	1535	2290
NOx Concentration dry ppm	708	648	454	318	619	435	348	73
CO Concentration dry ppm	85	78	35	52	74	41	36	202
CO2 Concentration dry %	5.89	4.65	4.61	4.06	5.47	4.59	4.16	1.47
O2 Concentration dry %	13.07	13.52	14.80	15.26	13.64	14.67	15.30	18.43
HC Concentration dry ppm	6	5	16	33	5	10	9	19
NOx humidity correction factor khd	1.098	1.112	1.134	1.094	1.156	1.149	1.139	1.156
Dry/wet correction kwr	0.935	0.944	0.943	0.950	0.935	0.942	0.0947	0.967
NOx mass fiow kg/h	2.41	2.33	1.51	0.77	1.94	1.40	0.91	0.30
CO mass fiow kg/h	0.161	0.154	0.063	0.070	0.122	0.070	0.051	0.432
CO2 mass fiow kg/h	175	144	130	85.7	142	123	91.7	49.4
O2 mass fiow kg/h	283	304	303	234	257	287	245	450
HC mass fiow kg/h	0.006	0.005	0.014	0.022	0.004	0.008	0.006	0.020
NOx emission g/kW•h	3.61	3.74	3.68	3.14	3.13	3.29	3.13	59.3
weighting factor	0.15	0.15	0.15	0.1	0.1	0.1	0.1	0.15
Emission value g/kW•h	3.66							

4.3.4The Result of Diesel Engine Emission Test

Table 12: The Result of Diesel Engine Emission Test

Test Mode	C1
Manufacture	Chongqing Cummins Engine Company Ltd.
Engine Type	KTA38-G
Rated Power	720kw

Rated Speed	1200r/min
Max. Permissible NOx Emission (Technical rules for statutory inspection of inland ships 2015)	10.9g/kW•h
Engine Serial Number:	HFNXSJ-01
Engine Specific NOx Emission	3.66g/kW•h

4.3.5 Conclusion

The selected ship was built in 2013.The rated power of conveyor belt power is 720kw, rated speed 1200r/min. According to the Technical Rules for Statutory Inspection of Inland Ships (2015) ,the emission limit of the NO_x of the diesel is 45.0n-0.2g/kW•h, that is10.9g/kW•h. The NO_x emission value of the test diesel engine is3.66g/kW•h. The results conform to the requirements of Technical Rules for Statutory Inspection of Inland-river Ships (2015).

4.4 Summary of this chapter

On the whole, the issuance of the certificate on Prevention of Air Pollution for Inland-River Ships can not only meet the requirements of domestic laws and regulations, but also are able to meet the requirements of international conventions. In this chapter, by showing the process and basis for the issuance and the detection of nitrogen emission from an auxiliary engine, the requirements of inland regulations are basically consistent with the international regulations MARPOL ANNEX IV. That is to say, regulations of inland vessels are formulated and implemented in accordance with the requirements of international laws and regulations. This shows that the decision makers of inland regulations are more macro and international in considering this aspect. The advantage of this is that it saves time and money for ship-owners, and provides convenience for executives to perform. Its practical application value is fully reflected on H/MR. This kind of certificate issued in accordance with the regulations of inland rivers and ships will also be easily recognized by the maritime authorities of Hong Kong and Macao.

And, when the resolution is implemented specifically, emission test is able to meet requirements. Through a complete and detailed demonstration of the process of nitrogen emission detection and the last testing report, we can draw a conclusion that the current nitrogen emission detection process of inland ships could basically meet international standards and requirements, and the results of the detection also meet relevant standards. In the process of testing, we can see that the selection of the test cycle, the selection of test points and the use of the testing instruments are fully in line with the requirements of international resolutions. This shows that at present, there are useful conditions for inland ships to carry out this type of inspection according to the requirements of international conventions. This provides a test condition for inland vessels sailing on H/MR.

However, the whole process may not be perfect, for example, when tested on board, it is impossible to avoid accidental errors. There are some bad factors, such as the shaking of ships, the influence of harsh environment on human beings, and so on. They might lead accidental errors. Therefore, we need to constantly improve the testing process and implement the regulations more prospectively.

Compared with Chapter 3， the result meets the requirements of Tier II and does not meet tier III. But now the maritime safety administrations of Hong Kong and Macao are accredited to inspection certificates of inland-river vessels. That is to say, if they satisfy the regulations of inland-river vessels, the certificate issued by the ship inspection department of Guangdong can be obtained, while Hong Kong and Macao will approve the certificate.

And, we have found that the detection of nitrogen emissions is applicable to resolution 177(58). But there is a very small difference between domestic rules and international conventions on the requirements of preventing the issuance of air pollution certificates, which is the difference between the certain emission limits. But this does not prevent the issuance of air pollution certificates and the application to Hong Kong and Macao.

All in all, In H/MR that need to meet the international regulations, some provisions of the inland waterway regulations have already met the specific requirements, and requirements of Resolutions that need to be implemented.

Chapter 5: Similar management modes in foreign countries

The route between the mainland of China and Hong Kong and Macao is unique all over the world. It is very special for a sovereign state to manage two specific types of waterway transport and three different kinds of jurisprudence.

Still, the Rhine River Road is similar to it and managed very successfully over years. The biggest difference between them is that the H/MR is governed by a sovereign state while the countries flowing through the Rhine are sovereign states. But, we can learn quite a lot from the Rhine international shipping management, especially on management and technical aspects. (Zu, Q.D, 2015)

5.1 Backgrounds of the Rhine international shipping management.

The Rhine is the largest river in Western Europe. It flows through several European countries and is 1232 kilometers long. Since the Vienna conference in 1815, it has become an international shipping channel, about 869 kilometers (540 miles) long, far to the Swiss German border of Rhine, and finally to North sea near Rotterdam.

Among many famous navigable international rivers, the Rhine international shipping management has a long history, mature operation and remarkable effect. There are many international treaties signed around the Rhine shipping, the most important of which is the earliest International Convention on the International River Shipping Management System, namely, the Mannheim convention of the international river free navigation system, and the earliest international organization in the world, the Rhine Central Airlines Transport Committee. After several decades of operation of the Convention, the International Convention and statute

of the international navigable waterway system was built in 1921on the basis of the experience of shipping transnational management in the Rhine. With the advancement of the European integration process, a series of regional rules and instructions on inland river shipping have been introduced after the establishment of the European Union. These new mechanisms of the EU inland shipping laws combined with the original international conventions have made the cooperation of countries in the international shipping management of the Rhine closely and standardized. This also greatly promoted the development of the shipping industry on Rhine River, and made Rhine become the busiest river in the world. Most importantly, at the same time, it also realized the internationalization and standardization of the Rhine shipping.

The most important thing is that, in the ten or twenty years after the formal establishment of the EU, the number of new EU International River shipping laws and regulations had been greatly increased, and the content was very rich. It also involved many levels of shipping, transportation management and marketization of international river shipping. In this period, many decrees made great breakthroughs in the Rhine international shipping management, such as the unification of ship technical standards, the coordination mechanism of ship withdrawal, the multinational mutual recognition of shipping qualification, the international shipping safety management, the construction of international shipping information service system, etc.

5.2 Centralized management and organization

The current international shipping business on the Rhine is still mainly managed by Central Commission for the Navigation of the Rhine (short for CCNR), which is a long history international organization. As the most professional and experienced organization, it provides concrete specifications for the day-to-day management of transnational transportation of the Rhine by making numerous laws and regulations.

The regulations include the Rhine navigation rules, transportation regulations of dangerous goods, police regulations, quarantine regulations, inspection regulations and so on. The technical standards mainly include the standard of navigable navigation of the Rhine system, the agreement on the standardization of the logistics of the Rhine, the standard of the

qualification assessment of the unified captain's certificate, the standard of the qualification of the crew, the standard of ship inspection, the standard of the emission limit of ships and so on.

These regulations and norms concerned with the details of international river shipping can be recognized to be the capillaries of the legal mechanism of the Rhine international shipping management, which has a great role in the specific shipping practice.

5.3 The unification of the technical standards of ships sailing on the Rhine.

After the Mannheim convention was signed, in order to implement the principle requirements for strengthening the unified management of technical indicators, such as the structure and strength of the Rhine ships, CCNR has formulated the ship inspection regulations to regulate the various technical standards of ships engaged in shipping. Vessels sailing on the Rhine are generally unified into several more standardized ship types, which are favorable for waterway management and navigation safety. Although these technical rules do not have to be uniform, it is only the general requirement of ship type unification, but after the long effort of CCNR, the ships sailing on the Rhine have realized the standardization and unification of the ship type earlier, which greatly facilitated the safety management.

Of course, CCNR also formulated the rules for the emission limits and installation of engines, and inserted them into the Instructions 2006 / 87 / EC of the technical requirements for the inland river ships.

5.4 A reference to H/MR

By understanding the management and technical regulations of the Rhine, we can find that inland vessels navigating across administrative regions can be standardized. Therefore, we can learn from the practice of the Rhine to further optimize the management of the special historical navigating route. First of all, we can try to establish a special coordination committee to manage H/MR, such as the entry threshold, exit mechanism and some other laws and regulations, and then they can formulate or coordinate the regulations and technical specifications for the ship. These regulations could be in line with the actual situation of the route, and higher than the

standards of other inland vessels. In this way, we can manage and promote the safety of this route more efficiently。

Chapter 6: Conclusion

Through the description of this article, we can find the way to solve the contradiction of the requirements of inland vessels to meet the requirements of H/MR. We know the inspection of inland ships in the prevention of air pollution, which can be in accordance with the requirements of domestic regulations and the requirements of relevant resolutions of international conventions to issue certificates and carry out effective testing. After meeting the requirements of the international convention, such vessels satisfy the condition for sailing in this route. As a special domestic route, ships navigating this route need to meet the requirements of local maritime departments in Hong Kong and Macao, that is, to meet the requirements of international conventions.

The basis for detection of nitrogen emissions by inland vessels is consistent with international conventions. At present, there is no uniform technical specification for ship inspection on this route. But through analyses, we have found that both of them use Resolution 177(58). The whole nitrogen emission test process of inland river ships is carried out in strict accordance with the contents of the resolution. It shows that the inspection in inland waterway vessels is required to meet the requirements of H/MR. However, if the technical specifications can be unified or related to the inspection agreement, or maritime departments of three sides could establish effective ship inspection communication mechanism, it will be more convenient for ships on that route.

We can establish communication mechanism with reference to the management of the Rhine. At present, it is difficult to establish a special management committee similar to CNNR, but a coordination committee can be established to coordinate shipping management, ship inspection

management. They can provide performance or other protection for daily ship navigation. Some ship technical specifications and standards can also be discussed.

All of the measures mentioned above are designed to better meet the requirements of Hongkong and Macao maritime departments, and to better meet the technical requirements of the transport of Hong Kong and Macao.

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