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Investigation report on the fire and explosion accident of the "M" ship in Ningbo, Zhejiang Province on August 9

事故调查报告公开

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Report Introduction

At around 1346 on August 9, 2024, the Liberian container ship "M"

Bozhoushan Port Co., Ltd. Beilun Second Container Terminal Branch No. 2 berth operation

During the process, a container loaded on the starboard side of the No. 1 cargo hold caught fire and exploded.

Some nearby containers and the hull were damaged.

According to the Maritime Traffic Safety Law of the People's Republic of China

Regulations on the Investigation and Handling of Maritime Traffic Accidents and other laws and regulations, the establishment of maritime administration agencies

Therefore, the investigation team launched an accident investigation and evidence collection work.

The investigation team adhered to the principles of comprehensiveness, objectivity, fairness and timeliness, and conducted in-depth and comprehensive

Through on-site inspection, investigation and evidence collection, scientific experiments, and expert discussion,

The course of the accident, its causes and direct economic losses were ascertained, the responsibility for the accident was determined, and a

Provided safety management recommendations.

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Investigation report on the fire and explosion accident of the "M" ship in Ningbo, Zhejiang Province on August 9

1. Overview of the accident

At 1346:30 on August 9, 2024, the Liberian container ship "M" berthed Ningbo Zhoushan Port Co., Ltd. Beilun Second Container Terminal Branch No. 2 Berth (Abstract) Position: 29°56.7' N/121°50.4' E) During the operation, the dangerous goods collection on the starboard side of the bow Packing (Container No.: MWCU6639680, Loading Position: 020982, Contents: Tert-butyl perbenzoate) caught fire and exploded, causing damage to some nearby containers The ship was damaged, resulting in direct economic losses of about 90 million yuan, constituting a large-scale water transportation accident. accident.

Figure 1: Accident location

2. Professional Terminology

1. AIS: Automatic Identification System

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2. CCTV: Closed Circuit Television

(III) TEU: Twenty-foot Equivalent Unit (IV) UN: United Nations Number

(V) TBPB: Tert-Butyl Peroxy Benzoate

ester

ÿÿÿSADT:Self Accelerating Decomposition Temperature, SADT

(VII) TMR: Time to Maximum Rate, induction period, from current temperature to

The time at which the maximum reaction rate corresponds to the temperature

8. VTS: Vessel Traffic Service

(IX) IMDG: International Maritime Dangerous Goods Code

III. Investigation and Evidence Collection

The investigation team collected the legal documents of the accident ship, crew certificates, cargo information and relevant

The log records were collected and CCTV video of the dock during the incident was retrieved;

The scene was inspected; the crew members and other relevant personnel were interviewed;

The weather, sea conditions and navigation environment of the waters where the incident occurred were investigated;

production, transportation, packing, storage, loading, declaration and other related information; investigated the safety of ships

The company commissioned a professional thermal safety laboratory to conduct a thermal safety assessment of TBPB.

Experiments and model predictions.

IV. Overview of ships, crews and shipping companies

1. Main technical data and information of the vessel.

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Ship name: M Port of Registry: Mongolia

IMO No.: 9457737 Callsign: A8XY6

Ship type: container ship Hull material: steel

Length: 305.6 meters Width: 40.0m

Depth: 20.16m Gross Tonnage: 76787

Net Tons: 41396 Main engine power: 58015 kW

Date of completion: May 17, 2011 Navigation area: Unlimited navigation area

Ship owner and place of registration: ALL OCEANS TRANSPORTATION INC./ Monrovia, Liberia

Ship manager and place of registration:YM (SINGAPORE) PTE.LTD/ Singapore

(2) Vessel certification status.

The "M" vessel holds a ship nationality certificate issued by the Liberian Maritime Administration. Minimum safe manning certificate, safety management certificate issued by DNV, company A copy of the certificate of compliance, holding a cargo ship construction safety certificate issued by the American Bureau of Shipping, tonnage Certificate, load line certificate, dangerous goods fitness certificate and other inspection certificates. Within the validity period.

(3) Crew conditions.

The vessel has 20 crew members on board for this voyage, all of whom hold a certificate of entry into force signed by the Liberian Maritime Administration. The ship's manning meets the requirements of the "Minimum Safe Manning Certificate for Ships" held by the ship. Requirements. The main crew members are as follows:

Ji, captain, holds a certificate of unlimited navigation area with a gross tonnage of 3,000 tons and above issued by Shanghai Maritime Safety Administration.

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The master's certificate of competency of the ship is valid and issued on May 3, 2024 in Shenzhen.

Shenzhen Shekou boarding service, resting in the room before the incident, after hearing the sailor on duty report abnormal

Go to the bridge to give commands.

Gu, the first mate, holds a license for unlimited navigation area of 3,000 gross tons and above issued by Shanghai Maritime Safety Administration.

The certificate of competency for the master of the ship is valid and issued on August 6, 2024.

Offshore vessel service, in the deck office at the time of the incident.

Xie, second mate, holds a license of 500 gross tons and above issued by Shandong Maritime Safety Administration for unlimited navigation area.

The certificate of competency for the second mate of the ship is valid and issued on August 6, 2024.

Serving on a ship at sea, and was on duty at the bridge during the incident.

Zhou, a sailor on duty, holds an assistant-level aviation certificate issued by the Taiwan Provincial Transportation Department.

Certificate of competency for duty seaman (watchman) in 2024

He joined the ship in Shanghai on June 14, 2017 and was patrolling on the deck at the time of the incident.

(IV) Shipping company information.

The registered owner of the vessel "M" is ALL OCEANS TRANSPORTATIO

N INC. (hereinafter referred to as Quanyang Company), registered in Monrovia. The ship manager is Y

M (SINGAPORE) PTE.LTD (hereinafter referred to as YM Singapore Company), registered place

In Singapore. Quanyang Company is a wholly-owned subsidiary of YM Singapore Company;

The Singapore company is a wholly-owned subsidiary of YM.

HM (Shanghai) International Shipping Agency Co., Ltd. (hereinafter referred to as HM Company) is responsible for

Ming Company's related affairs in mainland China. Quanyang Company signed a time charter agreement with YM Company.

Quanyang Company leased the vessel "M" to YM Company.

The actual operation and management of the "M" vessel is directly under the responsibility of YM Company; HM Company

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Responsible for cargo solicitation, the booking approval and loading of dangerous goods are ultimately the responsibility of YM Company.

(V) Supervision and management situation.

The last port state security inspection of the “M” vessel was on January 24, 2024 in Shenzhen.

Shenzhen Maritime Safety Administration conducted the inspection and found 2 defects, both of which were related to life-saving equipment and

The incidents are not related.

(6) Route conditions.

The "M" ship is a regular ship from China to the Middle East, with the port sequence: Shanghai - Ningbo - Xiamen

Gate - Shekou - Klang (Malaysia) - Jebel Ali (UAE) - Hamad (Qatar)

Tal) - Umm Qassar (Iraq) - Hamad (Qatar) - Jebel Ali (Arabia)

United Arab Emirates – Singapore – Shanghai. The single voyage takes about 50 days. This voyage number is 079W.

The previous port is Shanghai, the next port is Xiamen, and the destination port of this dangerous goods shipment is Jebel Ali, UAE.

V. Situation of the goods involved

1.1 Introduction to TBPB

The technical name of the cargo loaded in the container in question is tert-butyl perbenzoate.

It belongs to Class 5.2 of the International Maritime Dangerous Goods Code. Benzoic acid peroxide

Tert-butyl ester (TBPB), molecular formula C11 H14 O3, is an organic peroxide.

A colorless to slightly yellow liquid with a slightly aromatic odor.

Polymerization processes of propylene, vinyl acetate, diallyl phthalate and isobutylene

TBPB is used as an initiator. The TBPB molecule contains a peroxide bond (-OO-)

Thermal instability, it will decompose when heated, releasing a lot of heat.

The rate of heat loss is lower than the rate of heat release, so combustion, explosion, etc. are very likely to occur.

The main decomposition products of TBPB are carbon dioxide, methane, tert-butyl alcohol,

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Benzoic acid, benzene, etc. will produce suspended particles and droplets when decomposing, forming white smoke.

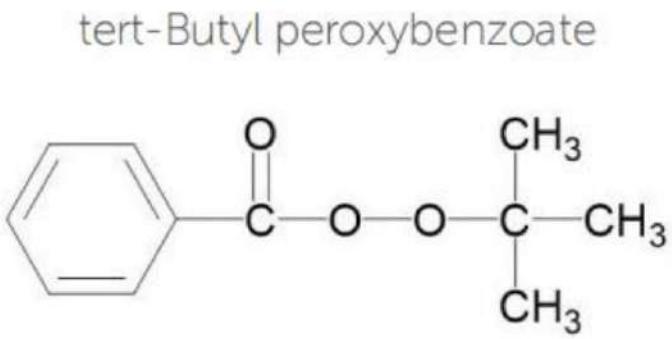

Figure 3: TBPB molecular structure

(2) Characteristics of the goods.

According to the relevant description of the International Maritime Dangerous Goods Code, Class 5.2 has Organic peroxides are thermally unstable substances that can generate heat and self-accelerate decomposition. In addition, such substances may have one or more of the following properties: explosive Decomposes explosively, burns rapidly, is sensitive to impact or friction, reacts with other substances Dangerous reactions, damage to eyes. Easily decomposes exothermically at room or elevated temperatures. Contact with impurities (e.g. acids, heavy metal compounds, amines) Friction or collision energy Initiates decomposition. The decomposition rate varies with temperature and with the composition of the peroxide. Decomposition can release harmful or flammable gases or vapors. For some organic peroxides The transportation temperature needs to be controlled. Some organic peroxides may decompose explosively. This property can be improved by adding diluents or using appropriate packaging. Many peroxides burn violently.

Article 2.5.3.2.4 of the International Maritime Dangerous Goods Code does not contain benzoic acid peroxide Tert-butyl ester requires temperature control during sea transportation.

(3) Situation of goods production enterprises.

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The TBPB manufacturer involved is a Jiangxi New Materials Co., Ltd. (hereinafter referred to as Jiangxi

The company was established on June 16, 2020 and is located in Yichun City, Jiangxi Province.

The company holds the Safety Certificate issued by the Jiangxi Provincial Emergency Management Department on November 14, 2023.

Production License", valid from September 29, 2022 to September 28, 2025

Permitted scope: tert-butyl perbenzoate (2000t/a), benzoyl peroxide

(2000t/a), 2,4-dichlorobenzoyl peroxide (3000t/a), by-product peroxide

Di-tert-butyl (109t/a).

The company has a safety department, a technical department, a production department, a quality inspection department, and a sales department.

The production department consists of workshop director, tert-butyl peroxybenzoate team leader,

Benzoyl oxide team leader. There are two Class A warehouses, one for storing benzoyl peroxide and the other for storing

Formyl and tert-butyl perbenzoate, with warehouse management personnel.

6. Ambient temperature and weather and sea conditions

(a) Ambient temperature.

Query Shanghai weather related information. Since July 2024, Shanghai has entered

The high temperature weather continued, with the maximum daily temperature exceeding 35ÿ on 21 and 22 days in July and August respectively.

26 days, including 28ÿ to 40ÿ between July 25 and August 7.

The highest daytime temperature reached 40ÿ. According to the on-site packers, on July 25

1500-1700 The ambient temperature during packing is about 35ÿ.

According to the August 9, 2024, data provided by Ningbo Meteorological Disaster Emergency Warning Center

The hourly maximum temperature near Beilun Wharf is recorded, and 1300-1400 near Beilun Mountain.

The highest temperature was 38.9ÿ, the highest temperature of the day.

At 8:39 on August 9, an orange high temperature warning signal was issued.

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Due to the impact, the highest temperature in some areas of Beilun can reach 37-39ÿ, and even above 40ÿ in some places.

According to the ship's logbook, the temperature was 33°C at 12:00 on August 9.

(2) Weather and sea conditions.

During the voyage from Shanghai to Ningbo, the "M" ship visited the Yangtze River Estuary and Ningbo-Zhoushan waters.

The weather was clear, visibility was good, and the wind force was 3-4.

Towards southeast, the current is about 1 knot, with light waves.

7. Cargo loading

1. General situation

When docked at Ningbo Port, the “M” vessel was loaded with a total of 2,128 TEUs (4,113 TEUs).

There are 29 dangerous goods containers (27 on deck and 2 in the cabin, totaling 255.2

tons), 28 transit containers, and 1 unloaded at Ningbo Port (unloaded at the time of the incident).

The “M” ship plans to unload 1,045 containers in Ningbo, including 897 empty containers.

pcs (872 pcs in 40ft, 25 pcs in 20ft), 148 heavy boxes (125 pcs in 40ft,

23 20-foot containers, including 1 dangerous goods container). At the time of the incident, 701 containers had been unloaded.

Containers, including 592 empty containers (569 40-foot containers, 23 20-foot containers), 109 loaded containers

(86 40-foot containers, 23 20-foot containers, including 1 dangerous goods container).

The "M" ship plans to load 1,018 containers in Ningbo, all of which are heavy containers.

There are 929 40-foot containers and 89 20-foot containers, including 15 dangerous goods containers, 13 plug-in

At the time of the incident, 295 heavy containers were loaded (242 40-foot containers and 53 20-foot containers).

including 2 dangerous goods boxes).

At the time of the incident, the "M" ship was carrying 1,722 natural containers.

(ii) 01-03 Loading conditions of the bay compartment.

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When the “M” vessel berthed at Ningbo Port, 24 natural containers were loaded at bay 01-03.

There were 18 medium and heavy containers and 6 empty containers. At the time of the accident, 4 containers were loaded on the deck of the 03 Bei 14 row.

The boxes (3 full boxes, 1 empty box) have been unloaded. Of the remaining 20 natural boxes, 5

The dangerous goods are located at 011082, 031082, 031084, 031086,

020982, except for the container in question which was loaded on the starboard side, the other four dangerous goods containers were loaded on the

port.

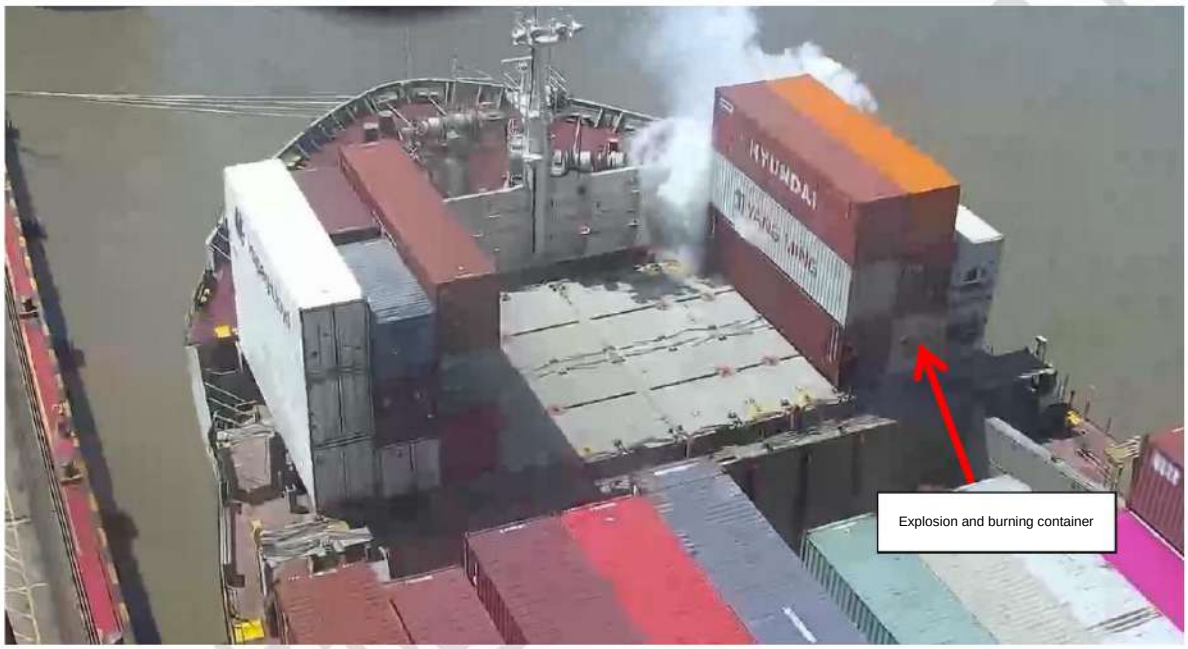

Figure 2: Cargo loading situation at bay 01-03 at the time of the incident

(3) Stowage and isolation of exploded and burning containers.

The container in question was loaded on the first floor of the first hold.

UN 3103 cargo stowage category is D, limited to

Deck loading, stowage code SW1, need to avoid heat sources; "M" dangerous goods fitness certificate

The book states that Class 5.2 dangerous goods may only be loaded on deck.

When the “M” arrived at Ningbo Port, it was carrying 29 dangerous goods containers, namely

Class 2.2, Class 3, Class 5.2 (the dangerous goods in the container in question), Class 6.1

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Class 1, Class 8 and Class 9 dangerous goods are all in closed containers.

For closed containers, dangerous goods of Class 5.2 and dangerous goods of Classes 3 and 8

The isolation requirement is "isolation", that is, 1 container space is separated from the front and rear, and 1 container space is separated from the horizontal

It is forbidden to install them in the same vertical line (unless separated by a deck);

The isolation requirement for Class 6.1 is “keep away”, which means there is no restriction in the fore-aft and lateral directions.

On the vertical line; no segregation requirement with Class 9. At the same time, the segregation code for UN3103 cargo is

SG35, SG36, and SG72 need to be "isolated" from acids and alkalis.

The stowage plan and dangerous goods list of the "M" ship showed that the container in question was

No other dangerous goods containers are loaded in any of the containers, and no other dangerous goods are loaded vertically.

In summary, the stowage of the container in question complies with the international dangerous goods regulations and the ship's dangerous goods certificate of fitness.

Book requirements.

8. Goods packaging and packing

1. Packaging conditions.

The packaging containers used for the goods that exploded and burned were blue plastic cans, also known as plastic cans.

Non-detachable tank top tank, capacity 25L, size 420*310*270mm, tare weight 1.7KG,

There is a vent on the top. The batch number of the packaging container is 3H1/Y1.6/100/24CN/C400123.

The production date is June 1, 2024, and the manufacturer is a new material limited company in Jiangxi.

Company. Jiujiang Customs issued the "Inbound and Outbound Goods Packaging Performance Specification" on June 6, 2024.

The inspection result sheet shows that this batch of packaging containers meets the requirements of Class II packaging.

On 28th of this month, Yichun Customs issued the "Results of the Identification of the Use of Dangerous Goods Transport Packaging for Outbound Transportation"

The "List" shows that the applicability and usage of the packaging container meet the requirements of international hazardous regulations.

According to the requirements of the International Dangerous Goods Code, UN3103 cargo is subject to the packing guideline P520.

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The packaging method of TBPB is OP5, and the maximum liquid volume is 30L.

International Danger Regulations for special packaging of organic peroxides: All containers

If the package is sealed, a strong

internal pressure, in which case a vent may be installed.

As far as danger occurs, the amount of contents must also be limited.

The design must ensure that when the package is in a vertical position, liquid will not leak and impurities cannot

Intrusion. If present, the outer packaging shall be designed so that it does not affect the operation of the ventilation device.

In summary, there is no abnormality in the packaging of the goods and it complies with the requirements of international dangerous goods regulations.

(2) Condition of container body.

The container in question is a refrigerated container (plugged in) with refrigeration function.

Manufactured in 2003, it passed the inspection of the American Bureau of Shipping and was issued a production certificate on March 9, 2003.

On July 23, 2024, Shanghai HX Container Services Co., Ltd.

A rental inspection report was issued for the container, which showed that there was no abnormality in the quality of the container body.

Before packing on July 25, Shanghai JY Enterprise Development Co., Ltd. (hereinafter referred to as JY Company)

The packers and the XH Safety Solutions Co., Ltd. (hereinafter referred to as XH Company) supervisors

The inside and outside of the box were checked and no abnormalities were found.

In summary, the container in question was not deformed, damaged or otherwise unsuitable for sea use before the incident.

Abnormal conditions of transportation.

(3) Packing conditions.

The container number involved is MWCU6639680, loading position 020982, loading

The technical name of the cargo is tert-butyl perbenzoate (TBPB, Class 5.2 dangerous goods,

UN3103), net weight 16000KG, gross weight 17088KG. Use blue plastic

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Cans (volume: 25L), package quantity 640 cans, net weight of each can 25KG,

Gross weight 26.7KG. Every 32 cans are loaded on a wooden pallet and tied with lashing straps.

After solidification. There are 20 pallets in total in the box, 2 pallets in a row, 9 rows in total,

The inner row has 2 layers, and the rest have 1 layer. The second layer of the innermost row and the outermost row

Each can of cargo is labeled

The correct shipping name, UN number and other important cargo information is marked on the container.

Signs/plats showing the correct hazards are posted on all four sides of the box.

In summary, there is no abnormality in the packing of the goods, which complies with the safety regulations for packing dangerous goods containers by sea.

Full technical requirements.

IX. Cargo transactions, bookings, declarations, customs clearances, and transshipments

(1) Transaction details of the goods involved.

On March 30, 2024, JT Chemical Co., Ltd. (hereinafter referred to as JT Company)

Ordered 16 tons of TBPB from Nantong Chemical Technology Co., Ltd. (hereinafter referred to as Nantong Company).

25 kg each can, total 640 cans, and 32 cans are required to be packed into one pallet, total 20

On June 7, Nantong Company ordered 29.6 tons of TBPB from Jiangxi Company, including

16 tons were sold to JT Company, 1.6 tons were sold to Malaysia, and 12 tons were sold domestically.

The above 16 tons of TBPB were resold to Company P. Company P designated the consignee as Iran.

Lang Company.

Nantong Company holds a dangerous chemical business license issued by the Rudong County Administrative Approval Bureau.

The license is valid from April 25, 2023 to April 24, 2026.

The scope includes TBPB.

(ii) Booking status

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In June 2024, Company P commissioned Shanghai YX International Logistics Co., Ltd. (hereinafter referred to as YX Company) is responsible for domestic freight forwarding business. YX Company entrusts FHX International Logistics (Shanghai) Co., Ltd. (hereinafter referred to as FHX Company) to carry out booking, and FHX Company also commissioned We booked the space with Shanghai CR International Logistics Co., Ltd. (hereinafter referred to as CR Company). Booked HMM through Shanghai COSCO Shipping Logistics Co., Ltd.'s public booking platform HMM shares the space of YM's "M" ship.

To ensure the quality of delivery, the port of destination, Jebel Ali Port, United Arab Emirates, The policy impact (such cargoes need to be plugged into the refrigerated container during storage at the port yard), P Company YX Company was commissioned to transport the cargo using refrigerated containers. However, due to the limited space on the ship, Failed to book refrigerated container space, so YX Company negotiated with P Company to use refrigerated container Loading, but transported as an ordinary box without plugging in during sea transportation, after arriving at Jebel Ali Finally, P Company agreed to the plan, and then YX Company implemented it. OK.

On July 26, 2024, after CR booked the space, HMM sent an email to ask if it CR Company replied to the email to confirm whether to use refrigerated containers instead of dry cargo containers for transportation. HMM headquarters will send basic cargo information such as cargo technical specifications to YM by email The Dangerous Goods Center asked whether to accept the shipment, and the Dangerous Goods Center of YM Company replied to the email on the same day. Confirm that the container can be loaded on the ship.

(3) Declaration of vessels and cargoes.

YX Company commissioned Shanghai LL International Freight Forwarding Co., Ltd. (hereinafter referred to as LL Company) Company) to make a safe and transportable declaration of dangerous goods. On July 24, LL Company submitted a The Dangerous Goods Safety Transport Declaration Form was submitted to the Bureau of Transportation and the cargo declaration was completed.

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Sinotrans Shipping Agency Co., Ltd. (hereinafter referred to as Sinotrans) carries dangerous goods on board ships

On July 30, the shipping agency submitted a report on dangerous goods on board to the Pudong Maritime Safety Administration.

Cargo declaration form, complete the ship declaration. The ship and cargo declaration are normal and the process meets the requirements.

(IV) Customs declaration status.

On August 4, 2024, YX Company commissioned the customs declaration company MS International Logistics (

Shanghai) Co., Ltd. (hereinafter referred to as MS Company) for customs declaration, and MS Company

The customs declaration form was submitted to complete the customs declaration.

(V) The transportation situation of the goods involved.

YX Company commissioned Shanghai DE International Logistics Co., Ltd. (hereinafter referred to as DE Company)

Responsible for container packing and road transportation, DE Company commissioned JY Company to carry out the packing work

Industry.

On July 24, Jiangxi Company commissioned a vehicle to transport the palletized goods from the factory.

The cargo was transported from Jiangxi to Shanghai. The cargo on the same truck totaled 17.6 tons of TBPB, 22 pallets

pallets, including the 16 tons (20 pallets) involved in this incident, and another 1.6 tons (2

pallets) were sold to Pasir Gudang, Malaysia.

At around 1440 on July 25, the vehicle arrived at JY Company and began to unload

During the packing operation, the packing temperature was consistent with the ambient temperature at about 35°C.

TBPB sealed the box after packing was completed on the same day, and the packer signed the packing certificate.

The containers were stacked in the open-air yard of JY Company.

The packing process was supervised and XH Company issued a loading supervision report on July 29.

On August 4, DE Company arranged a vehicle to transport the container in question to Shanghai GC Dangerous Goods Co., Ltd.

Dangerous Goods Co., Ltd. (hereinafter referred to as GC Dangerous Goods Warehouse) and stored them in an open-air yard.

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GC Hazardous Depot arranged a transport vehicle to transport the container in question to the ZD Branch of Shanghai Port Group.

Then install it directly to the "M" wheel.

The above-mentioned transport vehicles and their affiliated companies all hold valid dangerous goods road transport licenses.

The driver and escort personnel hold a valid road dangerous goods transport driver or

Escort qualification certificate. No abnormality was found in the process from factory transfer to loading.

The investigation found that on July 25, the same batch of goods as the goods involved were shipped from the manufacturer.

1.6 tons of TBPB (sold to Pasir Gudang, Malaysia) arrived at JY Company at

JY Company loaded the container with the container number FCIU5318822 (ordinary dry cargo container).

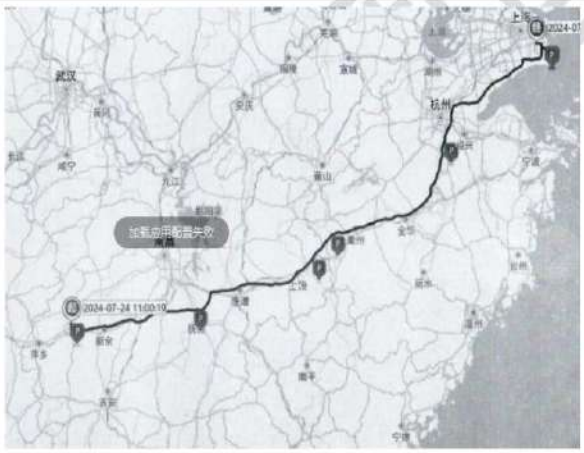
A container also contained 3.84 tons of DTBP (Di-Tert-Butyl Peroxide, UN3107) and was stored in the open-air yard of JY

Company.

FCIU5318822 container was transported to GC hazardous storage and stored in the open-air yard on August 3

Loaded to “OOCL LE HAVRE” and unloaded at Pasir Gudang, Malaysia on August 13

The goods were returned empty on August 16.



Vehicle GPS records from Jiangxi to Shanghai

Condition of the goods when they arrived at JY Company

Figure 1: Transportation from Jiangxi to Shanghai by land

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Goods enter the port city dangerous warehouse

Cargo out of the city warehouse

Figure 2: Records of containers entering and leaving the port city's dangerous warehouse

Figure 4: Hoisting onto the ship from the dock

10. Accident Process

The accident process was mainly based on the interrogation record, the ship's AIS track, and the CC of the on-site dock.

TV footage and statements from relevant personnel.

At around 0050 on August 7, 2024, the "M" ship loaded with 4113 TEUs departed from Shanghai Port.

The ZD branch of the group set sail from berth 3# and headed for Ningbo Beilun.

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At around 0312 on August 9, the vessel docked at Ningbo Beilun Second Container Terminal Branch.

Company 2# berth.

At around 13:30, Zhou, a sailor on duty, smelled an unusual irritating odor while inspecting the bow.

taste.

At around 1331, the sailor on duty found the container involved in position 02 (Container No.: MW

CU6639680, loading position: 020982) Slight white smoke, transparent

Slightly yellow liquid leaked, accompanied by white smoke and a "hissing" sound.

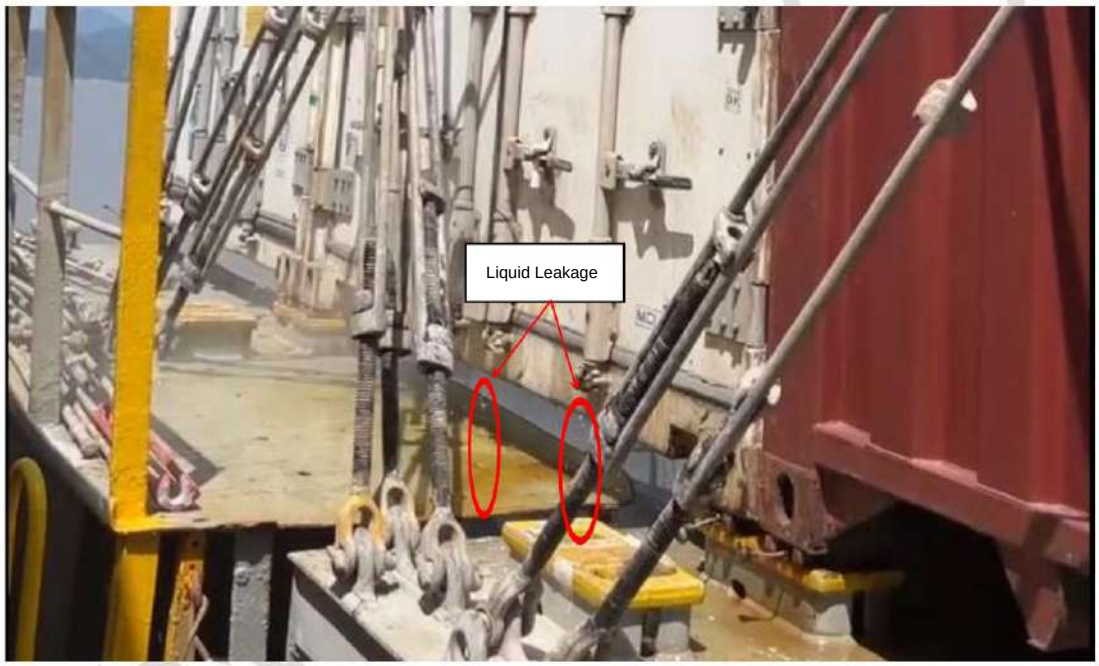

Figure 5: Liquid cargo leaking onto the deck

At around 1333, the sailor on duty reported the situation to the second mate and the chief mate via high frequency.

After receiving the report, the second mate went to the scene to check.

At around 1337, the amount of white smoke coming out of the container in question continued to increase.

The second mate and sailors at the bow were notified to evacuate, and the captain activated the fire alarm at the bridge.

All the people on board were asked to assemble at the assembly point near the deck office.

At 1338:12, CCTV at the on-site terminal showed that the direction of the container door in question was

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A small amount of smoke was seen.

Figure 6: A small amount of smoke from the bow

At 1338:30, the speed of the white smoke eruption increased, and the starboard bow was covered by smoke.

A small amount of white smoke overflowed from the exhaust fan of the container compressor involved.

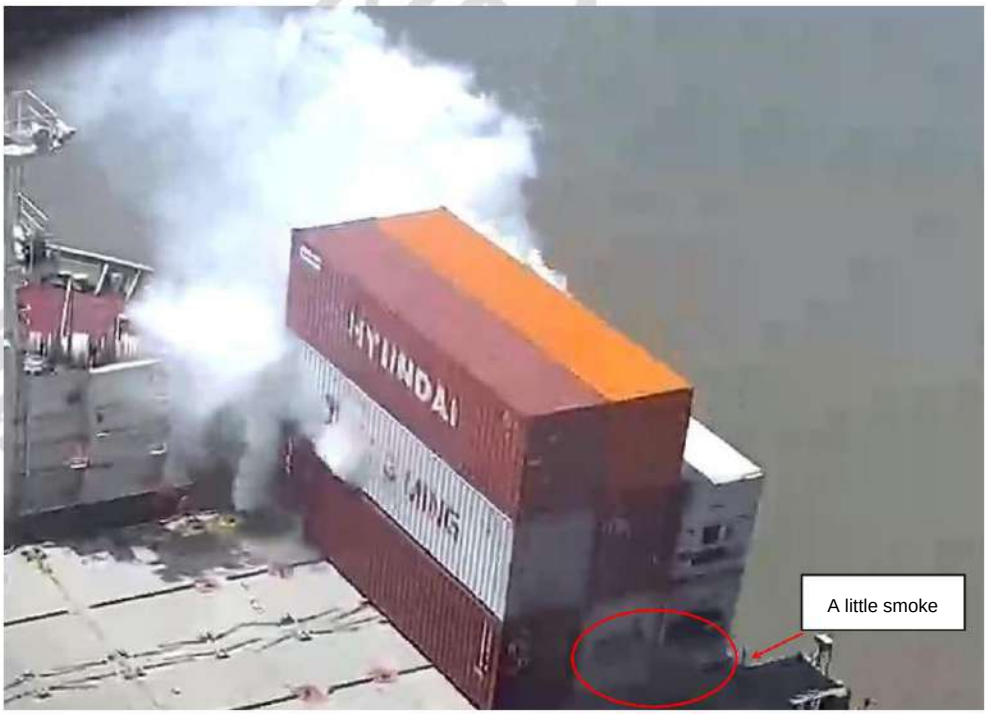

Figure 7: The starboard bow is covered by smoke

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At 1339:00, a large amount of smoke erupted over the bow of the ship. The container compressor involved

The amount of white smoke overflowing from the exhaust fan increased.

Figure 8: Increased smoke from the compressor exhaust fan

At 1339:20, a large amount of white smoke erupted into the air, covering the starboard side of the bow.

Figure 9: Smoke covering the starboard bow

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From 1339:20 to 1346:29, white smoke mixed with light yellow continued to spray in large quantities.

Covering the entire bow position.

Figure 10: Bow situation at 1346:29

At 1346:30, the container exploded and burned, causing the container and the surrounding 3

Containers (Container No.: SEGU9098453, TGBU6448277, HDMU6698

375) disintegrated; 2 containers (Container No.: SEGU9145703, YMMU654447

8) Fell on the dock and beach; 4 containers (container numbers: HLBU9673964, HL

BU9400661, HAMU2142020, TCNU2319688) fell into the sea. Parts are adjacent

The container caught fire.

At around 1348, the captain asked everyone to evacuate to the quarter deck.

At around 1354 hours, all 20 crew members on board were evacuated ashore.

XI. Emergency Response

At around 1350 on August 9, Ningbo Maritime Search and Rescue Center received a report that the Beilun Second Episode

Dangerous goods in transit loaded on the Liberian ship "M" at berth 2 of the container terminal branch

The dangerous cargo container exploded and caught fire. After receiving the report, the Ningbo Maritime Safety Administration immediately launched the

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The Provincial Maritime Search and Rescue Center shall immediately report to the Provincial Maritime Search and Rescue Center.

After receiving the report, the search and rescue center initiated an emergency response in accordance with the provincial plan requirements.

After the accident, leaders at all levels of the Ministry of Transport, Zhejiang Province and Ningbo City attached great importance to it.

The two search and rescue centers promptly implemented the instructions of their superiors.

Directors of the provincial and municipal maritime search and rescue centers

The whole process of tracking and command, the executive deputy director and deputy director of the provincial and municipal maritime search and rescue centers

At the same time, they went to the duty rooms of the provincial and municipal search and rescue centers to direct the rescue operations and coordinate the efforts of various parties.

We quickly organized on-site disposal work: First, we used VTS to

Water traffic control is implemented in the waters between Huangmang and Beilunshan Wharf, and ships are suspended from berthing and leaving.

Operations and dangerous operations, passing ships should stay away from the waters to prevent secondary accidents.

It is to organize the crew, ship dock staff, dock container vehicles and bridge cranes and nearby ships

Third, urgently coordinate with relevant units and personnel to quickly determine the relevant positions.

Enter the name, quantity, nature and stowage of each type of cargo to form the actual loading situation of the cargo.

The fire situation map provides a scientific basis for the selection of on-site fire-fighting methods and materials.

Experts from multiple departments and fields, including firefighting, ports, ecological environment, and ship inspection, have established an emergency response team.

The expert group provided full guidance on emergency response at the dock site, promoted fire fighting and ship

Drainage and other work were carried out in an orderly manner. Fifth, 11 fire-fighting tugboats and 1 professional rescue ship were coordinated.

"Donghai Rescue 102", a chemical emergency ship "Sinochem Emergency" and 56 fire trucks, etc.

The forces coordinated firefighting in accordance with the mode of "sea and land coordination, saturation spraying, and cooling firefighting."

Sixth, coordinate vessels to implement on-site alert, assign pollution prevention vessels, and deploy oil containment vessels at sea.

Seventh, coordinate with the ecological environment department to monitor the air quality and water quality on site.

Carry out real-time detection to prevent secondary hazards. Eighth, mobilize drones to find the source of fire in the box.

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Verification of hull damage, on-site firefighting assistance, and other aspects are monitored around the clock.

After rescue, the fire on the "M" ship was basically extinguished at 0630 on the 10th.

Disposal forces continued to spray the smoking container to cool it down and prevent it from re-igniting.

Firefighters boarded the ship to detect the fire; at 2100, the fire situation was basically stable, with only a small amount of residual fire in the box.

At 12:00 on August 11, two containers that had caught fire were lifted off the ship and landed.

The last burning container on the ship was breached and foam was sprayed into the container.

At 17:00 on August 11, firefighters boarded the ship and found that the temperature of the box was consistent with the outside temperature.

Abnormally high temperature points. According to the "Expert Evaluation Methods for Termination (Suspension) of Maritime Search and Rescue Operations (Trial)

The explosion and burning of a dangerous cargo container on the M vessel was a serious problem.

The disposal operation was completed. During the entire emergency disposal process, no casualties were caused and the water was

Transportation was safe and orderly, and no secondary disasters occurred.

During this period, a total of 4 patrol boats ("Haixun 22", "Haixun 07105", "Haixun 0

7128" and "Haixun 07132"), 1 professional rescue ship "Donghaijiu 102", 1 chemical

Professional emergency ship "Sinochem Emergency", 11 fire tugboats, 8 pollution emergency boats, 10

Other emergency boats, 56 fire trucks and 4 drones were deployed on site to carry out emergency response work.

do.

12. On-site inspection

The investigation team conducted an on-site inspection of the "M" ship on August 11, 2024 and found

The explosion caused the containers on the starboard deck of hold 1 to disintegrate or fly away, and the containers on the port side to burn.

The damage was serious, the hatch cover of cabin 1 was seriously deformed, and the nearby deck and hull were damaged and deformed.

Some of the loaded containers caught fire and some of the containers in holds 1-4 were flooded.

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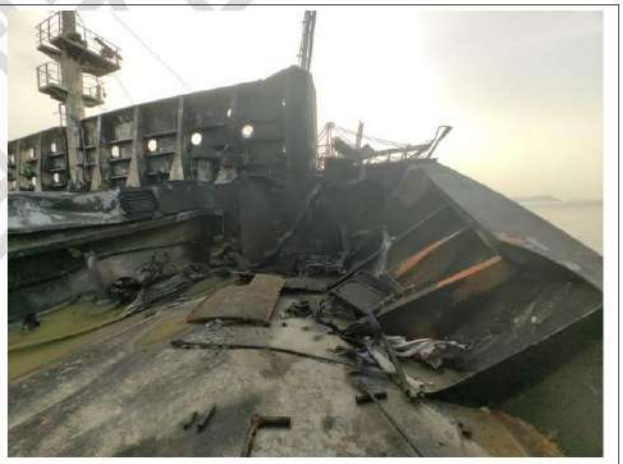
Figure 11: Overall situation on site

	
1. The hatch cover of the cabin was seriously damaged.	The starboard side of the ship was damaged and deformed

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Fire on port side container

06 Beiwei container body caught fire

Water ingress into the cabin

Water ingress into the cabin

Figure 3: Regional inspections

13. Losses from the accident

According to statistics, among the 20 containers loaded on deck 01-03 of the “M” ship, 4

6 were blown up, 10 were burned; some containers in other locations were destroyed.

Fire or flooding damage; the hatch cover of the No. 1 compartment of the "M" ship and the nearby hull were damaged and deformed.

The economic loss was about 90 million yuan.

14. Analysis of the Cause of the Accident

In this accident, all the goods, cargo packaging cans, and refrigerated containers involved were destroyed.

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The investigation team conducted an investigation on the cause of the accident from the entire accident chain and around the factors of the accident.

The analysis is as follows:

1. Vessel factors. The “M” vessel is seaworthy and suitable for loading, the crew is competent, and the crew is on duty.

During the shift, we conducted a tank inspection as required, discovered the cargo leakage early, and took corrective measures.

Accurate emergency measures were taken to evacuate personnel in time and avoid casualties.

2. Cargo factors. From the International Maritime Dangerous Goods Code and the trials of professional organizations

Experiments have found that TBPB is thermally unstable and can self-decompose at room temperature.

The decomposition reaction releases a lot of heat and produces gas or steam. The higher the temperature of the cargo

The faster the self-reaction accelerates. In this incident, an unplugged refrigerated container was used to load TBPB.

The non-electric refrigerator has good thermal insulation and airtightness, poor heat dissipation, and is nearly insulated and airtight.

The closed environment isolates the heat loss. The heat generated by the self-decomposition reaction of TBPB is

The TBPB accumulates in the storage box and the temperature inside the box increases, which accelerates the self-decomposition reaction of TBPB.

It develops into thermal runaway and eventually causes fire and explosion.

3. Environmental factors. Since July, Shanghai has been experiencing a hot summer with high

On July 25, during the packing of the TBPB cargo, the packing temperature and the surrounding

The ambient temperature was consistent (around 35°C).

Ningbo continues to experience high temperatures, with daytime temperatures reaching around 40°C. Containers are piled up in the open air.

The temperature outside the box is higher. The high temperature weather objectively causes the temperature inside the box to rise when TBPB is packed.

High, which affects the stability of goods and increases transportation risks.

4. Management factors. First, the carrier did not do enough when reviewing the cargo transportation plan.

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[1] Simulation experiments show that the TBPB reaction heat exceeds 1380 J/g and the adiabatic temperature rise exceeds 800°C. According to the "Specifications for Safety Risk Assessment of Fine Chemical Reactions" (GB/T 42300-2022), the severity of the decomposition reaction is the highest level, which is catastrophic.

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The carrier failed to take precautions against high temperatures in summer, the self-heating of the cargo, and the lack of plugging

Based on the actual situation of electric refrigerated containers, such as thermal insulation, the stability of goods and the risk of thermal runaway are analyzed.

After a thorough safety assessment, we agreed to use an unplugged refrigerated container to transport the dangerous goods.

There was negligence and no attention was paid to the temperature changes in the box during transportation.

The transportation plan of transporting TBPB in unplugged refrigerated containers during the hot season is inappropriate.

TBPB shippers failed to take into account the thermal insulation and airtightness of unplugged reefers in hot weather

Comprehensively assess the risk of thermal runaway of TBPB and avoid improper selection of unplugged reefer containers.

nor did they provide more effective warnings to the carriers.

5. Other aspects. First, no abnormalities were found in other links during the transportation of goods.

The packaging cans used for the goods in question have passed the customs performance inspection and usage appraisal.

The energy and quality meet the requirements. There is no abnormality in the land transportation from the manufacturer to the packing yard.

During packing, the packers and supervisors checked and found no deformation, damage or leakage of the packaging cans.

There was no leakage, and no abnormality was found in the land transportation and loading and unloading operations from packing to loading.

The inspection report of the container showed that the quality of the container was normal.

The ship was not affected by severe weather such as strong winds and waves during its departure from Shanghai and berthing in Ningbo.

The same batch of goods produced by the manufacturer are packed in the same batch of packaging cans and shipped at the same time

A batch of TBPB shipped to the same yard and loaded into a regular container at the same time, August 3

After loading in Shanghai on 14 August, the cargo arrived safely at the Pasir Gudang Port in Malaysia for unloading on 13 August.

No abnormalities occurred during transportation.

In summary, the investigation team determined that the shipper,

The carrier chose to use unplugged refrigerated containers to transport TBPB in hot weather conditions.

Influence of insulation and airtightness of non-electric refrigerators, heat generated by TBPB self-decomposition reaction

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Gathering in the box, causing the temperature of the goods in the box to rise, causing the goods to decompose faster

The reaction, until thermal runaway occurs, is the key factor leading to this fire and explosion.

15. Conclusion

The accident occurred on board the “M” vessel, which was carrying an unplugged refrigerated container (container

No. MWCU6639680) was a fire and explosion accident caused by thermal runaway of cargo.

When the carrier and the shipper agree, select and review the TBPB transportation plan for the ticket,

Failure to exercise sufficient caution in light of the high temperature at the time and the exothermic nature of the cargo's self-decomposition reaction

Risk factors such as thermal insulation and airtightness of unplugged refrigerated containers have an impact on packing

The potential safety risks in the transportation process are not fully assessed.

In hot weather, the TBPB was shipped in unplugged refrigerated containers, which caused the cargo to

The heat generated by the decomposition reaction accumulates in the box, and the temperature of the goods in the box rises sharply, causing

The cargo's self-decomposition reaction accelerated until thermal runaway occurred, which was the cause of the fire and explosion.

The investigation team determined that both the carrier and the shipper were responsible for the accident.

responsibility.

16. Safety Management Suggestions

1. Suggestions for freight carriers.

1. Improve the booking and review system for Class 5.2 dangerous goods.

Booking management, strict review of dangerous goods safety technical information, no

When choosing a transport plan for Class 5.2 packaged dangerous goods that require temperature control, consider the environment and

The environmental temperature, container characteristics, cargo packing time and transportation voyage duration are combined

Assess transportation safety risks and prudently use unplugged refrigerated containers for transportation that do not require temperature control

Class 5.2 dangerous goods.

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2. Take more cautious management measures for Class 5.2 dangerous goods.

Pay special attention to containers of organic peroxides and strengthen regular temperature measurement and ventilation as appropriate.

Eliminate safety hazards through appropriate means such as wind.

(ii) Suggestions for cargo consignors.

Strengthen the training of dangerous goods transportation knowledge and strengthen the management of dangerous goods booking.

Understand the physical and chemical characteristics of the cargo and inform the carrier, and strictly review the safety technology of dangerous goods.

Information, for dangerous goods of class 5.2 packaged in IMDG regulations that do not require temperature control,

When choosing a transportation plan, you should consider the ambient temperature, container characteristics, cargo packing time, and

Comprehensively assess transportation safety risks based on factors such as the duration of the transport journey, and use non-plugged cooling with caution

Class 5.2 goods that do not require temperature control are shipped in containers.

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