Pollution Cleanup Operation Plan

Qingdao Shunli Ocean Service Co.,Ltd.

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一、General Principles

1.1 Purpose of Compilation

To standardize the company's pollutant cleanup operations in Qingdao Port area and adjacent coastal waters, clarify operational processes, technical standards, and safety requirements, ensure the rapid, efficient, and scientific disposal of pollution accidents such as vessel oil spills and chemical leaks, minimize the damage of pollutants to the marine ecological environment, shoreline resources, and related rights and interests, and protect the safety of operators and public interests. This plan is formulated in accordance with relevant laws, regulations, and emergency cleanup capacity requirements.

1.2 Scope of Application

This plan applies to various vessel-related pollutant cleanup operations carried out by the company in Qingdao Port area (including terminal berths, anchorages, waterways, etc.) and surrounding coastal waters (bounded by Qingdao's maritime jurisdiction). It includes, but is not limited to, the emergency disposal of pollution accidents such as vessel oil spills and bulk liquid chemical leaks, as well as daily pollution prevention-related cleanup operations assisting vessels.

1.3 Compilation Basis

- Marine Environmental Protection Law of the People's Republic of China
- Water Pollution Prevention and Control Law of the People's Republic of China
- Emergency Response Law of the People's Republic of China
- Regulations on the Prevention and Control of Vessel-induced Pollution to the Marine Environment
- Provisions on the Prevention and Preparedness and Emergency Response to Vessel-induced Pollution to the Marine Environment
- Requirements for Emergency Oil Spill Cleanup Capability of Vessel Pollution Cleanup Units
- Guidelines for the Use of Oil Spill Dispersants (GB/T 18188.2-2000)
- Oil Spill Dispersants - Part 1: Technical Requirements (GB/T 18188.1-2021)
- Qingdao Municipal Emergency Plan for Marine Oil Spill Incidents

1.4 Terms and Definitions

- Pollutants: Substances such as oils and hazardous chemicals that enter water bodies due to vessel operations, collisions, groundings, leaks, etc., and may damage the water environment and ecosystems.

- Emergency Cleanup: Urgent disposal actions carried out after a pollution accident to control the spread of pollutants, recover and remove pollutants, and protect environmentally sensitive resources.
- Secondary Pollution: New pollution caused by improper disposal during cleanup operations, such as the transfer and spread of pollutants, or the leakage and irregular disposal of cleanup equipment and recovered pollutants.
- Environmentally Sensitive Resources: Protected resources in Qingdao Port and adjacent coastal waters that are vulnerable to pollution damage, such as marine biological habitats, mangroves, coral reefs, coastal wetlands, nature reserves, drinking water sources, aquaculture areas, and coastal tourist areas.
- Oil Boom: Flexible or rigid protective equipment used to block and enclose oil pollution to prevent its spread.
- Oil Recovery Equipment: Specialized equipment used to recover oil pollution from water surfaces, including oil skimmers, oil absorbent mats, and oil skimming devices.

1.5 Working Principles

- Prevention First, Rapid Response: Strengthen daily prevention and emergency preparedness, establish a rapid response mechanism, immediately initiate operational procedures upon receiving a pollution accident report, and arrive at the scene to carry out disposal in the shortest possible time.
- Scientific Disposal, Classified Implementation: According to factors such as pollutant type, leakage volume, water environment, and meteorological conditions, scientifically select cleanup technologies, equipment, and methods, and formulate targeted disposal plans to improve cleanup efficiency.
- Safety First, People-oriented: Strictly abide by safe operating procedures, strengthen personnel safety protection and on-site safety management, and prevent safety accidents and secondary pollution during operations.
- Ecological Priority, Strict Prevention of Secondary Disasters: Embed the concept of ecological protection throughout the cleanup process, prioritize the protection of sensitive resources, standardize the use of cleanup equipment and the disposal of recovered pollutants, and strictly prevent secondary pollution.
- Coordinated Linkage, Clear Division of Labor: Strictly follow the connection requirements of the "Company Emergency Plan - Qingdao Municipal Emergency Plan for Marine Oil Spill Incidents", obey unified command, and strengthen coordinated cooperation with maritime, environmental protection, port management, emergency management and other departments.

二、Overall Emergency Strategy

2.1 Emergency Response Classification

Combined with the characteristics of Qingdao Port waters (dense waterways, concentrated anchorages, abundant coastal sensitive resources) and the impact of pollution accidents, the emergency response is divided into four levels:

- Level I Response: Major pollution accidents, such as large-scale oil spills from large oil tankers and hazardous chemical vessels (oil leakage ≥ 100 tons, hazardous chemical leakage ≥ 50 tons), with pollutants spreading to sensitive resource areas or potentially causing major ecological damage.
- Level II Response: Significant pollution accidents, such as vessel oil leakage of 50-100 tons and hazardous chemical leakage of 20-50 tons, with pollutants approaching sensitive resource areas or causing serious impacts on port operations.
- Level III Response: General pollution accidents, such as vessel oil leakage of 10-50 tons and hazardous chemical leakage of 5-20 tons, with pollutants confined to local waters of the port area and not affecting sensitive resources.
- Level IV Response: Minor pollution accidents, such as vessel oil leakage < 10 tons, hazardous chemical leakage < 5 tons, or leakage of domestic sewage and garbage, with a small pollution scope and controllable impact.

2.2 Emergency Organization and Dispatch

1. Response Initiation: Upon receiving a pollution incident alarm, the Company’s General Administration Department shall immediately verify the incident information (vessel name, location, type of pollution, leakage volume, diffusion trend, etc.), and report to the Commander-in-Chief to activate the corresponding level of response in accordance with the grading standards and issue emergency instructions.
2. Resource Dispatch: Establish a nearby oil spill emergency equipment warehouse, set up 1 emergency material reserve point in Huangdao Port Area, storing oil booms, oil recovery equipment, absorbents, protective equipment, etc.; equip 2 professional cleanup vessels and 8 emergency auxiliary vessels.

2.3 Overall Disposal Process

1. Pollution Monitoring and Assessment: Upon arriving at the scene, immediately verify the pollutant type, leakage source, spread scope, and concentration distribution through on-site investigation, assess the threat level to sensitive resources, and form a preliminary assessment report.
2. Pollution Source Control: Prioritize measures to block the leakage source (such as closing valves, using plugging equipment, emergency unloading, etc.) to prevent continuous leakage of pollutants.

3. Pollutant Containment: According to hydrological and meteorological conditions such as water flow, wind direction, and water depth, quickly deploy oil booms to construct a containment area to block the spread of pollutants, especially focusing on protecting sensitive resource areas and port waterways.
4. Pollutant Recovery and Removal: Combine the pollution type and scenario, select targeted disposal methods such as oil recovery equipment, absorbents, and oil spill dispersants to maximize the recovery of pollutants.
5. Follow-up Disposal: Standardize the transfer and disposal of recovered pollutants and used cleanup equipment; conduct follow-up monitoring and restoration of polluted waters and shorelines, and evaluate the disposal effect.

三、Environmental Sensitive Resource Protection Plan

3.1 Investigation and Classification of Sensitive Resources

Sort out the main sensitive resources in Qingdao Port and adjacent coastal waters, and divide them into core protection category, key protection category, and general protection category:

- Core Protection Category: Jiaozhou Bay National Marine Park, Lingshan Island Provincial Nature Reserve, Laoshan Water Source Protection Area, coastal coral reef habitats, and activity areas of rare aquatic organisms (Chinese white dolphins, amphioxus).
- Key Protection Category: Laoshan Bay Aquaculture Area, West Coast New Area Coastal Tourism Resort, Tangdao Bay Wetland Park, and tidal flat wetlands around the port.
- General Protection Category: Ordinary coastal green spaces and shallow waters around non-core waterways.

3.2 Classified Protection Strategies

1. Core Protection Category:

- In the event of a pollution accident, prioritize setting up double oil booms (fireproof oil booms on the inner side and deep-water oil booms on the outer side) outside the sensitive resources to construct a "protective isolation zone" and strictly prohibit pollutants from entering the core area.
- Prohibit the use of chemical dispersants, chemical absorbents, and other materials that may cause secondary pollution in the core area, and give priority to physical containment and manual recovery methods.
- If pollutants approach the core area, immediately coordinate with maritime departments to implement traffic control, suspend operations of surrounding vessels, activate emergency diversion channels, and guide pollutants to non-sensitive areas.
- Simultaneously link with environmental protection, forestry, fishery and other departments to carry out auxiliary measures such as emergency evacuation of sensitive organisms and habitat protection.

2. Key Protection Category:

- Adopt the "containment + rapid recovery" strategy, deploy regular oil booms at the boundary of sensitive resources to prevent pollutants from spreading to aquaculture areas and tourist areas.
- Environmentally friendly absorbents can be used in appropriate amounts in areas not directly in contact with sensitive resources, and absorbents are strictly prohibited from entering aquaculture water bodies or tourist beaches.
- After the operation, promptly clean up residual pollutants on the shoreline and tidal flats, conduct intensive monitoring of water quality in aquaculture areas, and evaluate the pollution impact.

3. General Protection Category:

- Adopt regular containment and recovery measures, reasonably select cleanup technologies and equipment to ensure effective removal of pollutants and avoid the expansion of the pollution scope.

3.3 Key Protection Measures

1. Dynamic Monitoring and Early Warning: Real-time obtain hydrological and meteorological (water flow, wind direction, tide), water quality monitoring data, predict the spread path of pollutants, and deploy protective forces in advance.
2. Priority Deployment Mechanism: Upon receiving a pollution alarm, if the accident location is close to a sensitive resource area, adopt the principle of "first protection, then cleanup", prioritize dispatching forces to deploy oil booms at the boundary of sensitive resources, and then carry out leakage source plugging and pollutant recovery.
3. Equipment Selection and Control: For operations in sensitive resource areas, select non-toxic and environmentally friendly cleanup equipment (such as natural fiber oil absorbent mats), and avoid using chemical products containing heavy metals and non-degradable components.

四、Pollution Source Control Plan

4.1 Sorting of Main Contracted Vessel Types and Cargo Types

The main contracted vessels of Qingdao Port include container ships, oil tankers (crude oil, fuel oil, diesel), bulk carriers (coal, ore), chemical tankers (methanol, ethanol, acids and alkalis, aromatics), LNG carriers, etc. The corresponding main pollutant risks are as follows:

Vessel Type	Main Cargo Types	Key Pollution Sources	Pollution Risk Characteristics
Container Ships	Various goods (including packaged hazardous chemicals)	Vessel fuel oil, leakage of packaged goods	Dispersed leakage points, complex types of hazardous chemicals, prone to causing toxic and harmful pollution
Oil Tankers	Crude oil, fuel oil, diesel	Cargo oil tank leakage, fuel oil tank leakage, oil spill during loading and unloading operations	Large leakage volume, fast spread speed, serious pollution to water bodies and shorelines
Bulk Carriers	Coal, ore	Vessel fuel oil, cargo dust (water sedimentation)	Mainly oil pollution, dust sedimentation may affect water transparency
Chemical Tankers	Methanol, ethanol, acids and alkalis, aromatics	Cargo tank leakage, dripping during loading and unloading operations	Pollutants are toxic and corrosive, prone to causing acute damage to water bodies and organisms
LNG Carriers	Liquefied natural gas	Fuel oil leakage, small amount of LNG leakage (gasification)	LNG gasification causes no water pollution, but the fuel oil leakage risk is the same as that of oil tankers, and fire and explosion prevention is required

4.2 Targeted Pollution Source Control Plans

4.2.1 Oil Tankers (including Fuel Oil Transport Vessels)

- Prevention and Control:
  - Before operation, verify the sealing condition of the vessel's cargo oil tanks and fuel oil tanks, check the integrity of loading and unloading equipment (oil delivery hoses, valves), sign a safety operation agreement, and clarify the responsibilities of both parties.
  - Arrange special personnel to monitor the loading and unloading operations throughout the process, install oil spill monitors to monitor for leaks in real-time; control the loading and unloading speed to avoid oil spills due to excessive pressure.
  - Require vessels to be equipped with a sufficient number of emergency plugging equipment, oil booms, and oil absorbent mats to ensure that the vessels themselves have initial emergency disposal capabilities.
- Emergency Control for Leakage:
  - If a cargo oil tank/fuel oil tank leaks, immediately instruct the vessel to close the relevant valves and stop loading and unloading operations; use wooden wedges, plugging plugs, and other equipment to block the leakage port. If the leakage volume is large, activate the emergency unloading plan to transfer the remaining oil to standby vessels or storage tanks.
  - Quickly deploy oil booms to construct a containment area around the vessel to prevent oil pollution from spreading; simultaneously activate oil skimmers, oil absorbent mats, and other equipment to recover oil from the water surface.
  - If an oil spill occurs due to the rupture of a loading and unloading hose, immediately close the valves at both ends of the hose, remove the damaged hose, and replace it with a standby hose; contain and recover the leakage area.

4.2.2 Chemical Tankers

- Prevention and Control:
  - Before operation, verify the physical and chemical properties (toxicity, corrosiveness, volatility, water solubility, etc.) of the hazardous chemicals carried, formulate a special operation plan, and equip corresponding protective equipment (chemical protective clothing, gas masks, acid and alkali resistant gloves, etc.) and emergency disposal equipment (neutralizers, absorbents, plugging equipment).
  - Strictly abide by the safe operating procedures for hazardous chemical loading and unloading during operations, control the operating pressure and flow rate, use anti-static equipment, and avoid spark generation that may cause leaks or explosions.
- Emergency Control for Leakage:
  - Water-soluble chemicals (such as methanol, ethanol, acids and alkalis): use absorbents to absorb residual pollutants on the water surface. For acidic leaks, an appropriate amount of alkaline neutralizer (such as sodium carbonate) can be added,

and for alkaline leaks, an acidic neutralizer (such as citric acid) can be added. Monitor the pH value during the neutralization process to avoid secondary pollution due to excess.

- Water-insoluble chemicals (such as aromatics): Refer to the oil pollution control method, adopt the method of containment + adsorption + recovery, and strictly prohibit the use of oil spill dispersants (which may cause chemical spread and aggravate toxic effects).
- Leakage of toxic and harmful chemicals: Operators must wear full set of chemical protective equipment, set up a warning zone, and prohibit irrelevant personnel from entering; if volatile gas leakage occurs, coordinate with maritime departments to implement traffic control to prevent fire and explosion risks.

4.2.3 Container Ships

- Prevention and Control:
  - Before operation, verify the fixing condition of containers, check the packaging labels and sealing status of hazardous chemical containers to confirm compliance with transportation requirements; focus on checking for leakage traces in containers loaded with liquid hazardous chemicals.
  - Strengthen cargo hold inspections during vessel navigation and berthing, especially in severe weather, to prevent container displacement and falling that may cause cargo leakage.
- Emergency Control for Leakage:
  - If a container falls into the water or is damaged leading to cargo leakage, first determine the type of leakage through monitoring and select targeted disposal methods: prioritize salvaging and recovering solid goods (such as packaged chemicals); refer to the chemical tanker leakage disposal plan for liquid goods.
  - Domestic sewage leakage: Use absorbents to absorb floating objects on the water surface, add microbial purifiers to accelerate water purification, and avoid sewage spreading to aquaculture areas or water sources.
  - Vessel fuel oil leakage: Implement the oil pollution control plan to quickly contain and recover.

4.2.4 Bulk Carriers and LNG Carriers

- Bulk Carriers:
  - Prevention and Control: Before operation, check the sealing condition of the vessel's fuel oil tanks and oil delivery pipelines; install dust-proof facilities at the terminal during coal and ore loading and unloading to avoid a large amount of dust drifting into the water body; require vessels to standardize the discharge of tank washing water, which must be discharged up to standard after sedimentation treatment.
  - Emergency Control: Dispose of fuel oil leakage according to the oil pollution disposal plan; for dust sedimentation pollution, use high-pressure clean water to flush dust

floating on the shoreline and water surface, and collect the flushing wastewater into sewage treatment facilities to avoid direct discharge into the sea.

- LNG Carriers:
  - Prevention and Control: Before operation, check the tightness and safety of the fuel oil system and LNG loading and unloading system; equip special fire and explosion prevention equipment, and strictly prohibit open flames at the operation site.
  - Emergency Control: Dispose of fuel oil leakage according to the oil pollution disposal plan; in case of a small amount of LNG leakage, focus on preventing fire and explosion risks, evacuate surrounding personnel and vessels, strengthen ventilation, and resume operations after the natural gas is gasified and diffused.

五、Marine Pollutant Recovery and Cleanup Plan

5.1 Oil Spill Containment Plan

5.1.1 Functions of Oil Booms

1. Performance Requirements of Oil Booms by the Environment

In the "Oil Boom Standards", the waters where oil booms are used are divided into four types: calm waters, calm rapid waters, sheltered waters, and open waters. Calm waters refer to waters with a wave height of 0-0.3m and a water flow speed of less than 0.4m/s; calm rapid waters refer to waters with a wave height of 0-0.3m and a water flow speed of 0.4m/s or more; sheltered waters refer to waters with a wave height of 0-1m; open waters refer to waters with a wave height of 0-2m or more. Different water environments have different performance requirements for oil booms. No single oil boom can be applied to all water environments. Only by selecting an oil boom that meets the performance indicators according to the specific water environment can the function and role of the oil boom be fully exerted.

Performance Requirements of Oil Booms in Different Waters

	Calm Water Surfaces (Lakes, Harbors) with Wave Height < 0.3m	Calm Water Surfaces with Current (Such as Rivers)	Sheltered Coastal Waters with Wave Height < 1.5m	Open Waters with Wave Height > 1.0m
Freeboard	0.2-0.5m	0.3-0.5m	0.4-0.6m	0.5-1.0m
Draft	0.2-0.5m	0.3-0.7m	0.4-0.8m	0.6-1.5m
Buoyancy-to-Weight Ratio	3:1-10:1	3:1-10:1	5:1-12:1	8:1-15:1
Total Strength	Not less than 10Kn	Not less than 30Kn	Not less than 50Kn	Not less than 150Kn

2. General Principles for Selecting Oil Booms

When selecting an oil boom, the performance requirements of the water environment for the oil boom and the basic performance parameters of the oil boom should first be considered, followed by the on-site environment and the operational performance of the oil boom.

- Water Environment: The water environment generally refers to three situations: one is calm water with a wave height of 0.3m (lakes, ports, etc.); the second is calm water with current (such as rivers); the third is sheltered waters with waves higher than 1.0m and open waters with waves higher than 1.0m.
- Performance Parameters of Oil Booms: The performance parameters of oil booms here refer to freeboard, draft, buoyancy-to-weight ratio, and total tensile strength.

- Operational Performance of Oil Booms: The operational performance of oil booms usually includes durability, ease of deployment, good wave-following performance, fast deployment speed, good shoreline sealing, easy maintenance, convenient storage, and applicability.

In addition to carefully considering the above factors, when selecting an oil boom, performance, price, and other aspects should be compared according to the deployment purpose (containment, diversion, or protection), deployment requirements, operating environment, use and maintenance, etc., so as to select an oil boom that is truly suitable for the actual situation. Oil Boom Selection Guide

Symbol Explanation: 1. Good; 2.Medium; 3. Poor		Oil Boom Type				
		SolidFloat Type	Inflatable Type	RetractableSelf-inflating Type	External Tension Member Type	Barrier Type
EnvironmentalConditions	Offshore Hs > 3ftV < 1kn	2	1	2	1	2
	Port Hs > 3ftV < 1kn	1	1	1	2	2
	Calm Water Hs > 3ftV < 0.5kn	1	1	1	2	1
	High Current V > 1kn	2	2	3	1	3
	Shallow Water Depth < 1m	1	2	2	3	3
Performance Characteristics	Use in Presence of Rough Objects	1	2	3	3	2
	Reserve Buoyancy	2	1	1	2	3
	Wave-following Performance	2	1	1	2	3
	Strength	2	1	3	1	1
OperationalCharacteristics	Easy to Transport	2	2	1	3	2
	Easy to Clean	1	1	1	3	1
	Compressibility	3	1	1	2	3

3. Examples of Oil Boom Selection:

- Selection of Oil Booms for Open Waters

When selecting an oil boom for open waters, the following should be mainly considered:

- Strength of the oil boom: The selected oil boom must be able to withstand various external forces exerted by wind, waves, and currents on the oil boom;
- Ease of deployment: The selected oil boom should be able to be easily deployed from the vessel or other places to the water surface and form an ideal containment shape;
- Storage space: When an oil spill occurs, the vessel going to the oil spill site may carry a lot of emergency equipment, and at this time, it should be considered whether the vessel deck has sufficient space;
- Buoyancy-to-weight ratio: Experience has shown that the buoyancy-to-weight ratio of oil booms deployed in open waters should be above 8:1;
- Freeboard and draft: The size of freeboard and draft should be determined by the wave height and current conditions of the water area used.

Based on the above factors to be considered, referring to the Oil Boom Selection Guide, for open waters, the inflatable curtain-type oil boom is an ideal choice.

- Selection of Oil Booms for Coastal Waters

Deploying oil booms in coastal waters is generally for diverting oil spills, with a wide deployment range and a relatively long deployment time. Therefore, when selecting an oil boom, the main factors to be considered are:

- Puncture resistance: It is recommended to use solid float-type oil booms or inflatable rubber oil booms that are not very sensitive to puncture;
- Current and tide: In areas with weak currents, standard central barrier-type oil booms can be used; in rapid waters, barrier-type oil booms with reinforcing strips or curtain-type oil booms with counterweight chains as reinforcing strips should be selected.

- Selection of Oil Booms for Terminal Waters

For oil booms used to protect terminal waters, the first consideration is easy and rapid deployment. Self-inflating oil booms or solid foam barrier-type oil booms are suitable for this purpose. If the current in the terminal waters is rapid, barrier-type oil booms or solid float-type oil booms should be selected. If fixed or semi-fixed oil booms are deployed at berths with large waves, oil booms with high strength and high buoyancy-to-weight ratio should be selected. Rubber oil booms or solid foam barrier-type oil booms are suitable for this situation, and these two types of oil booms are not very sensitive to sharp objects.

1. Deployment Forms of Oil Booms

The containment, diversion, and prevention functions of oil booms for oil spills are achieved through appropriate deployment forms. According to different water types, the deployment forms of oil booms can be mainly divided into two situations: deployment forms in open waters and deployment forms in coastal and river waters.

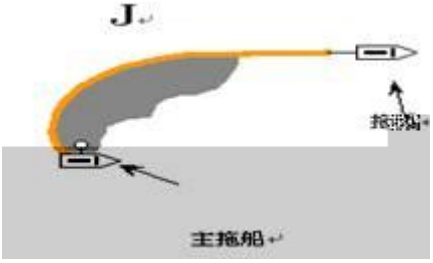
- Deployment Forms of Oil Booms in Open Waters

The form of oil boom deployment in open waters mainly depends on the purpose of deployment and the number of vessels participating in the deployment. Typical containment deployment forms include single-vessel deployment (single-side towing and double-side towing), two-vessel deployment, and three-vessel deployment.

(1) Single-vessel Deployment Form

The single-vessel deployment form requires oil spill recovery vessels, booms (outriggers and floats), oil booms, or oil booms equipped with oil skimmers and other equipment. The length of the boom is selected according to the size of the vessel, generally 5-15m. Single-vessel towing includes single-side towing (extending the boom from one side of the vessel) for sweeping oil spills on the water surface, and double-side towing (extending the booms from both sides of the vessel). The shape of the oil boom towed by a single vessel is usually V-shaped. However, deploying large oil booms in this form will limit the maneuverability of the vessel.

V-shaped single-side towing is to connect the oil boom to the vessel and the top of the outrigger respectively. The length of the oil boom on one side of the V-shape usually ranges from 10m to 50m, mainly depending on the size of the vessel. This deployment form can only form one recovery area, so the oil skimmer should be placed at the bottom of the V-shape, where the oil spill is most concentrated, for recovery. During the recovery process, the boom should be observed and adjusted continuously to make the bottom of the V-shape as close to the vessel's side as possible to facilitate recovery. If the recovered oil spill is in a solid state during single-side towing, an oil collection net should be used for recovery.



Single-vessel Single-side Towing of Oil Boom

If oil booms are deployed on both sides of the vessel, two recovery areas can be formed. This not only makes the forces on both sides of the vessel basically the same but also makes the vessel easier to maneuver than single-side sweeping. It should be noted that double-side sweeping requires a spacious area. If the towable water area is narrow, double-side towing cannot be adopted.

Successful double-side towing operations require a lot of relevant equipment. Therefore, for the vessel, a wide deck space is required to store sufficient oil spill recovery and storage equipment, as well as sufficient space for emergency personnel to carry out cleanup operations.

(2) Two-vessel Deployment Form

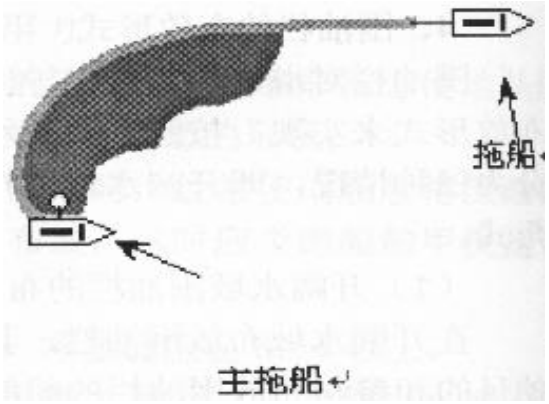
Two-vessel oil boom deployment usually adopts J-shaped deployment, also known as J-shaped towing.

This deployment form generally requires two vessels at the same time. One serves as the main towing vessel, used to tow the shorter end of the oil boom, and stores the required recovery equipment and recovery operators; the other serves as the towing vessel, used to tow the longer end of the oil boom. The length of the oil boom needs to be 200-400m. The length of the oil boom from the main towing vessel to the bottom of the J-shape is 20-40m, and the oil skimmer is placed at the bottom of the J-shape. The oil boom should be as close as possible to one side of the main towing vessel (10-20m) to facilitate the operation of the oil skimmer or other recovery equipment.

In order to obtain and maintain the ideal shape of the bottom of the oil boom, the shape of the bottom of the oil boom can be appropriately adjusted by pulling the rope connecting the oil boom and the vessel.

When the two-vessel deployment form is used for oil spill diversion, the length of the oil boom is generally 100-400m. If the oil boom is too long, it is difficult for the auxiliary vessel to maintain the ideal position, and the efficiency of the system will decrease.

During two-vessel towing operations, in general, the main towing vessel is the command vessel. The main towing vessel should send instructions to the towing vessel in front in a timely and accurate manner according to the oil spill sweeping situation. The towing vessel should maintain good communication with the main towing vessel at all times, and adjust the course and speed in a timely manner in strict accordance with the instructions. Only in this way can the good J-shaped sweeping form be maintained at all times to achieve the ideal oil slick recovery effect.



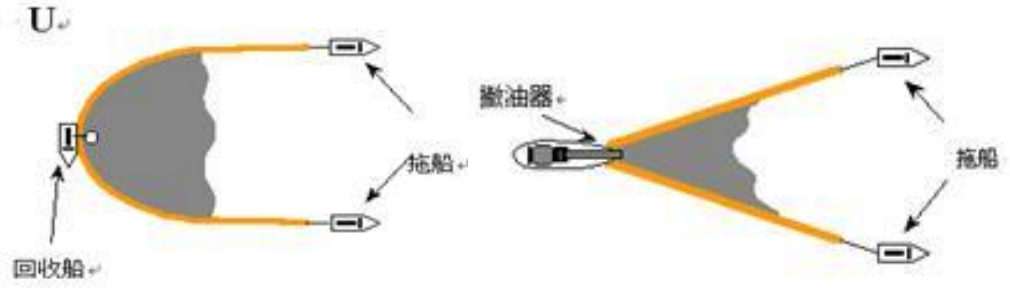
Two-vessel J-shaped Deployment of Oil Boom

(3) Three-vessel Deployment Form

In order to increase the oil spill sweeping area, it has been gradually found in practice that using three vessels for oil boom deployment and sweeping has a better effect. The three-vessel deployment form usually adopts a U-shaped or open U-shaped containment shape. U-shaped containment mainly uses two vessels to tow the oil boom in parallel. During towing, the length of the oil boom generally needs to be 600m. Compared with J-shaped towing, two vessels operating in parallel are easier to maintain the correct position. While the two towing vessels in front advance simultaneously, the third vessel should always be outside the bottom of the U-shape according to the speed of the two towing vessels, and use oil skimmers and other suitable recovery equipment to recover the oil spill gathered at the bottom of the U-shape. This form of sweeping operation has a large recovery volume.

Therefore, before the operation, the cargo capacity of the third vessel (recovery vessel) should be fully considered to avoid the inconvenience caused by the need to return midway or repeatedly replace the recovery vessel due to insufficient cargo capacity during continuous operation.

The open U-shaped containment is further developed from the U-shaped containment. The two sections of the oil boom extend 3-10m to both sides at the opening to form a funnel. The bottom of the U-shape is adjusted by ropes to make its opening width 5-10m to reduce the impact of turbulence on the oil slick. This form can control the flow of oil spills and make recovery easier. Then, the third vessel is used for oil spill recovery through single-side or double-side sweeping.



Three-vessel U-shaped Deployment of Oil Boom Three-vessel Open U-shaped Deployment of Oil Boom

For the three deployment forms mentioned above, whether it is the main towing vessel or the vessel responsible for recovery operations, during the sweeping and recovery operations, it should always be observed whether eddy currents or reoccurrence of oil film floating appear behind the oil boom. If these phenomena occur, it indicates that the towing speed is too fast, and the speed should be gradually reduced until these phenomena disappear.

(4) Deployment Forms of Oil Booms in Coastal Waters

The deployment form of oil booms in coastal waters depends on the deployment purpose. If it is used for containment, the form of connecting beach oil booms with other oil booms should be adopted; if it is used for diversion, the form of overlapping deployment of multiple layers of oil booms should be adopted.

The deployment method of coastal oil booms is different from that in open waters. To make each deployment method of oil booms play its due role, the following factors should be considered:

1. The conditions of the water environment to be protected, especially the flow direction and speed of the deployed water area, so as to determine the correct deployment angle. Experience has proved that when the flow speed perpendicular to the oil boom exceeds 0.7 kn, the oil spill will escape from under the oil boom, and the containment oil boom will not achieve the purpose of containing the oil spill. Therefore, in coastal waters with rapid currents, the oil boom should be deployed at a certain angle to the flow direction to reduce the movement speed of the oil spill relative to the oil boom. The greater the flow speed, the smaller the angle between the oil boom and the flow speed should be.

2. Consider the tidal range and water depth of the local water area. When deploying oil booms in coastal and shallow waters, it should be considered whether the tidal range and water depth of the local water area meet the draft requirements of the oil booms. The water depth should be at least 3 times the draft of the oil booms. Otherwise, the oil booms will lose their function. To prevent oil spills from polluting the river banks and intertidal zones, beach-type oil booms should be considered.

3. Deployment of Oil Booms

According to the type of oil boom and the area of use, the company's main methods for deploying oil booms are deployment from vessels and deployment from the shore.

(1) Deployment from Vessels

For deployment from vessels, the oil boom should be stored and fixed on the vessel's deck. The following steps should be followed when using a vessel to deploy an oil boom:

1. Selection of towing vessel. Correctly selecting a towing vessel when deploying an oil boom is also the key to achieving effective containment. The selection of a towing vessel can generally be calculated according to the principle that each 200 (Newtons) of towing force is equivalent to 1 standard rated horsepower of the ship's engine. For example, to tow an oil boom with a resistance of 20,000 (Newtons) by a single vessel, a towing vessel with more than 100 horsepower must be selected. If two vessels are used for U-shaped towing of an oil boom with a resistance of 40,000 (Newtons), two towing vessels each with more than 1,000 horsepower must be selected.
2. Determination of deployment plan. The main towing vessel is responsible for the specific deployment and operation of the oil boom, and other auxiliary vessels are subject to the unified command of the main towing vessel. The operators on the main and auxiliary towing vessels must be determined in advance, have practical experience and operational capabilities in deploying oil booms, and maintain smooth communication.
3. Preparation before deployment. Secure the oil boom and other related equipment on the vessel's deck. If there is no oil boom reinforcement point on the deployment vessel's deck, reinforcement equipment should be installed to prevent the oil boom from being accidentally dragged into the water during operation.

For barrier-type oil booms and solid float-type oil booms, the oil boom storage device can be placed at the stern of the vessel.

For inflatable oil booms, a large deck space is usually required between the storage device and the stern to facilitate deployment operations. The required deck space depends on the length of the single air chamber of the oil boom, which is usually 5-6 m.

Finally, firmly fasten the towing equipment to the oil boom itself. When deploying an oil boom with a counterweight chain, the towing equipment should be connected to the counterweight chain, and this connection must be checked before deployment.

1. Deployment. During the initial deployment of the oil boom, the deployment vessel should sail at a slow speed. After 10 to 20 m of the oil boom is released, slightly increase the ship's speed, and drag the remaining oil boom out through the resistance of the water to the oil boom. When there is no oil containment, the linear towing speed of the oil boom is

generally about 5 kn. The linear towing speed of the oil boom with strong breaking strength can reach 7-8 kn, but not exceeding 10 kn. The curve towing speed is 3-4 kn, and the U-shaped towing speed is less than 2 kn. During towing, prevent the oil boom and towing equipment from being entangled in the propeller.

This deployment method does not require an auxiliary vessel. Of course, the use of an auxiliary vessel can make the deployment operation easier and safer. When using an auxiliary vessel, the two vessels should maintain communication to avoid accidents.

If deploying barrier-type oil booms and solid float-type oil booms, no other operations are required, and they can be deployed immediately. Self-inflating oil booms can also be deployed directly.

If multiple oil booms are stored on the deck, they can be placed on one side of the vessel to facilitate the connection between the oil booms. During deployment, start with the oil boom at the stern of the vessel, and then deploy the oil booms connected closely together.

If deploying an inflatable oil boom, use an air compressor to inflate it, and the winch should rotate slowly. When the last few sections of the oil boom are deployed, operate carefully to avoid the end of the oil boom on the vessel falling into the water.

The towing rope of the oil boom must be firmly connected to the vessel's deck in advance. When deploying the last section of the oil boom, first deploy the freely floating towing rope, then fasten the towing rope of the oil boom to the bollard or similar object, and fasten it to the auxiliary towing vessel. At this time, the deployed oil boom can start containment operations.

(2) Deployment from the Shore

Deploying an oil boom from the shore is more complex than deploying it from a vessel. Select the location for deploying the oil boom in advance. Use a vessel to drag the oil boom from the shore into the water against the current and contain it into the required shape.

The procedure for deploying an oil boom is basically the same as that for deploying an oil boom from a vessel, except that an auxiliary vessel is required. A person on the shore line commands and maintains contact with the vessel.

When one end of the oil boom is fixed on the shore, the auxiliary vessel tows the oil boom and keeps it in the correct position. In coastal areas with very rapid currents (3-6 kn), deploying a 200 m oil boom requires a vessel with high power to maintain the correct position of the oil boom.

In terminal areas with large tidal changes, the tidal range should also be considered.

1. Anchors for Oil Booms

In various deployment forms of oil booms, due to the influence of wind, current and many other factors, it is difficult for the oil boom to maintain the predetermined shape and achieve the effect of containing oil spills. It is very expensive to use vessels to maintain the deployment shape of the oil boom, and the use of anchors is more economical. Therefore, in the case of containing relatively fixed oil spill sources, using anchors to maintain the containment shape of the oil boom is the most common.

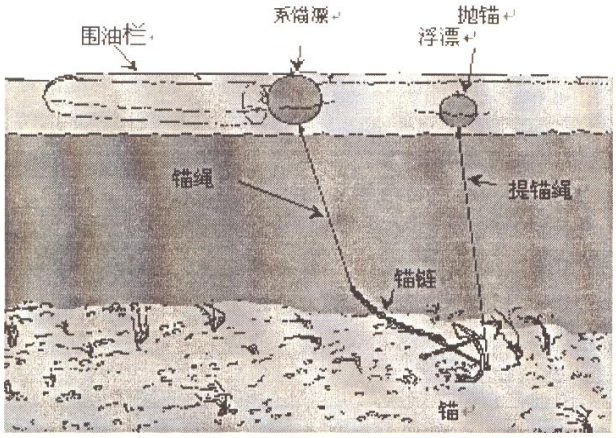
When using anchors, the seabed structure (sand, stone, or rock), flow direction, flow speed, water depth and other relevant conditions should be mastered to ensure the effectiveness and safety of the anchors. There are two cases of using anchors:

(1) If the flow direction of the water area where the oil boom is deployed is unidirectional, the anchor must be placed on the side of the oil boom facing the flow direction;

(2) If the flow direction changes, such as in the intertidal zone, anchors should be set on both sides of the oil boom. Most oil booms have anchor hanging seats or oil boom joints for connecting anchors.

The number and size of anchors depend on the force acting on the oil boom (wind, current, waves), flow direction, length of the oil boom, size of the vessel and other factors. In general, for float oil booms (with a height of about 1.2 m), one or two anchors are thrown every 40-80 m. For inflatable oil booms (with a height of 2 m), 2-4 anchors can be thrown every 100 m.

According to the requirements for anchors for oil booms in JT/T465-2001 "Oil Booms", for manually launching and recovering anchors, the weight of a single anchor should not exceed 150 kg. The types of anchors can be high-holding power anchors, fishing gear anchors or swallow-tailed anchors, navy anchors, Danforth anchors, four-claw anchors, and single-arm anchors. Usually, anchors with a lifting device of 20-100 kg are used.



Deployment Form of Anchors for Oil Booms

To prevent the anchor from being lifted by wave action, the length of the rope connecting the anchor and the anchor buoy should be at least 3 times the water depth. The length of the anchor rope under different sea conditions:

- Under general sea conditions, the length of the anchor rope is 5 times the water depth;
- In calm waters, the length of the anchor rope is 3 times the water depth;
- Under severe sea conditions, the length of the anchor rope is 7 times the water depth.

The size of the anchor buoy is determined by the weight of the anchor. Usually, the volume of the anchor buoy is 60 to 250 L. From a safety perspective, to prevent the anchor recovery time from being too long and affecting the rapid movement of the oil boom, a quick-release device, such as a shackle, is usually used between the anchor buoy and the oil boom.

During the use of the anchor, the anchor rope may break or get stuck. To facilitate anchor recovery, an anchor buoy is usually used to mark the position of the anchor; when the anchor

is stuck, the anchor is recovered from the opposite direction through the anchor rope with the help of the anchor buoy. The length of the rope between the anchor and the anchor buoy should be at least 2 times the water depth.

5.1.2 Recovery and Storage of Oil Booms

There are two cases of oil boom deployment: long-term deployment and temporary deployment. Long-term deployment does not involve frequent recovery. Usually, only temporarily deployed oil booms involve recovery, cleaning and maintenance, and storage. This section introduces the operation steps and precautions for the recovery, cleaning and maintenance, and storage of oil booms.

1. Recovery Operation of Oil Booms

The recovery of oil booms is the reverse operation of deployment. The recovery operation of solid float-type oil booms is relatively simple, but the recovery speed is slow; the recovery operation of inflatable oil booms is relatively easy. The main steps of the recovery operation are as follows:

- The auxiliary towing vessel first unhooks the towing cable of the oil boom, so that the oil boom is only connected and towed by the main towing vessel;
- According to the water conditions, the main towing vessel should preferably sail against the current to make the oil boom unfold in a straight line behind the stern of the vessel;
- Use a winch or oil boom winding frame to slowly pull the oil boom onto the deck or wind it on the winding frame;
- For inflatable oil booms, the gas in the air chamber needs to be released while being recovered during the recovery process, and the air chamber cover should be kept;
- During the winding process, check whether the oil boom is damaged and make a record.

1. Precautions During Recovery

- During the recovery process of the oil boom, attention should be paid to safety. The oil boom contaminated with oil will be very slippery, which increases the difficulty of the recovery operation, and will also contaminate the equipment and operators. The deck will be slippery due to oil pollution.
- Assign a person to conduct on-site inspection of the recovered oil boom and keep a record. Repair any damage.
- Equip an appropriate amount of oil absorbent mats on the deck to promptly wipe off the oil spilled on the deck.
- If the oil brought during recovery makes the deck extremely slippery and poses a safety hazard, the operation can be suspended, and the recovery operation can be continued after proper cleaning.

1. Cleaning of Oil Booms

Oil booms repeatedly used for oil spill containment generally do not need to be cleaned. However, if the oil boom is used to protect non-oil-contaminated areas or is put into shoreline

cleanup operations and the oil boom to be used is idle halfway or needs to be stored in the warehouse, it needs to be cleaned.

When cleaning the oil boom, it should be cleaned with a special cleaning device while being recovered. If there is no special cleaning device, the oil boom can be recovered first and then cleaned on the shore, but a cleaning area should be set up to avoid the spilled water from cleaning causing secondary pollution.

For manual cleaning of the oil boom, first use a scraper (preferably wooden) to gently scrape off the thick oil layer adhering to the surface of the oil boom, then clean it with warm water or brush it with a dispersant, and finally wipe it clean with an oil absorbent mat. When using an oil boom cleaning device, the cleaning angle between the spray gun and the surface of the oil boom should preferably be less than 45°, and the water temperature used should not be too high. As long as the surface oil can be removed, the lower the temperature, the better, so as to avoid premature aging of the oil boom. Finally, rinse the oil boom thoroughly with fresh water and place it in a cool place to dry before storing it in the warehouse.

1. Storage and Maintenance of Oil Booms

The storage and maintenance of oil booms are directly related to the ability to carry out rapid oil spill emergency response and effectively implement containment operations. To ensure rapid response, the storage location of oil booms should be as close as possible to terminals, operation points, and sensitive resource protection areas, and the storage location of oil booms should facilitate the entry and exit of vehicles and vessels. For oil booms stored outdoors, ensure that the storage location has good drainage, pay attention to pest control and moisture prevention, and avoid direct sunlight; for oil booms stored indoors, also pay attention to moisture prevention and ensure good ventilation conditions, and take necessary measures to prevent pests in the storage location in advance (such as spreading rodenticide) according to the situation; oil booms that need to be stored folded should be placed on shelves and no other items should be stacked on them to avoid deformation of the oil boom due to excessive pressure. Regularly unfold the stacked oil booms for inspection, and avoid the original folding marks when refolding; if the oil boom needs to be stored on a reel, avoid distortion of the oil boom during winding, and regularly fully unfold the wound oil boom, inspect it, and then rewind it. The maintenance of oil booms mainly refers to daily maintenance and maintenance after the end of recovery operations. The maintenance after the end of recovery operations mainly checks whether the oil boom is damaged, whether the accessories are complete, or whether they need to be replaced and repaired; daily maintenance generally checks whether the oil boom is worn, broken, fiber aged, connector corroded or damaged due to pulling and other loading and unloading reasons, and conducts necessary repairs and replacements; for oil booms deployed in water for a long time, regular maintenance is also required. Generally, according to specific conditions, the oil boom should be regularly dragged ashore to remove marine organisms and other adhesives attached to the surface of the oil boom; regardless of the type of maintenance and maintenance, detailed records should be made and inspection and maintenance items should be arranged according to the records to ensure that all contents related to the oil boom can be generally inspected and maintained within a certain period of time, so that the oil boom is always in a good standby state.

5.2 Emergency Plugging Plan

When the hull is damaged, the vessel operator shall take emergency plugging measures at the first time. According to the company's own plugging equipment, after arriving at the scene, the company shall take plugging measures if the safety conditions permit.

5.2.1 Several Common Methods for Handling Hull Damage

While draining water, the crew should be organized to use various equipment for plugging. If the hole is small, various lightweight equipment such as wooden plugs, wooden boards, wooden wedges, wooden columns, and hook bolts can be selected to block from the inside of the ship's side;

If the hole is large, a light canvas plugging blanket or a heavy steel cable plugging blanket can be hung outside the ship's side to cover the hole and prevent seawater from seeping in.

5.2.2 Plugging Equipment

The company currently has main equipment including plugging blankets, plugging plates, plugging boxes, plugging screws, plugging wooden plugs, etc.

5.2.3 Precautions for Plugging Operations

First, obtain information on the safety and emergency measures such as the fire and explosion hazard and toxicity of the oil products from the vessel operator, pay attention to taking explosion-proof measures, and use explosion-proof plugging equipment; operators should wear protective clothing, protective shoes, protective glasses, and protective gloves;

Understand the condition of the hull damage (shape and size of the breach, liquid pressure, etc.), and evaluate the applicability of the company's plugging equipment and the feasibility and safety of the plugging operation;

Assess the wind, wave, and current conditions at the accident scene, which must meet the safe operation conditions;

During the plugging operation, there must be safety supervision;

In case of dangerous situations, the plugging operation should be stopped immediately.

5.3 Vessel Collision Pollution Cleanup Operation Plan

The pollution source of oil spill accidents caused by collisions is mostly bilge oily water. The oil spill will be continuous and difficult to eliminate in a short time, forming an oil spill belt on the sea surface with the current, and the oil layer will not be very thick.

Adopt the method of deploying oil booms downwind to intercept, and then use oil skimming equipment to recover after a certain oil film thickness is formed in the oil boom.

Due to the small amount of oil spill in such accidents, continuous oil spill, and the influence of wind, waves, and sea conditions, irregular oil belts are often formed, which requires constant adjustment of the containment state, takes a long time, and the cleanup workload will increase accordingly. Therefore, if the accident scene is in open sea areas, the method of spraying oil dispersants can be adopted to eliminate the oil spill on the sea surface. This method can not only reduce the investment of cleanup forces but also be simple and effective.

Equipment and Materials to be Used:

- Marine spraying devices, manual spraying devices.
- Auxiliary vessels (can use cleanup operation vessels for close-range cleanup).
- Oil dispersants, oil absorbent mats, oil absorbent tow booms, ropes, etc.
- Communication tools, transportation tools.

5.4 Vessel Grounding Pollution Cleanup Operation Plan

Oil spill accidents caused by grounding are mostly instantaneous large-scale oil spills.

For such large-scale oil spills, first, control the oil spill source, and quickly plug or transfer the damaged oil tanks.

At the same time, effectively contain the accident vessel. If the leakage volume is large, set up interception along the oil spill flow direction and consider the areas that may be polluted by the oil spill, such as estuaries, water intake ports and other sensitive areas, and take protective measures (such as oil boom diversion) to prevent the oil spill from causing greater harm.

Recover the contained oil spill as soon as possible, and take necessary safety and fire prevention measures.

Operation Plan:

- Use solid float-type oil booms to contain the grounded vessel, and use anchors to position the oil booms.
- Heat the crude oil of the oil tanker and use unloading pumps to unload it to other vessels.
- Use oil collection nets or fishing nets to recover the caked crude oil on the water surface.
- Use oil skimmers suitable for recovering high-viscosity oil spills to recover the oil spills on the water surface.
- Manually and mechanically remove the oil spills on the terminals and breakwaters.

Equipment and Materials to be Used:

- Unloading pumps, oil collection nets, oil skimmers, oil storage equipment.
- Shovels, bucket trucks, equipment loading and unloading vehicles, cranes, transport vehicles.
- Two trawler vessels, oil unloading and transfer vessels.

5.5 Mechanical Removal of Marine Oil Spills

5.5.1 Selection of Oil Spill Recovery Equipment

The selection of recovery equipment should first consider the water environment, and then the type of oil spill. Waters can be divided into three categories: open waters, shallow waters, and swamp waters.

(1) Selection of Oil Spill Recovery Equipment for Open Waters

Oil spill recovery equipment used in open waters should have good wave-following performance and be easy to operate on working platforms such as vessels to adjust the position of the oil spill recovery equipment. The types of oil spill recovery equipment suitable for this water area include: marine double-side mounted oil skimmers and brush disc-type oil skimmers.

(2) Selection of Oil Spill Recovery Equipment for Shallow Waters

Shallow waters refer to coastal, port, lake, or river waters. Oil spill recovery equipment used in shallow waters should be simple in structure and easy to operate. Large-scale recovery equipment is not applicable. Selection principles: the oil skimmer should be small in size, shallow in draft, simple in structure, easy to operate, insensitive to sediments in shallow water such as sand, sediment, sludge, and stones, and adaptable to a certain water flow speed, etc., and easy to deploy.

(3) Selection of Oil Spill Recovery Equipment for Onshore Use

Onshore oil spill recovery is mainly carried out manually, and the equipment mainly includes mechanical equipment and tools such as oil skimmers, pumps, tank trucks, shovels, and buckets.

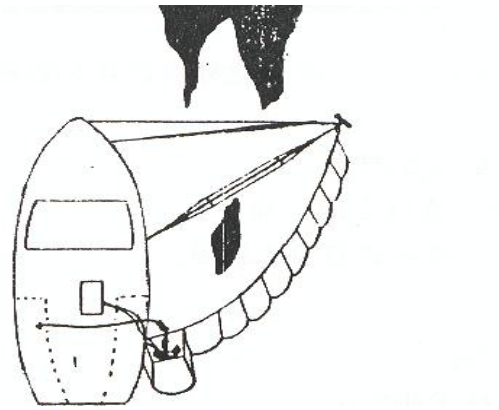
5.5.2 Mechanical Removal Plan for Marine Oil Spills

(1) Mechanical Removal of Marine Oil Spills with the Cooperation of Oil Booms

Mechanical removal of marine oil spills adopts an oil collection system composed of oil booms and oil skimmers, etc., or oil absorbent materials and oil spill recovery vessels. This section introduces the technical scheme of the oil sweeping system composed of oil booms and oil skimmers, and divides the operation schemes into single-vessel, two-vessel, and three-vessel oil sweeping operations according to the number of vessels used during the operation.

Single-vessel Oil Collection System

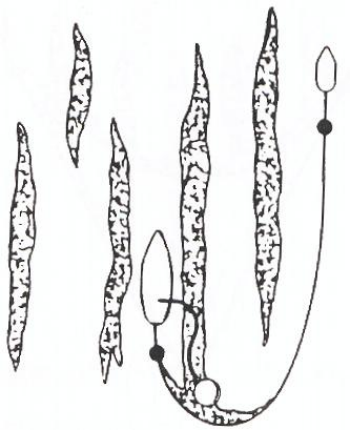
This system can fix the oil boom with rigid supports and ropes on one side of a single vessel, and place an oil skimmer connected to the vessel's power source at the end of the oil boom close to the vessel. The oil gathered in the oil boom at the end close to the vessel is pumped into the vessel's oil storage tank through the oil skimmer.



Single-vessel Oil Collection System

Two-vessel Oil Collection System

This system consists of two vessels, a special oil boom, and an oil skimmer. The oil boom is towed into a "J" shape by two vessels, and the oil is recovered by the oil skimmer placed at the top of the oil boom and pumped into the oil storage tank of the vessel close to the oil skimmer.



Two vessels tow the oil boom into a "J" shape, and one vessel deploys the oil skimmer.

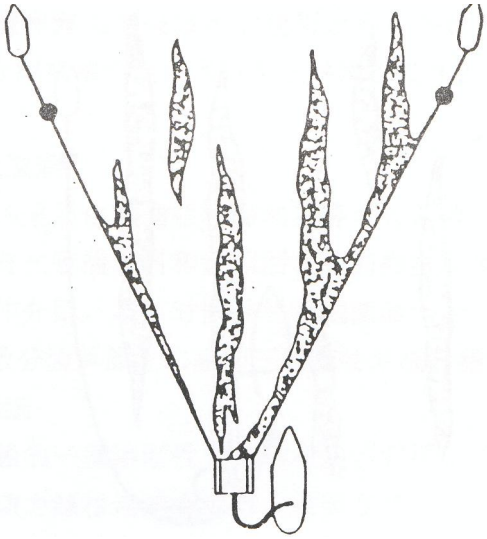
Another two-vessel oil collection system is a single-vessel oil collection system plus an additional small vessel. The small vessel is connected to the single-vessel oil collection system through a short section of oil boom and tightened. The two vessels are arranged as shown in Figure to increase the oil containment rate.

Single-vessel oil collection system plus an additional vessel to tow the oil boom to increase the oil containment rate.

Three-vessel Oil Collection System

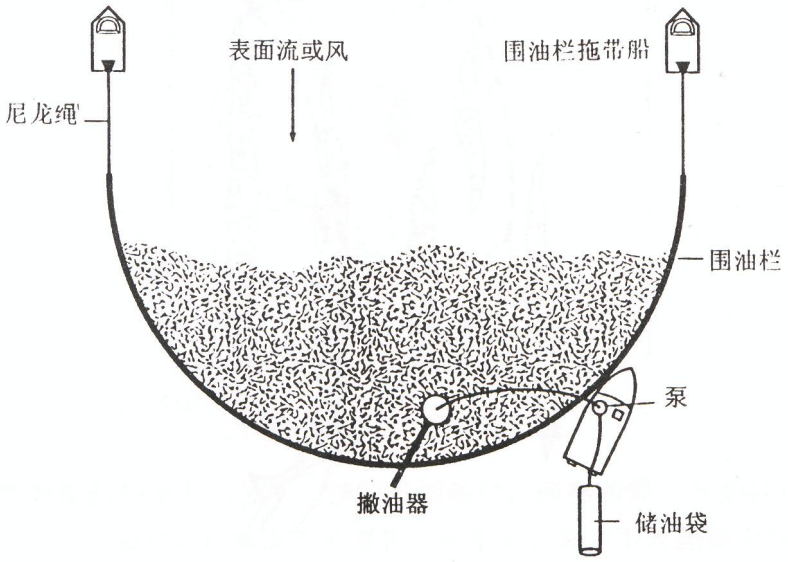
This system consists of three vessels, oil booms, and oil skimmers, and can be deployed in the following three ways:

① Two vessels tow the oil boom into a "V" shape, and the oil is recovered by the oil skimmer placed at the top of the "V" shaped oil boom and pumped into the oil storage tank of the third vessel.



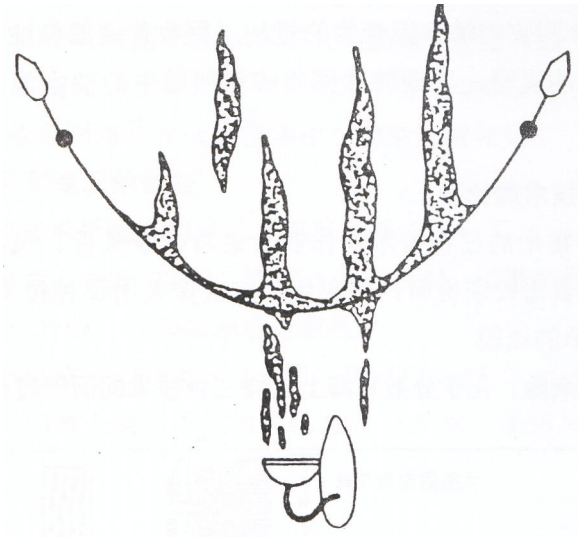
Two vessels tow the oil boom into a "V" shape, the oil skimmer is set at the top of the "V" shape, and the oil is transferred to the third vessel.

② Two vessels tow the oil boom into a "U" shape, the oil is gathered at the top of the oil boom, and pumped to the oil storage tank or oil bag of the third vessel through the oil skimmer hose and pump.



Two vessels tow the oil boom into a "U" shape.

③ Two vessels tow the oil boom into a "U" shape at a speed of 1-2 knots, the oil is gathered at the top of the oil boom, and the oil is allowed to escape at the top of the "U" shaped oil boom. The escaped oil is recovered with a single-vessel oil sweeping system. In this case, it is best to use a DIP-type oil skimmer, which can work well when the oil boom fails.



Two vessels tow the oil boom into a "U" shape, and the escaped oil is recovered with a single-vessel oil collection system.

(2) Matters Needing Attention During the Operation of the Oil Collection System

Wave height, wind waves, and current speed will limit the performance of the oil collection system. Some oil skimmers may fail. It is recommended to use oil skimmers with good wind, wave, and current resistance.

In multi-vessel operations, joint operations are required at a speed of 1-2 knots. The coordination of several vessels and oil boom towing is very difficult. Crew and operators must be trained by the maritime bureau and have high navigation skills.

In order to meet the oil film as quickly as possible, the appropriate length of the oil boom towed by two vessels is 400m to 600m. During towing, prevent the oil boom from being twisted into a spiral shape during high-speed towing. To avoid sudden stress on the towed oil boom, the rope between the oil boom and the towing vessel must be of sufficient length. 60m or longer is suitable for towing a 400m oil boom. During low-speed towing, the optimal towing point of the oil boom needs to be changed according to the wind direction and towing direction.

When towing a "U" shaped oil boom, the number of sections of the oil boom is generally odd to avoid the connection between each section of the oil boom being at the top of the "U" shape, allowing oil to escape from the connection of the oil boom. After the boom is formed, it is towed at a low speed (less than 0.5m/s) at sea. The oil film can be slowly gathered in the towed oil boom, and the gathered oil can be recovered by the oil skimmer.

The containment effect of the oil boom can be judged by observing the top of the "U" shape or "V" shape with the eyes. If oil droplets are observed rising behind the oil boom, it indicates that oil is escaping from under the oil boom. If eddy currents appear behind the oil boom, it indicates that the oil boom is being towed too fast. However, even if the oil boom performs very well, a shiny oil film will appear behind it.

In actual operations, the oil film cannot be seen from the cabin of the towing vessel, nor can the top of the oil boom be seen. Therefore, a vessel with radio communication is needed to

command the actions of the towing vessel, so that the floating oil film can be effectively contained and gathered.

If the expected amount of oil-water mixture to be recovered exceeds the capacity of the oil storage tank of the recovery operation vessel, additional vessels or oil bags should be equipped to transfer the oil-water mixture in the cabin of the recovery operation vessel and transport it to coastal facilities. It is recommended to select the oil skimmer with the highest recovery efficiency to save the valuable oil storage space at the oil spill scene.

5.6 Use of Oil Spill Dispersants

5.6.1 Classification

According to GB/T 18188.1-2021 "Oil Spill Dispersants - Part 1: Technical Requirements", dispersants are divided into conventional type (also known as ordinary type) and concentrated type. The classification of dispersants is based on the ratio of surfactants and solvents they contain.

Conventional dispersants: Composed of a mixture of aliphatic hydrocarbon solvents and surfactants, the surfactant content does not exceed 30%. Conventional dispersants cannot be used after being diluted with water.

Concentrated dispersants: Usually contain oxidized aliphatic hydrocarbon solvents, and the surfactant content is generally 50% to 75%. Concentrated dispersants are divided into those that can be diluted with water and those that cannot be diluted with water.

5.6.2 Factors Affecting Dispersion Efficiency and Usage Ratio

(1) Factors Affecting Dispersion Efficiency

Viscosity and Pour Point of Oil

Dispersants are not suitable for highly viscous oils. The lower the viscosity of the oil, the higher the dispersion efficiency. If the viscosity of the oil is very high, the dispersant will fail. Generally speaking, when the dynamic viscosity of the oil is lower than 2000 centipoise, the dispersion efficiency of the dispersant is higher. Once the viscosity of the oil exceeds 2000 centipoise, the dispersion efficiency of the dispersant decreases. When the viscosity of the oil reaches 5000 to 10000 centipoise, the dispersant basically loses its effect.

The pour point of the oil also affects the dispersion efficiency of the dispersant. When the pour point of the oil is greater than or close to the ambient temperature, the dispersion efficiency of the dispersant is low. Generally speaking, if the pour point of the oil is about 5℃ lower than the ambient temperature, the dispersant can be used.

Weathering Degree of Oil

After a certain period of time, the oil spill will evaporate and emulsify, resulting in increased viscosity and formation of "water-in-oil" emulsions, making the dispersant lose its dispersion effect on it. Even for oils with low viscosity and pour point, the dispersion efficiency will decrease or even be difficult to disperse if dispersants are used two days after the spill.

Salinity and Temperature

Most dispersants have better dispersion efficiency in seawater than in fresh water, and the higher the water temperature, the better the dispersion effect. The reason is that the viscosity of the oil decreases as the temperature increases.

Properties of the Dispersant Itself

Due to the incomplete same composition of dispersants and different solvents used, their dispersion ability for oil spills is also different. For example, conventional dispersants are suitable for high-viscosity oils, while concentrated dispersants are suitable for low-viscosity oils. This is because the solvent of conventional dispersants is a hydrocarbon compound, which has good solubility for oils, making it easy for the dispersant to penetrate into the oil layer; while the solvent of concentrated dispersants is alcohol or ethylene glycol, which has poorer solubility for oils than hydrocarbon solvents. Therefore, concentrated dispersants are more suitable for low-viscosity oils.

Mixing and Stirring

Stirring can fully mix the dispersant with the oil, facilitating the solvent of the dispersant to enter the oil layer. When the sea conditions are poor, the dispersion effect of the dispersant will be enhanced. If dispersants are sprayed on calm sea surfaces, manual stirring should be performed.

(2) Usage Ratio of Dispersants

The usage ratio of dispersant/oil is between 1/100 and 1/10, depending on the type of oil and the thickness of the oil film. For oil spills of the same scale, the higher the specific gravity, viscosity, pour point, and oil layer thickness, the higher the usage ratio of the dispersant; for oil spills of the same scale and type, the thicker the oil film, the more difficult it is for the surfactant in the dispersant to enter the oil layer, and the higher the usage ratio of the dispersant. Therefore, usually, after recovering the thick oil layer, dispersants are used to treat the floating oil film on the sea surface, so that the surfactant can easily enter the oil layer, and the dispersant can maintain the normal usage ratio.

Conventional dispersants have strong oil dissolving ability and good effect in treating high-viscosity oils and weathered oils. They should be sprayed directly when used, but stirring is required after spraying. Such dispersants cannot be diluted with water before use, and the usage ratio (dispersant/oil) is preferably between 1:1 and 1:3.

Concentrated dispersants have high oil spill dispersion efficiency and poor effect in treating high-viscosity oils. They can be sprayed directly or mixed with seawater for spraying when used, but the former has a better effect. Such dispersants do not require stirring after spraying. The usage ratio (dispersant/oil) is preferably between 1:10 and 1:30.

5.6.3 Usage Management of Dispersants

Using dispersants to treat oil spills on the sea surface only changes the existing form of oil in the sea water, not the chemical properties of the oil spill. Moreover, improper use can cause secondary pollution of the water body. The use of oil spill dispersants should comply with the requirements of laws, regulations, and usage guidelines.

(1) Article 70 (3) of the Marine Environmental Protection Law of the People's Republic of China stipulates: Vessels, terminals, and facilities shall report to the relevant departments for

approval or verification in accordance with relevant provisions before using chemical dispersants.

(2) Article 11 of the Regulations of the People's Republic of China on the Prevention and Control of Vessel-induced Pollution to the Marine Environment stipulates: Vessels shall not arbitrarily use chemical oil dispersants after an oil pollution accident or illegal oil discharge. If it is necessary to use them, an application shall be submitted to the harbor superintendency administration by telephone or in writing in advance, stating the brand of the oil dispersant, the planned dosage, and the place of use. It can be used only after approval.

(3) Dispersants can be considered for treating floating oil on the water surface or accidental oil spills in the following cases:

- Floating oil on the water surface or accidental oil spills may move to the coast, aquaculture areas, and other water areas sensitive to oil spills, threatening commercial, environmental, or comfort interests, and cannot be dissipated by natural evaporation or the action of wind, waves, and currents before reaching the above-mentioned sensitive areas, nor can they be contained or recovered by physical methods;
- For oil spills that are difficult to treat by physical and mechanical methods, the total damage caused by using oil spill dispersants to promote their dispersion into the water body is less than the damage caused by leaving the oil on the water surface without treatment;
- The oil spill occurs in non-port waters with a water depth greater than 20m, which can be used first and then reported to the competent department;
- The type of floating oil on the water surface or accidental oil spill and the water temperature are suitable for chemical dispersion (generally speaking, the water temperature needs to be higher than the pour point of the oil to be treated by more than 5℃), and the meteorological, sea conditions and other environmental conditions are suitable for the dispersion of the dispersed oil;
- In irresistible cases where oil fires, explosions, etc., endangering human life or facility safety have occurred or may occur.

Dispersants are not suitable for use in the following cases except for irresistible cases where human life or facility safety is endangered or may be endangered:

- The oil spill is a volatile light oil such as gasoline or kerosene, or a thin oil film with rainbow characteristics;
- The oil spill is a high-wax, high-pour point oil that is difficult to chemically disperse;
- The oil spill is not in a fluid state at the ambient water temperature or forms thick fragments of water-in-oil emulsions with clear edges after several days of wind erosion;
- The oil spill occurs in closed shallow waters or calm waters;
- The oil spill occurs in fresh water sources or areas with significant impacts on aquatic resources.

5.6.4 Usage and Restrictions of Dispersants

Using dispersants to treat oil spills on the sea surface has many advantages. During the use of dispersants, attention should be paid to the areas where dispersants are allowed to be used, the dosage, and other issues to be considered and the usage ratio.

(1) Use of Dispersants in Different Waters

Different waters have different requirements for the use of dispersants. According to the water depth, water exchange capacity, and marine organisms of the waters, the waters where dispersants are used are divided into three cases.

Recommendations for Using or Not Using Dispersants

Waters or Sensitive Areas	Recommendations
Open ocean with water depth above 20 m	A. Dispersants can be used and may be a better method
Closed bays and harbors; waters adjacent to unstable intertidal zones; waters adjacent to the coastal zone; coastal beaches, pebble, and gravel areas	B. Using dispersants is a feasible method to mitigate oil spills, but there are restrictions on water exchange capacity and water depth; other methods can also be preferred, and sometimes several methods can be used simultaneously.
SwampsHabitats of birds and marine mammalsSalt flatsSeagrass bedsIntertidal seagrass bedsSheltered rocky intertidal zonesSheltered pebble beachesPebblesQuicksand	C. In principle, dispersants should not be used or should be avoided.However, in some cases, their use is allowed, such as where the use of dispersants can be fully flushed by tides and currents, and the use of dispersants may be approved to avoid long-term environmental impacts of oil.D. If the threat of oil spill has long-term impacts on one or several sensitive areas, the use of dispersants can be considered.

a) Dispersants are allowed to be used. When the dispersed oil can be uniformly mixed into the water body and undergo large-scale mixing and dilution, the concentration of the oil-dispersant mixture is very low, which will not cause any impact on any organisms in the water body. There are no restrictions on the use of dispersants in such waters, and the dosage is determined according to the oil volume. Open oceans with a water depth of more than 20 m belong to this category.

b) Dispersants are allowed to be used, but the use time or dosage is limited. For closed bays and harbors, if such waters have strong water exchange capacity and can exchange more than 90% within a day, their use is allowed. When using, the season, water depth, and tidal characteristics should also be considered. For example, the use of dispersants should be restricted or limited in the spawning season of sensitive organisms.

c) Dispersants are generally not allowed to be used, such as sensitive shorelines. However, if the impact cycle of oil is very long, their use can also be considered.

(2) Dosage of Dispersants

For waters with a water depth of less than 20 m, under the condition that the marine ecology can accept it, the allowable dosage of dispersants should be determined according to the water depth. The allowable dosage should be calculated based on the fact that the mixed concentration of the oil-dispersant mixture uniformly mixed in each water layer (from the surface to the bottom) of the water body does not exceed 10 ppm.

Dosage of Dispersants in Waters of Different Depths

Water Depth (m)	<1	1 ~ 2	2 ~ 5	5 ~ 10	10 ~ 20	>20
Dispersant Dosage (liters/mu)	<3.785	3.785	7.57	18.925	37.8	Dispersants are allowed to be used, but the dosage should be determined based on the amount of oil on the water surface

5.6.5 Spraying of Dispersants

Dispersants can be sprayed by vessels or manually. The choice of spraying method mainly depends on the type of dispersant, the location and area of the oil spill, and the effective utilization rate of the vessel used for spraying. The company is equipped with corresponding spraying equipment for vessel spraying and manual spraying: PSB150 spraying device and PSC40 portable spraying device.

(1) Vessel Spraying: PSB150 Spraying Device

The PSB150 spraying device is mainly used to spray various types of oil dispersants on oil spill surfaces to remove oil pollution from water surfaces, shorelines, rocks, buildings and other places. It can also be used to spray clean water and detergents to clean oil booms or other items.

(2) Manual Spraying: PSC40 Portable Spraying Device

The PSC40 portable spraying device is a wheeled structure with wheels, easy to move, suitable for use on ships and land, and convenient for manual operation. This equipment is equipped with a spray gun to spray oil spill dispersants onto the oil-polluted water surface in the form of impactful small particles. After the oil spill dispersants are fully mixed with the oil spill, the oil spill is dispersed into the water. The PSC40 spraying device is a water surface oil spill treatment equipment. When the oil spill layer is thin, this equipment can be used to spray oil spill dispersants on the water surface with the approval of relevant departments to achieve the purpose of eliminating oil pollution as soon as possible. The main technical parameters are as follows:

Model	PSC40
Maximum Injection Capacity	40L/min
Maximum Horizontal Range	10m
Maximum Suction Lift	3m
Power	3-4kw
Weight	120kg
Overall Dimension (L×*W*×H)	840×*940*×800mm

Working Principle: The machine uses the output power of a diesel engine to drive a three-cylinder piston pump through a V-belt. The three-cylinder piston pump suctions oil spill dispersants from the storage container of oil spill dispersants through a suction pipe, and then sprays them onto the oil-polluted water surface under pressure through a high-pressure rubber hose and a hand-held spray gun. The spraying pressure is adjusted with the "pressure automatic relief valve" by observing the pressure gauge.

The spray gun is designed in a gun shape. Squeeze the trigger to open the valve of the gun. The high-pressure liquid flows through the spray gun hose and is sprayed out from the spray gun. Release the trigger, and the valve closes under the action of the spring to stop the spraying operation. At this time, the "pressure automatic relief valve" makes the three-cylinder piston pump automatically relieve pressure. The spray gun can be used for long-distance direct current spraying or short-distance fog spraying, which is adjusted with the adjusting sleeve at the front end of the spray gun.

(3) Spraying Rate

The spraying rate depends on the type of oil spill, the thickness of the oil film, and the flow state of the oil. Two methods can be used to control the spraying rate: changing the pump rate, or keeping the pump rate constant and changing the ship's speed. The calculation formula for the pump discharge rate is as follows:

Pump discharge rate (L/min) = 0.003 × Spraying rate (L/ha) × Ship speed (knots) × Spraying width (m)

(4) Precautions for Spraying Operations

Generally, the spraying sequence should start from the thicker part of the oil film and the outer edge of the oil film, not from the middle or the thinner part of the oil film.

If the oil film is in coastal waters, the best operation method is to operate as parallel to the shoreline as possible.

The ship should operate along the wind direction to avoid dispersants being blown onto the deck.

If the oil belt is a narrow strip perpendicular to the wind direction, the ship should spray along the oil belt on the upwind side of the oil film. Considering that the dispersant spray is laterally offset by the wind, the ship can only spray with the single arm on the downwind side.

The spraying operation of dispersants should be carried out as soon as possible after the oil spill accident, because if the time is too long, the weathering of the oil will cause "emulsification" and reduce the dispersion effect.

(5) Application of Dispersants on Shorelines

The application of dispersants on shorelines should be analyzed according to specific conditions, and there is no universal method. However, for oil spills on beaches, dispersants are not sprayed directly, but within a short time (30min) after being washed by seawater. For tidal shorelines, spraying should be carried out before high tide to avoid bringing oil into the bottom layer. For the cleaning of rocks, revetments and other man-made structures, manual scrubbing is usually used, followed by high-pressure water flushing.

It should be noted that the use of dispersants is prohibited in sensitive areas such as industrial water intake ports and salt fields when applying dispersants on shorelines.

5.7 Oil Absorbent Material Operation Plan

5.7.1 Oil Absorbent Mats

Oil absorbent mats are the most common and widely used synthetic adsorbent materials. Oil absorbent mats are generally placed around machinery to absorb oil leaked from machinery, and can also absorb oil spills on water surfaces.

The main technical parameters of oil absorbent mats are as follows:

Test Result	Test Result	Test Result	Test Result	Test Result	Test Result
Serial Number	Test Item Name	Unit of Measurement	Performance Index	Test Result	Test Basis
1	Oil Absorbency	g/g	More than 10 times its own weight (20℃, 1000-second fuel oil)	8.73	JT/T560-2004Marine Oil Absorbent Mats

Usage Method:

Laying Method: Lay the oil absorbent mat flat on the oil-polluted surface to ensure full contact between the oil absorbent mat and the oil pollution. For large-area oil pollution, adopt overlapping laying (overlap width not less than 10cm) to increase the coverage area; for oil pollution on water surfaces, the oil absorbent mat can be tied to a buoy to prevent drifting.

Recovery Operation: After the oil absorbent mat is saturated with adsorption (generally, the adsorption capacity reaches 10-20 times its own weight), use a fishing net or manually

recover it to avoid residue; avoid squeezing the oil absorbent mat during recovery to prevent secondary leakage of the adsorbed oil.

5.7.2 Oil Absorbent Tow Booms

Oil absorbent tow booms are made of oil absorbent mats processed into a diameter of generally 10-30cm, each section is 3-5m long, can be made into hundreds of meters or even longer with ropes of corresponding strength, and has quick-release joints at both ends. Oil absorbent tow booms can also be made into strip-shaped oil absorbent tow booms with a width of 30-40cm. The main technical parameters of oil absorbent tow booms are as follows:

Test Result	Test Result	Test Result	Test Result	Test Result	Test Result
Serial Number	Test Item Name	Unit of Measurement	Performance Index	Test Result	Test Basis
1	Oil Absorbency	g/g	More than 10 times its own weight (20℃, 1000-second fuel oil)	8.73	JT/T560-2004Marine Oil Absorbent Mats

a) Oil absorbent booms for drains/water intakes: Generally 3-5m long and 10-30cm in diameter. Such oil absorbent booms can also be connected with other oil booms to form 15-20m long oil absorbent booms. However, such oil booms are difficult to handle and prone to additional damage.

b) Guided oil absorbent booms: Long ropes with oil absorbent materials attached, similar to cables, which can be deployed in waters with high flow rates to recover high-viscosity oil, and only play a guiding role for low-viscosity oil.

c) Containment oil absorbent booms: The float is the oil absorbent material, which plays the role of oil absorption. There is a skirt under the oil absorbent material, which can play the role of oil spill containment.

1. Preparation Before Operation

(1) Equipment Inspection

Appearance Inspection: Check the main body of the tow boom section by section for damage, tearing, and fiber shedding, and ensure that the sealed joints (such as buckles and zipper joints) are firm and leak-proof; check the wear of the traction ropes at both ends of the tow boom (usually high-strength nylon ropes with a diameter ≥12mm), the breaking strength must be ≥50kN. If the wear exceeds 1/3 of the rope diameter or there are broken wires, replace them immediately; confirm that the buoyancy blocks supporting the tow boom (if equipped) are not damaged and have normal buoyancy to avoid the tow boom sinking.

Performance Test: Randomly select a 1-meter-long tow boom sample, soak it in simulated oil pollution for 3 minutes, measure the oil absorption after squeezing, check the quick joints of

the segmented tow boom, plug and unplug repeatedly 3 times to ensure smooth connection and good sealing.

(2) On-site Preparation

Operation Area: Confirm the spread range of oil pollution through on-site investigation, delineate the towing operation area, and avoid waterways, fishing net areas, and underwater obstacles (such as reefs and pipelines); if operating in an oil boom, adjust the position of the oil boom in advance to reserve a towing channel for the tow boom (width ≥1.5 times the length of the tow boom).

Equipment Deployment: Determine the connection method of the tow boom according to the number of operating ships. For single-ship operation, adopt the "single-point traction + tail buoy" mode (the tugboat pulls the tow boom at the front end, and the tail end is connected to a buoy to mark the position); for dual-ship operation, adopt the "opposite towing mode" (the two ships are parallel with a distance ≥ the length of the tow boom, and pull both ends of the tow boom synchronously). The two ships must be equipped with walkie-talkies to achieve real-time communication.

Personnel and Protection: Operators must wear non-slip shoes, oil-resistant gloves, safety helmets, and life jackets. If recovering volatile oil products, additional gas masks should be worn; the traction operation post should be equipped with 2 personnel (1 main operator and 1 supervisor) to avoid falls caused by sudden tension during single-person operation.

2. Operation Process

(1) Deployment and Traction Adjustment of Tow Booms

Deployment Operation: For single-ship operation, the tugboat sails slowly (speed ≤2 knots), and 2 operators cooperate to smoothly deploy the tow boom from one side of the ship's side to the water surface to avoid folding and winding of the tow boom; after deployment, fix the traction rope on the ship's special traction pile (wrap 3-5 turns to prevent slipping), and deploy the tail buoy 10 meters behind the tow boom.

Dual-ship Opposite Towing Adjustment: The two ships start synchronously, maintain parallel navigation, control the initial speed at 1-1.5 knots, adjust the distance between the ships through walkie-talkies to ensure that the tow boom is fully unfolded and in a straight line; if the tow boom bends, one of the ships should accelerate appropriately until the tow boom returns to a straight line.

(2) Monitoring of Oil Absorption Operation

Operation Parameter Control: The single-ship towing speed is maintained at 1.5-2.5 knots (excessively high speed may cause the tow boom to separate from the oil pollution layer, and excessively low speed may cause local oil absorption saturation); the dual-ship opposite towing speed must be consistent, and the speed difference ≤0.3 knots to avoid tearing of the tow boom due to uneven speed.

Oil Absorption Status Inspection: Observe the oil absorption of the tow boom through binoculars every 20 minutes. If the surface of the tow boom is completely covered by oil pollution, the color becomes dark, and there is no obvious oil absorption space (usually the oil absorption time ≤2 hours, adjusted according to the oil pollution concentration), stop towing

for recovery; record the towing time, navigation track, and oil pollution concentration during the operation, and estimate the recovered oil volume.

Cooperative Operation Coordination: If cooperating with an oil recovery ship, the oil recovery ship should follow 50 meters behind the tow boom. After the tow boom is saturated with oil absorption, the tugboat slowly sails to the oil recovery ship, and the oil recovery ship uses a crane or manually lifts the tow boom to the deck for squeezing and oil removal; during the oil removal process, a geomembrane should be laid on the deck to prevent oil pollution from leaking and polluting the ship's hull.

(3) Recovery and Oil Removal of Tow Booms

Recovery Operation: During recovery, reduce the tugboat speed to below 1 knot, and the operator slowly retracts the traction rope to pull the tow boom section by section to the ship's side to avoid damage to the tow boom caused by collision with the ship's side during dragging; the segmented tow boom should be disassembled and recovered section by section, and overall dragging is prohibited.

Squeezing and Oil Removal: Perform oil removal on the oil absorbent tow boom, and the oil removal rate must be ≥80%; the oil after oil removal flows into a special receiving container through an oil guide pipe, and the container should be replaced and sealed in time when the capacity reaches 80%.

Cleaning Treatment: The tow boom after oil removal should be rinsed with clean water to remove residual oil on the surface. The rinsing wastewater is collected into a sewage bucket and is strictly prohibited from being discharged directly; after cleaning, unfold the tow boom to dry, avoiding direct sunlight (to prevent material aging).

1. Maintenance

(1) Daily Maintenance

Post-operation Inspection: After each operation, inspect the main body of the tow boom section by section. For minor damage (hole diameter ≤5mm), use a special oil-resistant patch to paste and repair; if the sealed joint is loose or leaking, replace the sealing ring or buckle; the traction rope should be cleaned and dried, and then coated with anti-aging grease (coated once every 3 operations).

(2) Storage Management

Storage Environment: The tow boom should be stored in a dry and ventilated warehouse with a temperature controlled at 5-30℃ to avoid mold growth in a humid environment; keep away from fire sources and chemicals (such as oil spill dispersants, strong acids and alkalis) to prevent material corrosion.

Storage Method: The dried tow boom should be rolled up neatly, and the traction rope should be stored separately by hanging to avoid stacking and squeezing with the tow boom.

2. Emergency Disposal

(1) Equipment Failure Disposal

Tow Boom Tearing: If the tow boom is found to be torn (length >10cm) during operation, stop towing immediately. For single-ship operation, recover the tow boom slowly to avoid

expanding the tear; for dual-ship operation, the two ships decelerate to stop synchronously, and the ship close to the torn end recovers first. If the torn position cannot be recovered, deploy a buoy to mark the position, and arrange for diving operation to salvage later.

Traction Rope Breakage: Immediately activate the backup traction rope (each ship must be equipped with 2 backup traction ropes). For single-ship operation, first deploy a buoy to locate the tow boom, then replace the traction rope and reconnect; for dual-ship operation, the ship on the broken side should stand by in place, and the other ship slowly adjusts its course to approach the tow boom to avoid the tow boom drifting with the current.

Tow Boom Entangled with Obstacles: Stop towing, and investigate the entanglement position through divers. If the entangled object is a flexible object such as a fishing net, the diver can clean it manually; if entangled with a rigid object such as a reef, adjust the ship's position and slowly pull the traction rope to try to separate, and it is forbidden to pull forcefully to avoid breaking the tow boom.

(2) Safety Accident Disposal

Ship Collision Risk: If other ships approach during towing operations, immediately notify the operation area through the VHF marine radio (channel 16), and deploy warning lights and colored flags; if the other ship does not give way, the tugboat should suspend operations, slowly sail away from the operation area, and resume operations after safety is ensured.

Personnel Falling into Water: Immediately stop operations, throw a lifebuoy to the person who fell into the water, and nearby ships quickly sail to the falling point for rescue; during the rescue process, avoid the ship's propeller approaching the person who fell into the water. After rescue, check the person's physical condition. If in contact with oil pollution, clean immediately with soapy water, and send to the hospital for treatment if necessary.

Oil Pollution Spread: If the oil boom is damaged during operation leading to oil pollution spread, immediately stop the tow boom operation, dispatch a backup oil boom to block the gap, and after the oil pollution is re-contained, adjust the operation range of the tow boom to avoid the tow boom dragging the uncontained oil pollution to expand the pollution area.

5.7.3 Chemical Adsorbents

1. Scope of Application:

Oil Pollutants: Suitable for the adsorption and recovery of various vessel fuel oil, crude oil and other oil leaks, especially for the removal of small-area oil spills, oil pollution in shoreline gaps and equipment surfaces.

Chemical Pollutants: Suitable for the adsorption of organic solvents and some water-insoluble chemicals (such as benzene, toluene, diesel, etc.), not suitable for strong corrosive and strong oxidizing chemicals.

Scenario Adaptation: Can be used for pollution adsorption in different scenarios such as water surfaces, shorelines, ship decks, and equipment surfaces.

2.Usage Method:

Water Surface Pollution:

- Large-area Oil Spill: Uniformly spread natural adsorbents or deploy oil absorbent mats. The dosage of adsorbents is 3-5 times the volume of oil pollution; after adsorption saturation (usually 10-30 minutes), recover the adsorbents using fishing nets and oil skimmers.
- Small-area or Dispersed Oil Pollution: Directly lay oil absorbent mats or use synthetic adsorbents for targeted deployment, and replace them in time after adsorption saturation.
- Water-soluble Chemical Pollution: Deploy activated carbon adsorbents, stir evenly, adsorb for no less than 30 minutes, and then recover through filtration or sewage suction equipment.

Shoreline/Equipment Pollution:

- Tidal Flats/Beaches: Spread natural adsorbents during low tide, turn over with a rake to ensure full contact between the adsorbents and pollutants, and collect after adsorption; or lay oil absorbent mats for coverage and adsorption.
- Equipment/Terminal Surfaces: Directly wipe and cover with synthetic adsorbents or oil absorbent mats, and clean after adsorption. For gap pollution, the adsorbents can be filled into the gaps.

Gas Adsorption:

- Toxic Gas Leakage: Place activated carbon adsorbent bags around the leakage source or use activated carbon adsorption devices to continuously adsorb volatile gases and replace the adsorbents regularly.

3.Precautions (Prevention of Secondary Pollution)

The selection of adsorbents must match the type of pollutants. It is strictly prohibited to use a single adsorbent to dispose of all pollutants (for example, natural adsorbents have poor adsorption effect on water-soluble chemicals and are prone to pollution residues).

Adsorbents saturated with adsorption are hazardous wastes (especially those adsorbing toxic chemicals and oil pollution), which must be recovered in a timely manner, put into sealed bags or special containers, marked with the type of pollutants, and handed over to qualified units for harmless disposal. It is strictly prohibited to discard, dump or incinerate them at will.

Personnel Protection: Wear gloves, masks, protective clothing and other protective equipment during use to avoid the adsorbents contacting the skin or inhaling dust; when handling the adsorption of highly volatile chemicals, wear gas masks.

The use of synthetic adsorbents and chemically modified adsorbents is prohibited in core sensitive resource areas (such as water sources and coral reef habitats), and natural degradable adsorbents are preferred.

Avoid the adsorbents drifting with the wind when spreading. In case of strong wind weather, the spreading amount can be appropriately increased or the operation can be carried out during windless periods; avoid the adsorbents entering aquaculture water bodies and drinking water sources.

When using activated carbon adsorbents, avoid mixing with strong oxidants to prevent chemical reactions producing toxic gases; the adsorbed activated carbon must be stored in a sealed manner to prevent the released pollutants from being adsorbed again.

Timely clean up the residual adsorbent debris in the operation area after operation to ensure no omission; clean the used tools and equipment, and centrally treat the cleaning wastewater.

Storage Conditions: Adsorbents should be stored in a dry, ventilated and cool warehouse, away from fire sources, heat sources and corrosive substances to avoid moisture and failure.

5.7.4 Precautions for the Use of Oil Absorbent Materials (Prevention of Secondary Pollution)

Oil absorbent materials must be able to float on the water surface for several days or weeks when saturated, otherwise they cannot be recovered, causing secondary pollution.

When choosing to use oil absorbent materials, the disposal plan of the waste after oil adsorption should usually be considered to avoid secondary pollution.

Manual operation is often used during use. If a large amount of loose oil absorbent materials are used, a hair dryer should be used.

Strive to recover all oil absorbent materials that have adsorbed oil to avoid making the consequences caused by the oil spill more serious and causing secondary pollution.

In sea areas with strong winds, a single oil absorbent sheet cannot stay on the oil surface due to its light weight, and overlapping two or three sheets may have a better effect.

If the oil film becomes thinner and thinner, the recovery efficiency of the oil absorbent materials will become lower and lower, and it is necessary to use oil booms to enclose the oil to maintain the thickness of the oil film.

When deciding to use oil absorbent materials, ensure that the recovery and disposal equipment can be used normally, and the treatment effect can meet the requirements of the relevant competent authorities to prevent secondary pollution.

5.8 Safe Operating Procedures for Oil Recovery Equipment

5.8.1 Downward Belt-type Oil Skimmer

3. Preparation Before Operation

(1) Equipment Inspection

Appearance Inspection: Check the conveyor belt (usually oil-resistant rubber material) for damage, cracks, and deviation signs, and ensure that the joints are firm; check the surface of the drive roller and guide roller for cleanliness, oil accumulation or foreign matter entanglement; confirm that the frame and bracket are not deformed or rusted, and the connecting bolts are not loose.

Function Inspection: Start the equipment for no-load operation for 5 minutes, observe whether the conveyor belt runs smoothly, and whether there is abnormal noise, jamming or

severe vibration; check whether the speed control device (such as frequency converter) is normal, and test the speed control function by adjusting the speed (usually 5-15m/min); confirm that the oil scraper (located under the conveyor belt) is closely attached to the conveyor belt without excessive gaps or excessive scraping.

(2) On-site Preparation

Operation Area: Clean up obstacles around the equipment, delineate a safe operation area, and set up warning signs; if operating on a pollution cleanup ship, fix the equipment on the special base of the ship's deck, and use cables for auxiliary fixing to prevent the equipment from shifting due to ship shaking.

Personnel Protection: Operators wear non-slip shoes, oil-resistant gloves, safety helmets, and life jackets (for water operations). If recovering volatile oil products such as light oil, additional gas masks should be worn.

Environmental Assessment: Confirm that the water flow speed in the operation area ≤1.5m/s and the wind speed ≤8m/s; observe the thickness of the oil pollution layer to ensure that the thickness ≥2mm (if the thickness is too thin, the oil should be enriched through oil booms first).

1. Operation Process

(1) Start-up Adjustment

Start the equipment power system (motor or hydraulic drive device), run at the lowest speed first, and slowly adjust the angle of the conveyor belt (usually 15°-30°) to make the lower end of the conveyor belt immerse 10-15cm into the oil pollution layer, ensuring that the surface of the conveyor belt is fully in contact with the oil pollution.

Observe the Oil Scraping Effect: If the oil scraped by the oil scraper does not fully flow into the hopper, slightly adjust the angle of the oil scraper (turn the adjusting bolt clockwise or counterclockwise) until there is no oil leakage; if the conveyor belt absorbs a small amount of oil pollution, the speed can be appropriately increased (each increase ≤2m/min) to avoid oil splashing due to excessive speed.

(2) Oil Recovery Operation

Continuously Monitor the Equipment Operation Status: Check the tension of the conveyor belt (adjusted by the tensioning device, excessive looseness is prone to slipping, and excessive tightness is prone to damaging the conveyor belt) and the temperature of the transmission system (motor housing temperature ≤60℃) every 10 minutes.

Receiving Container Management: When the capacity of the receiving container reaches 80%, close the equipment feed end (or suspend the operation of the conveyor belt) and replace it with an empty container; seal the mouth of the full container during replacement to prevent oil leakage.

(3) Shutdown Operation

After the oil recovery is completed, first adjust the speed of the conveyor belt to the lowest, then turn off the power system; after the conveyor belt is completely stopped, rinse the residual oil on the surface of the conveyor belt, oil scraper, and hopper with high-pressure

clean water (pressure ≤0.8MPa). Collect the rinsing wastewater into a special sewage bucket and strictly prohibit direct discharge.

Check the status of each part of the equipment, clean up foreign matter, and add lubricating oil to the transmission bearings.

1. Maintenance

(1) Daily Maintenance

Post-operation: Clean the surface of the conveyor belt. If local damage to the conveyor belt is found, use a special oil-resistant patch to paste and repair; check the rubber material of the oil scraper, and replace it in time if it is aging or hardening.

Regular Inspection: Check the wear of the drive roller bearings, test the accuracy of the speed control device, and perform anti-corrosion treatment on the entire equipment (painting anti-rust paint).

(2) Long-term Storage

Adjust the conveyor belt to a relaxed state to avoid deformation due to long-term tension; store the equipment in a dry and ventilated warehouse, and cover the surface of the conveyor belt with a dust cloth to prevent accelerated aging due to direct sunlight.

2. Emergency Disposal

(1) Equipment Failure

Conveyor Belt Deviation: Immediately shut down the machine and adjust the position of the guide roller (through the adjusting bolts at both ends of the roller). If the deviation is caused by the offset of the conveyor belt joint, rejoin the conveyor belt; it is forbidden to start the machine before troubleshooting.

Motor Overload: Shut down the machine to check whether there is conveyor belt jamming (such as entanglement of foreign matter) or voltage abnormality. Restart after cleaning up the foreign matter. If the motor is still overloaded, contact maintenance personnel to inspect the motor windings.

(2) Safety Accident

Oil Leakage: If the receiving container leaks, immediately cover the leaked area with an oil absorbent mat and transfer the leaked oil to a new container; if the equipment pipeline leaks, shut down the equipment and replace the sealing gasket (such as O-ring).

Personnel Injury: If the operator slips or is scratched by equipment parts, immediately stop the operation, clean and disinfect the wound (if in contact with oil, rinse with soapy water), and send to the hospital for treatment if severe.

5.8.2 Turntable-type Oil Skimmer

3. Preparation Before Operation

(1) Equipment Inspection

Core Components: Check the rotating brush (usually nylon or polyurethane brush bristles) for shedding and bending. The wear of the brush bristle length ≤30% (replace the rotating brush

if exceeding); check whether the bearing of the turntable (circular frame driving the rotating brush to rotate) is flexible without jamming; confirm that the oil sump (located under the rotating brush) is not blocked or rusted, and the drain valve is tightly closed.

Power and Control System: Test the motor starting current (normal range ≤1.2 times the rated current), check whether the speed control knob and emergency stop button are functioning normally; if hydraulically driven, check the oil level of the hydraulic oil tank (the oil level must be between the oil level gauge marks) and whether there is leakage in the hydraulic pipeline.

(2) On-site Preparation

Operation Position: Place the equipment downstream of the oil boom containment area to ensure that the rotating direction of the rotating brush is opposite to the water flow direction (to improve the oil pollution adsorption efficiency); if operating in shallow water, place an anti-slip pad under the equipment to prevent it from sinking into the sediment.

Personnel and Environment: Operators wear the same protective equipment as the downward belt-type oil skimmer; evaluate the type of oil pollution. The turntable rotating brush-type oil skimmer is suitable for high-viscosity oil products (such as fuel oil and crude oil). If recovering light oil, it is necessary to use oil absorbent mats for assistance.

4. Operation Process

(1) Start-up Commissioning

Start the equipment, run the rotating brush at a low speed of 10-15r/min first, observe the fit between the rotating brush and the oil sump (the gap between the lower end of the rotating brush and the bottom of the oil sump ≤5mm). If the gap is too large, lower the height of the rotating brush through the lifting device.

Adjust Speed and Suction: Adjust the rotating speed of the rotating brush according to the viscosity of the oil pollution (5-10r/min for high-viscosity oil products, 10-20r/min for medium viscosity); start the oil skimmer or oil suction pump, adjust the suction force to ensure that the oil level in the oil sump is maintained at 1/2-2/3 height (excessively high oil level is prone to overflow, and excessively low oil level affects separation efficiency).

(2) Oil Recovery Operation

Real-time Monitoring: Check the wear of the rotating brush bristles every 15 minutes (if the brush bristles absorb a lot of impurities, stop the machine for cleaning) and the oil-water interface in the oil sump (check through the observation window. If the water content exceeds 30%, adjust the separation parameters of the oil skimmer);

Impurity Cleaning: If floating garbage (such as plastic debris and aquatic plants) accumulates in the oil sump, stop the machine and open the cleaning door of the oil sump, use a hook to fish out the impurities to avoid blocking the inlet of the oil suction pump.

(3) Shutdown Operation

Turn off the rotating brush drive motor. After the rotating brush stops, turn off the oil skimmer and oil suction pump; open the drain valve of the oil sump to discharge the residual water in the sump, then rinse the rotating brush, oil sump, and separation filter element with high-pressure clean water, and dry the equipment components after rinsing.

Check the temperature of the rotating brush bearing (≤55℃), vent the oil tank of the hydraulic drive system (if there are bubbles), and supplement the hydraulic oil to the standard oil level.

5. Maintenance

(1) Daily Maintenance

Rotating Brush: Check the status of the brush bristles every 8 hours of operation. If there is extensive shedding, replace the rotating brush as a whole; avoid using a hard brush when cleaning the rotating brush to prevent damage to the brush bristles.

Oil Sump: Disassemble the filter screen at the bottom of the oil sump and clean the impurities intercepted by the filter screen; check whether there is leakage at the weld of the oil sump, and weld and repair it and perform anti-corrosion treatment if there are cracks.

Hydraulic System: Test the viscosity of the hydraulic oil and replace the hydraulic oil filter element.

(2) Long-term Storage

Remove the rotating brush and hang it in the warehouse (to avoid deformation of the brush bristles due to pressure); apply anti-rust oil to the inside of the oil sump and seal all openings; cover the main body of the equipment with a rain cloth to prevent moisture and rust.

6. Emergency Disposal

(1) Equipment Failure

Rotating Brush Jamming: Immediately press the emergency stop button, check whether the rotating brush is entangled with foreign matter (such as fishing nets and ropes), manually rotate the rotating brush after cleaning to confirm that there is no jamming before restarting; if the jamming is caused by bearing damage, replace the bearing before starting the machine.

Hydraulic Leakage: Turn off the hydraulic pump, find the leakage point (usually pipeline joints or seals), replace the damaged seals (such as oil seals and O-rings), supplement the hydraulic oil to the standard oil level, and test the operation after venting.

(2) Safety Accident

Fire Risk: If the recovered oil catches fire when encountering an open flame, immediately use a dry powder fire extinguisher (water is prohibited) to extinguish the fire, and start the ship's fire protection system (for water operations) at the same time, and evacuate the operators to a safe area.

Equipment Overturning: If the equipment overturns due to wind and waves during operation on the ship, first ensure the safety of personnel, then use a crane (or ship's crane) to lift the equipment to the deck, check the damage of the equipment components, and it is strictly prohibited to use it without repair.

5.9 Safe Operating Procedures for Emergency Unloading Operations

一、Preparation Before Operation

(1) Risk Assessment and Plan Formulation:

- Verify the physicochemical properties of the goods to be unloaded (toxicity, corrosivity, flammability and explosivity), loading volume and leakage status, and assess risks of the unloading operation (e.g., fire and explosion, poisoning, expanded leakage).

- Specify the unloading method (pumping, gravity flow, negative pressure suction), unloading equipment, receiving containers/vessels, operation procedures, safety measures and emergency response plan, and submit for approval to the commander-in-chief and relevant departments.

(2) Equipment Inspection and Preparation:

Check the integrity, tightness, and compatibility of the unloading equipment (pumps, hoses, valves, storage tanks) (such as corrosion-resistant equipment for handling corrosive chemicals), and conduct a pressure test to ensure no leakage.

Prepare emergency equipment: plugging equipment, oil booms, adsorbents, fire extinguishers, protective equipment, first aid kits, etc., and place them in easily accessible positions at the operation site.

The receiving container/ship must have corresponding carrying capacity and protective facilities to ensure compatibility with the goods to be unloaded. The use of containers that do not meet the requirements is strictly prohibited.

(3) On-site Preparation and Personnel Training:

Delineate a warning area for the operation, set up warning signs, and prohibit irrelevant personnel and ships from entering; open flames are strictly prohibited at the operation site, and flammable/toxic gas monitors are equipped.

Operators must wear corresponding protective equipment (chemical protective clothing, gas masks, non-slip shoes, protective gloves, etc.), receive special training, be familiar with the operation process, risk points, and emergency disposal methods, and can only take up their posts after passing the assessment.

Check the ventilation conditions of the operation area. If it is a confined space or an area where toxic gases are likely to accumulate, forced ventilation measures must be taken.

二、Operation Process

Connect Equipment: Connect the unloading equipment to the ship's cargo hold and receiving container according to the unloading plan to ensure firm connection and good sealing; lay the hoses to avoid bending and pressure, and fix them with brackets if necessary.

Test Run: Start the unloading equipment for a test run, check whether the equipment operation status and pressure are normal, and whether there is leakage; if any abnormality is found, immediately shut down the machine for inspection, and continue the operation only after troubleshooting.

Unloading Operation:

Strictly control the unloading speed and pressure (set according to the equipment operating procedures and cargo characteristics) to avoid static electricity generation or container overload due to excessive flow rate.

Arrange special personnel to monitor the cargo hold liquid level, receiving container liquid level, and equipment operation status throughout the process, and immediately shut down the machine if abnormal liquid level or leakage is found.

Maintain good ventilation at the operation site during unloading, continuously monitor the concentration of flammable/toxic gases, and immediately stop the operation, evacuate personnel, and take ventilation, plugging and other measures if the concentration exceeds the standard.

For flammable and explosive goods, the operation equipment must be grounded for anti-static, and operators are prohibited from wearing chemical fiber clothes to avoid spark generation.

For corrosive goods, avoid collision of hoses and valves during unloading to prevent damage and leakage; if a small amount of leakage occurs, immediately absorb it with adsorbents and continue the operation after cleaning.

End of Operation:

After the goods in the cargo hold are completely unloaded, close the cargo hold valve and unloading equipment, disconnect the connecting hose, clean the hose and equipment, and collect and treat the cleaning wastewater.

Check whether there are residual pollutants in the cargo hold and operation area, and clean them up in a timely manner; recover the emergency equipment and protective equipment at the operation site and store them properly.

Seal the receiving container, mark the name, quantity, and unloading date of the goods, and transport and dispose of them in accordance with relevant regulations.

三、Emergency Disposal

Leakage Emergency:

- In case of leakage from equipment or hoses, stop operation immediately, close relevant valves and cut off the leakage source; contain the spilled substances with oil booms or anti-seepage membranes, absorb them with absorbents, and recover the spilled materials and absorbents. - If the leakage volume is considerable, activate the emergency response immediately, evacuate operating personnel to a safe area, expand the warning zone, notify the commander-in-chief and relevant departments, and take measures such as plugging leaks and transferring receiving containers.

Fire and Explosion Emergency:

If a fire or explosion occurs, immediately stop the operation, cut off the power supply, and evacuate personnel; use the corresponding fire extinguisher (such as a dry powder fire extinguisher for oil and chemical fires) to extinguish the fire. It is strictly prohibited to directly extinguish oil and flammable and explosive chemical fires with water.

If the fire spreads, immediately call the fire alarm number, cooperate with the fire department to extinguish the fire, and take containment measures to prevent the spread of pollution caused by the fire.

Personnel Injury Emergency:

If an operator suffers from poisoning, burns, or other injuries, immediately remove them from the operation environment and move them to a well-ventilated and safe area; if poisoned, keep the respiratory tract unobstructed, perform artificial respiration if necessary, and call the emergency number; if burned, immediately rinse the burned area with a large amount of clean water for more than 15 minutes, and then send to the hospital for treatment.

5.10 Prevention of Secondary Pollution

Prevention of Pollution from Cleanup Equipment: After the completion of the cleanup operation, thoroughly clean the oil skimmers, oil booms, oil absorbent mats and other equipment and materials. Collect the cleaning wastewater into a special container and hand it over to the sewage treatment plant for treatment to avoid direct discharge of the cleaning wastewater.

Prevention of Pollutant Disposal: The recovered oil pollution, materials adsorbing pollutants and other hazardous wastes must be put into sealed containers, properly marked, and handed over to qualified units for harmless disposal. It is strictly prohibited to discard, dump or incinerate them at will.

Protection of Operation Area: During the cleanup operation, avoid damaging the marine biological habitats, shoreline vegetation, etc. in the operation area; when flushing the shoreline with a high-pressure water gun, control the water pressure and flushing range to prevent sediment loss and shoreline erosion.

Prevention of Chemical Agent Use: Strictly control the dosage and scope of use of chemical agents such as chemical adsorbents and oil spill dispersants to avoid harm to water bodies and aquatic organisms due to excessive use; prioritize physical cleanup methods and reduce the use of chemical agents.

六、Shoreline Cleanup Plan

6.1 Types and Characteristics of Qingdao Port Shorelines

The shorelines of Qingdao Port and adjacent coastal waters mainly include:

Artificial Terminal Shorelines: Mainly composed of concrete and steel structure terminals, with regular shorelines and sufficient operation space. Pollution is prone to accumulate at the terminal front and gaps.

Tidal Flat Shorelines: Mainly distributed in areas such as Jiaozhou Bay and Laoshan Bay, dominated by sandy-muddy tidal flats. Oil pollution is prone to penetrate and adhere, making cleaning difficult.

Rocky Shorelines: Distributed in areas such as Laoshan and Lingshan Island, with many rock gaps. Pollutants are prone to residue and are close to sensitive resource areas.

Coastal Tourism Shorelines: Such as Golden Beach and Shilaoren Beach, dominated by beaches with a large number of people. They have high requirements for the timeliness and cleanliness of the cleanup operation.

6.2 Targeted Shoreline Cleanup Plans

6.2.1 Artificial Terminal Shorelines

7. Cleanup Process:

First, rinse the terminal surface and front with a high-pressure water gun to flush the accumulated oil pollution and pollutants to the water surface containment area, then recover the water surface pollutants through oil skimmers and oil absorbent mats.

For the residual oil pollution in the terminal gaps, manually clean with brushes, scrapers and other tools, and use oil absorbent cotton to absorb the oil pollution in the gaps.

The rinsing wastewater is collected into a sump through the terminal drain, and discharged up to standard after oil-water separation and filtration treatment.

1. Precautions:

Avoid direct impact of high-pressure water flow on terminal equipment and steel structures during rinsing to prevent equipment damage or coating peeling.

Check the terminal drainage system after the operation to ensure no pollutant residue.

6.2.2 Tidal Flat Shorelines

1. Cleanup Process:

Carry out the operation during low tide. First, use oil booms to isolate the polluted area of the tidal flat from the water body to prevent the backflow of pollutants during high tide.

For the surface floating oil, use oil absorbent mats for adsorption; for the oil pollution adhering to the sediment, adopt the "plowing-adsorption-collection" method. Use machinery or manual

labor to plow the surface 5-10cm of the tidal flat, lay oil absorbent mats to absorb the oil pollution, and then collect the oil absorbent mats saturated with adsorption and the polluted sediment.

If the polluted sediment is lightly polluted, it can be air-dried in a designated area and then backfilled; if heavily polluted, it should be transported to a qualified disposal site for harmless disposal.

1. Precautions:

Avoid excessive plowing during the operation to prevent damage to the tidal flat ecological environment and benthic organism habitats.

Complete the cleanup and containment of surface pollutants before high tide to avoid the spread of pollutants with the tide.

6.2.3 Rocky Shorelines

1. Cleanup Process:

For the oil pollution on the rock surface, spray with environmentally friendly cleaning agents (such as biodegradable oil removers). After the oil pollution is emulsified, rinse with a high-pressure water gun. Collect the rinsing wastewater into a portable liquid collection tank, and then perform oil-water separation.

For the residual pollutants in the rock gaps, manually clean with cotton swabs, small brushes and other tools, and recover with small oil suction equipment.

If close to sensitive resource areas, the use of chemical cleaning agents is prohibited, and pure physical methods (such as dry wiping and adsorption) are adopted for cleaning.

1. Precautions:

Operators are equipped with non-slip shoes and safety ropes to prevent slipping and falling when working on rocks.

Conduct water quality monitoring on the cleaned rock surface to ensure no pollutant residue.

6.2.4 Coastal Tourism Shorelines (Beaches)

1. Cleanup Process:

Immediately set up warning signs, evacuate tourists on the beach, and delineate a cleanup operation area.

For the floating oil and pollutants on the beach surface, use oil absorbent mats and oil absorbent sand for adsorption, and manually collect the adsorbed materials and polluted sand with shovels and rakes.

For the deeply infiltrated oil pollution, adopt the "layered cleaning" method to clean the surface 10-15cm of polluted sand and transport it to a designated area for treatment; if the pollution range is small, the sand covering adsorption method can be adopted. After covering, monitor regularly, and clean the covering layer after the oil pollution is degraded.

After the operation, rinse the beach surface with clean water to restore the beach to cleanliness. After passing the monitoring, lift the warning and allow tourists to enter.

1. Precautions:

The use of chemical cleaning agents that are harmful to humans or difficult to degrade is strictly prohibited. Food-grade adsorbents or natural adsorbents are preferred.

Avoid damaging the beach vegetation and landform during the cleaning process. Timely transport the waste generated during the operation and do not pile it up at will.

七、Safe Operation Plan

7.1 On-site Organization and Management of Cleanup Operations

I. Organizational Responsibilities

Comprehensive Coordination Team

Emergency On-duty: Implement a 24-hour emergency on-duty system, responsible for collecting vessel arrival information, receiving pollution incident reports and early warning messages, transmitting incident information to the commander-in-chief and all departments immediately to ensure timely initiation of emergency response and unimpeded information transmission.

Cleanup Organization: Undertake on-site command and coordination during emergency operations, overallocate cleanup personnel, materials, vessels and other resources, organize all operation teams to carry out cleanup operations, and implement all instructions and arrangements of the commander-in-chief.

Information Dissemination: Issue early warnings and operation instructions to all departments and posts, timely forward regulations, weather alerts and other information from maritime authorities, ensuring all personnel synchronously grasp emergency updates and safety requirements.

Document Management: Collect, sort, file and keep full-process records and image data of cleanup operations, establish complete emergency files, cooperate with maritime authorities in accident investigations, and provide compliant evidence for accident handling and claims.

External Coordination: Liaise with external regulatory authorities including Qingdao Maritime Safety Administration, summarize and report accident disposal progress, maintain good collaboration with regulators and contracted entities, and ensure compliant progress of emergency work.

Emergency On-duty Team

Vessel Dispatching: Conduct unified scheduling and route planning for emergency cleanup vessels and auxiliary vessels, ensure rapid arrival of cleanup vessels at the incident site, integrate vessel capacity resources, and guarantee efficient and compliant vessel scheduling.

Safe Operation: Exercise full control over the operational safety of cleanup vessels, supervise crew members in strictly following safety operation procedures, identify potential safety hazards during vessel navigation and operations, protect vessels and personnel, and prevent secondary accidents.

Containment & Removal: Lead offshore oil spill containment operations, carry out core cleanup work including oil boom deployment and oil skimmer operation, implement oil spill removal in accordance with the Pollution Removal Operation Plan, control oil spill diffusion and improve cleanup efficiency.

Temporary Storage: Manage temporary storage of on-site collected oil contaminants and oily waste, standardize the use and on-site stacking of storage containers, take anti-leakage and anti-proliferation measures to avoid secondary pollution.

Recovery & Transportation: Coordinate the recovery and transportation of oily waste, connect shore-based pollutant disposal links, ensure compliant transportation processes and complete records, and safely deliver pollutants to designated disposal units.

Logistics Support Team

Vehicle Dispatching: Manage the scheduling of emergency vehicles, transport vehicles and transfer vehicles, meet land transportation needs for cleanup materials, personnel and equipment, keep vehicles on standby at all times to satisfy commuting and transfer requirements for emergency operations.

Equipment & Materials: Be responsible for the procurement, storage, maintenance and distribution of cleanup equipment (oil booms, oil skimmers, oil absorbent pads, etc.), emergency supplies and protective equipment, ensuring sufficient supplies and well-functioning equipment ready for deployment.

Safety Protection: Equip, inspect and manage personal protective equipment (chemical protective suits, gas masks, life jackets, etc.) for operators, supervise proper wearing to prevent personnel injuries.

Communication Support: Maintain smooth communication during emergency operations, ensure normal operation of emergency communication equipment, walkie-talkies and network systems, and guarantee real-time and stable communication among teams.

Medical Aid: Provide emergency medical support, equip first-aid medicines, liaise with medical rescue institutions (120), conduct on-site first aid and medical transfer for operators, and safeguard the life and health of personnel.

Claims & Evidence Collection Team

Collect accident-related evidence including on-site pollution photos, videos, pollutant samples, operation records and equipment usage records, sort out relevant data (e.g., leakage volume, cleanup workload, material consumption, etc.), and provide complete and valid evidence support for subsequent accident claims, insurance settlements and legal procedures.

II. Operation Procedures

On-site Investigation: Upon arrival at the site, the operation team shall immediately conduct an on-site investigation to identify the pollutant type, leakage volume, diffusion range, distribution of sensitive environmental resources nearby, as well as meteorological and hydrological conditions, and formulate an investigation report.

Plan Formulation: Develop a targeted cleanup plan based on the investigation report, specifying the operation area, cleanup methods, equipment selection, personnel division and safety precautions, which shall be implemented after approval by the commander-in-chief.

On-site Setup: Establish an on-site warning zone, divide operation areas and safe passages, install and debug cleanup equipment to ensure normal operation; operators shall wear complete safety protection gear and get prepared for operations.

Cleanup Operation: Carry out operations in accordance with the cleanup plan with coordinated cooperation of all teams to ensure standardized, safe and efficient operations.

Operation Closure: After completing cleanup operations, properly dispose of recovered hazardous waste; recover, clean and maintain cleanup equipment and remaining materials; the Claims & Evidence Collection Team shall complete evidence documentation; check for on-site potential safety hazards, and evacuation is allowed only after confirming no safety risks.

III. Coordination Mechanism

Internal Coordination: Report operation progress every 2 hours and resolve on-site problems; the Communication Support Team shall ensure unobstructed information among all teams for efficient collaboration.

External Coordination: The Comprehensive Coordination Team maintains real-time communication with maritime, ecological environment, port administration and other relevant departments, timely reports operation progress, pollution disposal status and coordination matters in strict accordance with the Qingdao Offshore Oil Spill Emergency Response Plan; cooperate with relevant authorities in pollution monitoring and accident investigations; keep contact with contracted vessel entities to obtain vessel information and assist in pollution source control.

7.2 Connection with Emergency Plans

7.2.1 Connection with the Company's Emergency Plan

1. Response Initiation Coordination As a special operation support document to the Company's *Emergency Plan*, this plan shall be activated simultaneously with the corresponding level of emergency response initiated by the Company's Commander-in-Chief according to the incident severity after a pollution accident occurs, so as to clarify operational tasks and requirements.
2. Organizational Structure Connection: The on-site organizational structure in this plan is consistent with the emergency rescue system in the company's emergency plan to ensure unified command and clear division of labor; the on-site commander is designated by the company's emergency command headquarters and accepts the unified leadership of the company's emergency commander-in-chief.
3. Resource Allocation Connection: The cleanup vessels, equipment, materials, personnel, etc. required by this plan are all allocated from the emergency resource reserve system of the company's emergency plan to ensure the rapid arrival of resources.
4. Emergency Response Coordination: The cleanup procedures and technical methods in this plan shall be consistent with the emergency response procedures specified in the company's emergency plan. Major decisions during operations shall be submitted to the company's commander-in-chief for approval to ensure compliant disposal.
5. Follow-up Disposal Connection: After the completion of the cleanup operation, carry out follow-up disposal work in accordance with the requirements of the company's emergency plan, including pollutant disposal, equipment recovery and maintenance, accident investigation, summary and evaluation, and plan revision.

7.2.2 Connection with the Qingdao Municipal Emergency Plan for Marine Oil Spill Incidents

1. Response Classification Connection: The emergency response classification (Level I-IV) of this plan is consistent with the classification standard of the "Qingdao Municipal Emergency Plan for Marine Oil Spill Incidents" to ensure synchronized response levels and efficient coordination.
2. Command Coordination Connection: The operation site accepts the unified command of the maritime emergency command agency, designates a senior commander as the company's representative, and timely reports the operation progress, resource needs, and existing problems; strictly implement the instructions of the emergency command agency and cooperate with other emergency rescue forces to carry out collaborative operations.
3. Information Reporting Connection: The operation site reports the operation progress to the company's emergency command headquarters every 2 hours (including pollution control status, cleanup volume, equipment operation status, safety status, etc.). Immediately report major situations (such as pollution spreading to sensitive resource areas, operator injuries, equipment failures) to ensure unobstructed information.
4. Resource Sharing Connection: If the company's cleanup resources are insufficient, apply for support from the emergency command agency in accordance with the resource sharing mechanism (such as equipment from other cleanup units, traffic control from maritime departments); at the same time, the company's cleanup resources are also incorporated into the Qingdao Port emergency resource reserve system and subject to unified dispatch.
5. Emergency Conclusion & Transition:Upon completion of cleanup operations and confirmation through inspection, an application for operation conclusion shall be submitted to the maritime emergency command authority with the approval of the company's commander-in-chief. Upon approval, on-site operations shall be terminated and shifted to the post-disposal stage.