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DISCUSSION ON SHIPPING DANGEROUS GOODS ACCIDENTS RESCUE OF CHINA

By

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DECLARATION

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

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

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ABSTRACT

In recent years, with the rapid development of China's economy and trade, the type and amount of transportation of dangerous chemicals have increased significantly. Under normal circumstances, most hazardous and noxious liquid substances are in the form of a dedicated ship bulk cargo transport, only a relatively small part of the way to preclude the use of land. Under the rising traffic background, probabilistic safety and pollution incidents danger to dangerous goods vessels have also gradually increased. Once such ships have accidents, hazardous substance spill liquid will pose a huge threat to the marine environment and safety of people and property. China Ministry of Transportation as the Chinese water traffic safety authority, has more and more pressure on regulatory and emergency rescue.

This article explains constitutes of Chinese shipping dangerous goods emergency rescue system, points out deficiencies in the current maritime chemical tankers emergency rescue system, and explores dangerous goods ship emergency rescue decision system. At the same time, it proposes dangerous ship accidents rescue system ideas and improve measures to explore practical emergency rescue decision support technology to improve the effectiveness of dangerous goods ship accidents rescue to help.

KEY WORDS: Emergency rescue system; emergency decision making; emergency disposal measures; personal protection equipment.

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LIST OF ABBREVIATIONS

CEPPO	Chemical Emergency Preparedness and Prevention Organiazation
EPA	Environment Protection Agency
TRANSCAER	Transportation Community Awareness and Emergency Responce
COP	Conference of the Parties
SINOPEC	China Petroleum & Chemical Corporation
CNPC	China National Petroleum Corporation
CNOOC	China National Offshore Oil Corporation
ERPG	Emergency Response Planning Guideline
PPE	Personal Protective Equipment
IDLH	Immediately Dangerous to Life and Health
APF	Assigned Protection Factor

CHAPTER 1

INTRODUCTION

1.1 Overview of water transport of dangerous goods

1.1.1 Definition of dangerous goods water transport

According to the definition and the characteristics of the waterway transportation of dangerous goods, we defines water transport of dangerous goods as explosive, flammable, toxic, corrosive, or radioactive features things, which, in the process of shipping, port loading and unloading and storage, may cause personal injury, property damage and environmental pollution and need special protection.

1.1.2 Classes of water transport of dangerous goods

At present, the water transport of dangerous goods categories amounted to more than 1200 species, there are more than 300 kinds of common. According to the dangerous nature of the dangerous goods, it can be divided into nine categories, each of the following points again small class, as shown in table 1.1. (Yang & Xu, 1987)

1,Explosives	1.1	Explosion hazard material and items at the same time
	1.2	With jet danger but no major explosion dangerous substances and articles
	1.3	With burning danger or small explosion or jet dangerous goods
	1.4	Explosive substances which present no significant ha zard
	1.5	Very insensitive substances which have a mass explo sion hazard
	1.6	No explosion danger and no sensitive cargo
2,Gases	2.1	Flammable gases
	2.2	Non-inflammable gases
	2.3	Toxic gases
3,Flammable liquids	3.1	Low flash point, such as gasoline, sulfur dioxide, ethyl ether, etc
	3.2	Middle Flash point, such as industrial alcohol, benzene, etc
	3.3	High flash point, such as turpentine, etc

4,Flammable solids	4.1	Flammable solids
	4.2	Substances liable to spontaneous combustion
	4.3	Substances which, in contact with water, emit inflammable gases
5,Oxidizing substances and organic peroxides	5.1	Oxidizing substances
	5.2	Organic peroxides
6,Toxic and infections	6.1	Toxic
	6.2	Infections
7,Radioactive material	7	Radioactive material
8,Corrosive substances	8	Corrosive substances
9,miscellaneous dangerous substances and articles	9	Miscellaneous dangerous substances and articles

Table 1.1 Classes of water transport of dangerous goods

1.1.3 Dangers of water transport of dangerous goods

According to the definition and classification of water transport of dangerous goods, the waterway dangerous goods may result in five kinds of dangers, namely combustion and explosion, poison, radiation, corrosion and water environmental pollution (He & Jin, 1994). Specifically, they are as follows:

(1) Combustion and explosion

In water transportation of dangerous goods in China, most of the species and amount of dangerous goods have burning and explosion risk. Affected by the weather and other natural conditions and the influence of ship structure, it is easy for dangerous goods in transportation to cause spontaneous combustion, and produce an explosion. Although the dangers of fire and explosion to the safety of vessels and person are about the same, the developing process of the damage is different. Fire loss is proportional to the square to burning time, burning time twice, the loss is likely to increase in four times. the explosion will cause vessel damage or casualties in a short period of time.

(2) Poison

Shipping dangerous goods toxic can cause, directly or indirectly, from dangerous goods. Toxic and dangerous products can be absorbed into the body through the respiratory tract and other digestive or respiratory system, causing skin allergies, lethargy, coma, anesthesia or even death. Long-term effects may also cause cancer, deformities and gene mutation. When toxic substances go into the nature, they may increase pollution of air, soil, marine ecological environment, causing irreparable damage.

(3) Radiation
Rays produced by the radioactive cargo are not only a biological organism, vomiting, bleeding, cancer and even death within a short period manifested injuries, they can also cause some persistence and a certain latent long-term damage, leading to chromosomal aberrations organisms, which may influence the growth and development of posterity. What's more serious is that no effective way has been found to treat radiation damage at present. Radioactive materials packaging radiation damage is the main reason for the accident. At the same time, ports, terminals and ships carrying radioactive materials, can also result radiation accidents in loading and unloading, transport, in additional, non-compliance with the relevant standards, and operational requirements processes are the other reasons of this kind of accidents.

(4) Corrosion
Corrosive can not only cause significant harm to the human body functions, but also significant damage to the ship. Human exposure to acid corrosion, the tissue protein coagulation will form a shell to prevent damage to continue. High concentrations of acid not only make the skin cuticle protein necrosis, but can cause local tissue coagulation necrosis. Compared with various acids, alkalinities can cause greater damage to human body. Because a alkalinity in the human body, while the corrosion can produce saponification of fats or soluble basic protein, enabling human organs to be further damaged. Some corrosive substances, can quickly penetrate human skin protective layer, and into the human body, organs and dispersed in the body fluids, thereby inhibiting the activity of enzymes.

(5) Water environmental pollution
Ships, during their transport, directly or indirectly, will put some hazardous substances or energy into the water body, and thus human health, and all kinds of maritime environment, will be damaged and influenced. Maritime dangerous hazards can sometimes be far more than the consequences of fire or explosion.

1.2 Dangerous chemical transportation

Transport of dangerous chemicals from the beginning of the 1960s rose in developed countries in the West, with the rapid development of the world petrochemical industry, maritime traffic of dangerous chemicals is also increasing.

IMO has registered 2,000 kinds of bulk chemical species, 596 of which can be transported through specific ship at sea. After the fire risk, health risks, the risk of water and air pollution and the risk of reaction hazard assessment, these substances are included in the "International Bulk Chemicals Construction and Equipment of Ships"and" IBC CODE"and "MARPOL73 / 78 Convention" Annex amendments.

Since the reform and opening up, China has achieved the development of industry,

trade, transportation and the improvement of people's living standards. There has been a substantial increase in the production and demand of chemicals. The transportation of chemicals is also on the increase. In 1983 the first of a bulk chemical carrier "HUA YUN" was built, in 1997 the number of such carriers increased to 24, and in 2001 the number of the registered chemical tankers was 237. However, the development of maritime transport of chemicals is still lagging behind. There is still large shortage in the technical condition of the ship, crew quality, safe operation and so on. Up to now, China has only Hainan and Nanjing Tanker Corporation, which has a relatively large-scale transport fleet, but still on a smaller scale overall.

In the late 1990s, a number of dangerous chemicals transportation giants in developed countries started the industrialization of strategic layout on a global scale, business tentacles all over the world. For example, Norway's Odd Phil companies have investments in Brazil, the United States, Argentina and China's Ningbo, Dalian, Zhuhai and other places, in the form of joint ventures or wholly-owned construction of a number of technology, equipment, first-class chemicals terminals and storage tanks facility. In such a backdrop, China is also paying attention to dangerous goods terminal building, rational use of water resources, and some coastal cities in the Yangtze River are starting new construction, renovation, expansion of a number of hazardous chemicals wharf operations, and the number of vessels engaged in dangerous chemicals began to develop rapidly.

1.3 Dangerous goods ships accident emergency rescue

Maritime accidents involving dangerous chemicals have the following characteristics: suddenness, rapid diffusion, serious pollution, long duration and a wide range. Therefore, once the accident involving the dangerous goods occurs, it is likely to cause people to panic, and if it can not be disposed in time, it will surely cause secondary pollution hazards. Dangerous chemical tankers emergency rescue means rescue actions due to various causes of dangerous chemical tankers accidents and is likely to cause many casualties and other large social harm, the source for the timely control hazards, rescue injured persons, clear harmful consequences, protection and guidance of crew the withdrawal of organized rescue operations. For in the event of an accident, in order to take timely and effective measures to eliminate harm, reduce accidents hazards and prevent accidents deterioration, minimize accident losses, we need to establish a scientific emergency rescue system. With the development of economy and culture, rescue system is gradually established and improved through the cooperation and continuous exploration among the government, administration, enterprises and research institutions and other forces.

1.3.1 Foreign countries' emergency rescue system process

The process of the emergence and development of foreign dangerous chemicals emergency rescue system is accompanied by the development of chemical industry and various chemical accidents arising and development. In this historical process, governments, research institutions, and other related businesses actively seek progress of a more comprehensive chemical accident emergency response system from passive to active mode. In the United States, Britain, Germany and other developed industrial countries, there is a relatively sound legal system, a more stringent legislation, the development and improve of more specific laws and regulations make the illegal much more cost, ,the high cost of illegal urge most dangerous chemicals unit of those countries have a strong law-abiding sense of responsibility, We can say that they play a leading role in the national emergency rescue management transport of dangerous chemicals, and provide the support and guarantee for dangerous goods accident prevention and rescue.

The United States is one of the earliest countries that have established the chemical accident emergency rescue system. In 1986 the US Congress passed an amendment of SUPERFUND law, the law of "Emergency Planning and Community Right to Know Act" , which is the highest legal basis for emergency rescue. In addition, the US congress also passed emergency rescue and relevant laws and regulations as well as "Resource Conservation and Recovery Act", "Clean Air Act", "Oil Pollution Act", "Comprehensive Environmental Emergency Response, Compensation and Liability Act" and so on. In 1987 EPA (ENVIRONMENT PROTECTION AGENCY) and the Federal Emergency Management Agency issued a "Emergency Plan Technical Guide" and the "EPA Standard Risk Management Plan" put forward accident emergency requirements to the enterprises. The US EPA has established a special chemical emergency preparedness and prevention bureau (CHEMICIAL EMERGENCY PREPAREDNESS AND PREVENTION ORGANIAZATION), abbreviated as CEPPO, responsible for leading CEPPO establish sectoral cooperation and providing technical assistance in the following areas: chemical emergency prevention and preparedness, response to environmental crises, the public notice in the chemical hazards in their communities and share lessons learned about chemical accidents and the like. In the actual dangerous chemical accident emergency response process, the Fire Department is sector-specific implementation, the team responsible for extinguishing the fire, rushed to the scene to control developments of accident, rescue the injured out of danger, evacuate the people and complete the cleanup of the dangerous chemicals.

In some Western countries, the chemical industry has its own chemical warfare rescue forces. Enterprises organize transportation between accident mutual aid in the form of a network to help government departments to do community public emergency rescue training exercises and rescue work. Such networks are commonly found in Europe and North America, such as the establishment of the German chemical

transport accident “TUIS “mutual support network, Canada “TEAP” transportation accident assistance programs and more representative of the United States Transportation Emergency Committee “TRANSCAER” design (Pu, 2003) .

TRANSCAER (TRANSPORTATION COMMUNITY AWARENESS AND EMERGENCY RESPONSE) was established in 1994, members covering the entire chemical industry chain, including regulatory, manufacturing, transportation, retail, emergency response units. The organization mainly has the following two functions: (1) enhancing transport safety and handling of toxic substances; (2) educating and assisting the public transport toxic substances near the main line; (3) helping make the dangerous goods transport accident Community Emergency Response Plan. In addition, TRANSCAER also provides teaching and training, assists in the development of contingency plans, offers technical advice, conducts drills and other commercial activities, significantly strengthens personnel communication among manufacturers, transportation companies, retail businesses, emergency rescue units, This has enhanced a lot of the overall social emergency levels and resource allocation rationality .

Several foreign countries have set up a relatively complete database of dangerous chemical accidents, hazardous chemicals historical data provide adequate and reliable data for transportation studies , and achieved good research results.

Britain set up the National Chemical Emergency Centre in Javier. The chemical industry companies provide information for the center, and set up networking database, which is also connected with the fire department, can provide needed information timely. The emergency center set in the chemical safety comprehensive support program, and with a small rapid reaction force, equipped with professional equipment, can participate in small-scale emergency rescue.

In recent years, China’s Dangerous Chemicals Emergency System has also been improved. Shenyang, Wuhan, Jilin, Shanghai, Suzhou and other cities have established urban chemical emergency rescue information system. However, these emergency systems have some limitations, which can not automatically generate contingency plans to play a supporting role in decision-making.

1.3.2 Status of China's maritime emergency rescue system

China carried out maritime transport of chemicals later than developed countries, so the study of dangerous goods emergency response is not mature, and emergency response system is still not perfect. In recent years there have been many studies of dangerous goods emergency response, but related research is still not widely recognized and promoted. The existing staffing levels are low, contingency plans for

the nation's coastal ports are uneven, emergency response is weak. In addition there is a lack of professional technical support and professional emergency response fleet, what's more, inefficient use of resources and lack of organization exercise also made the emergency response capacity clearly insufficient. Compared with the level of development abroad, China's offshore dangerous goods accident response system construction management work remains to be further perfected. Establishing a scientific emergency response system and enhancing the dangerous goods and the ship's emergency response plan preparation and emergency response decision-making techniques are an urgent task of the current study.

1.3.2.1 Existing emergency resources and technology introduction

China Maritime Safety Administration, China Rescue and Salvage Bureau, dangerous goods companies and community clean-up companies are China's main offshore ship dangerous goods emergency power; however, in the face of uncertainty and sudden accident, existing emergency response system cannot effectively respond. This is mainly because it lacks effective risk analysis of incidents emergency decision, operational programs and professional emergency rescue force and so on. In the event of big, serious dangerous ship accidents, current emergency response force parties have organizational difficulties in playing their comprehensive rescue capabilities.

1.3.2.2 The existing problems

①Rescue facilities and equipment inadequate and old.

China Rescue and Salvage Bureau is responsible for the maritime search and rescue, fire fighting, emergency towing, maritime rescue, defense and other emergency relief work. In an accident the rescue ship also plays an important role in China's current strength is the national professional maritime rescue power. However, China Rescue and Salvage Bureau cannot function well due to its deficiencies in hardware and software construction. Anti-pollution facilities, rescue equipment and dangerous goods training which specialized in dangerous goods are rather inadequate. The professional training for the rescue crew is not in place, and the overall strength is limited.

②Ports and terminals emergency response capacity is rather poor.

Although the "MARPOL" Convention on the port configured to receive chemical sewage treatment equipment, contracting governments should take responsibility and get the work done under explicit request. However, due to limited conditions, many of our chemical terminals all have the difficulties in the economy, technology, management and other aspects, and can not comply with chemicals or sewage

receiving treatment device according to the Convention, and there are few ports have limited reception processing capability, the problem is they can only receive a few specific chemicals sewage. The current port reception facilities for hazardous chemicals are not optimistic, and the processing capacity of the existing reception facilities is very limited. These facilities actually can barely meet ports' requirement; but can not afford to ship pollutants which need to deal, so that in the emergency event, it can not play a substantive role. Furthermore, in accordance with relevant state regulations and standards, the existing port, dock emergency supplies are basically set for oil pollution incident, for dangerous chemicals goods, with only a small amount of personal protective equipment; they have no special recovery treatment apparatus, and are unable to cope with the bulk of the hazardous chemical spills. Because of the limitations of human, material and financial resources, when a dangerous goods ship incident occurs in port or offshore, it is difficult to respond effectively.

③Lack of professional marine chemical cleanup team.

Compare with ports and terminals emergency facilities, similar situation also exists in pollution clean-up team at sea. Marine clean-up ship and equipment are only for individual substances; even basic personal protective equipment does not meet the requirement. For larger scale ship accidents there are no dangerous goods emergency response capabilities.

Take Shenzhen City for example, Shenzhen has five environmental emergency assistance companies: Shenzhen Hazardous Waste Treatment Station Co., Ltd. Lvda environmental protection, Bao'an District, Shenzhen industrial waste green treatment Co., Ltd. Dongjiang Environmental Co., Ltd., Longshan environmental Science and Technology Co., Ltd. Wherein only the first three companies mainly engaged in recycling of hazardous chemicals, but only Shenzhen Hazardous Waste Treatment Station Co., Ltd and Lvda environmental protection provide dangerous chemicals emergency rescue services.

④Lack of scientific and applicable emergency response plan

For ships carrying dangerous goods, Ministry of transport, Ministry of Public Security and State Administration of Work Safety on January 23, 2006 jointly issued "on further strengthening the waterway road transport of dangerous chemicals management notice", requiring relevant departments to actively promote the provinces (cities) government to develop and improve contingency plans at all levels of pollution from ships and hazardous chemicals emergency rescue plan in accordance with the requirements of relevant laws and regulations and the State Council, and requested the provincial plans to be completed at the end of 2007. But in Dalian City it was until 2012 that they began to enact appropriate contingency plans. In Tianjin, Across the country, represented by a small number of provinces enacted

relatively complete maritime chemical emergency plans, while for others maritime chemical accident emergency response plan is lagging behind most of the coastal cities, existing plans targeted and operability is not strong, and lack of decision-making support.

⑤Lack of rescue decision-making

Although the study of dangerous chemicals emergency rescue decision-making has been paid more attention, it is still limited because research focuses on the preparation of contingency plans. Existing hazardous chemicals emergency response plan is divided into two levels:

The first is national, provincial and cities level dangerous chemicals emergency plans which divide responsibilities of various departments, but lack of accident scene operability for specific hazardous chemicals, and most only divided of the emergency level by casualties population. So it can not accurately determine the first time actions among the emergency levels.

Second, the enterprise-level contingency plans. Engaged in the transport of dangerous goods shipping companies to develop contingency plans in accordance with its own characteristics, with a strong operational, targeted. However, companies have limited emergency rescue capacity, and lack environmental awareness and capital investment. Thus, contingency plans tend to focus more on their own safety management and accident prevention. Facing large-scale dangerous chemical accidents, the enterprise itself simply can not cope.

Dangerous chemical incidents seriously jeopardize the survival of the environment. Once the similar incidents occur, we can control the risk of hazardous chemicals through timely and scientific emergency response system, and cut down the losses to a minimum at the time of the accident happens. Emergency rescue of chemical accident at sea is an important public administration functions of local government of coastal cities, they shall establish maritime chemical accident emergency rescue collaboration mechanism as soon as possible. Government and search and rescue commands center should coordinates such departments such as, maritime administration, salvage bureau, safety supervision, fire and health departments in regional maritime rescue system for chemical accidents.

1.4 Main content and meaning of this paper studies

Establishing and improving dangerous goods emergency response system is a complex, long-term project. Major accidents involving dangerous chemicals evacuate, contaminated area alert, medical aid, spill site decontamination, environmental monitoring and other issues, it needs the joint efforts of local Government, chemical industry, ports, shipping companies and other parties to give power. China Maritime

Safety Administration and its agencies as the charging department of the shipping of hazardous chemicals, has the great responsibility to regulate shipping, to prevent accidents and to enhance the emergency response capacity of the port. It should play a leading role in this process. Among its responsibilities are the coordination and communication with the government and related units and the use of all resources. It should speed up the establishment and perfection of the system, endeavor to include properties of dangerous goods, train professional and technical personnel, build emergency response team, coordinate emergency resources and organization of regional, establish emergency response plan and a series of related research projects.

The main task of our work, one aspect is to find deficiencies and suggest improvements by elaborating the basic constitution of dangerous chemical accident rescue system and comparing the existing emergency resources. the other aspect is to explore more practical and scientific emergency rescue mechanism and emergency disposal measures under the condition of existing emergency resources and technology,

CHAPTER 2

DANGEROUS GOODS SHIP ACCIDENTS EMERGENCY RESCUE SYSTEM CONSTRUCTION

Accident emergency rescue refers to the elimination or reduction of accident harm, to the revention of accident deterioration and the reduction of accident loss. Normally measures taken are: to organize the rescue, evacuation, etc; to control the hazard source; set closed, isolation scene area, decontamination; to monitor the disposal of hazardous goods.

When accident comes, in order to take timely and effective measures to eliminate, reduce accidents hazards and prevent accidents deterioration, minimize accident losses, we need to establish a comprehensive system of emergency rescue system. Dangerous goods emergency rescue system should include national, local, regional rescue system at different levels. National emergency rescue system should establish a general framework and operational mechanism, and establish and improve the rescue system at all levels on this basis.

2.1 The purpose and function of emergency rescue system

Generally, emergency rescue system can achieve its function through the completion of emergency preparedness, emergency response and recovery tasks to the various stages of work.

Preparation work which is carried out before the emergency occurred, mainly involves establishing emergency management capabilities; Response, also known as response reaction, should be taken immediately before, during and after the accident; Restoration work should be carried out immediately after the accident, first restore a minimum of service, and then continue to make the area returnto normal. Missions and work contents of each stage are shown in Table 2.1.

Mission of each stage	Contents
Prepare: All kinds of action taken before the accident happened, which purpose is to improve the ability of emergency response when the accident occur.	Emergency rescue policy and principles The emergency rescue mechanism Formulate emergency rescue plans Reserves of emergency supplies, and equipment Carry out the training and drills Sign emergency mutual agreement Emergency rescue information database, etc
Response:	Corresponding emergency system and

Immediate action when accidents will happen, happening and after the happen. The purpose is to protect people's life, reduce property loss control and eliminate accidents.	organization Report on the government institutions Implementation of on-site command Control expands and eliminate accident The evacuation and refuge Environmental protection and monitoring The search and rescue, etc
Recovery: After the accident, make the production and life returned to normal or further improved.	Damage assessment, Claims Clean up The review of emergency response plan Accident investigation

Table 2.1. Missions and work contents of each stage in emergency rescue system

2.2 Component of emergency response system

Emergency rescue work involves many sectors and various rescue team coordination. For the orderly implementation of the accident rescue, we need to improve laws and regulations under the premise of restraint, establish an effective organizational system, operation mechanism and system, and improve contingency Security System.

2.2.1 Legal basis

To effectively control pollution accidents particularly in large-scale pollution incidents, not one specific functional department can act alone; we require multiple departments or organizations. However， these organizations have different functions or affiliation in their daily work. For emergency rescue system, the relevant departments working together in emergency response operations, must establish and improve relevant laws and regulations, so that they are responsible for themselves when specifying the responsibilities and obligations, thus that emergency operations can be carried out smoothly according to plan in accordance with a given program. China has currently established a relatively comprehensive system, containing different levels of dangerous chemicals emergency laws and regulations, including:

(1) Legal: "People's Republic of China Maritime Traffic Safety Law," "People's Republic of China Marine Environmental Protection Law", "People's Republic of China Production Safety Law," "Emergency Response Law of People's Republic of China" and so on;
(2) Regulations: "Chemical Accident Emergency Rescue Management Approach" and so on;

(3) Government documents: "the State Council on serious safety accidents administrative accountability requirements", "provincial Hazardous Chemical Safety Management Implementation Measures" (Zhejiang People's Government Decree No. 184) and the like;
(4) National Standard: "List of Hazardous Chemicals" (State Administration of Work Safety Bulletin No. 2003 No. 1, "Major hazard identification of dangerous goods" “List of dangerous goods products” and so on.

In addition, China has done a lot of work in regulating the transport of chemicals, to prevent ship accidents, protect the safety of shipping and protection of the marine environment, has promulgated the "Ships carrying dangerous goods safety supervision and management regulations" and the "People's Republic of China and ship operational activities related pollution of the marine environment prevention regulations" “Dangerous chemical safety regulations " and other regulations (Liu & Zhou, 2004) .

2.2.2 Organizational structure of emergency response system

On August 3 and 4, 2012, two Containers of MV Maersk Kuantan loaded Cyanamide spate spill in Shenzhen Port, the accident and emergency rescue procedure is worthwhile to ponder.

The greatest feature of the disposal of the emergency incident is the two levels --City and District Emergency Management Office direct command instead of Shenzhen maritime rescue sub-centers which should be the most commanding position, maritime rescue sub-centers were only treated as an advisory role and assistance. On-site command system was in a state of chaos for a long time, thus affecting the efficiency and effectiveness of incident handling to a considerable extent.

Investigators found that in ShenZhen government Office of Emergency Management website, maritime search and rescue sub-centers is not on command structure of Shenzhen government, which are also listed in the plan did not include "the Shenzhen maritime emergency response plans." compare August 3, August 5 emergency response procedures, investigators believe, "Shenzhen maritime emergency response plans" disappeared to some degree in the existing municipal emergency response framework. Whether relevant leaders or departments are unaware of this, so the whole disposal process is in full accordance with the national emergency response usually practices, but rarely considers emergencies at sea which have their own technical, foreign and other characteristics.

At present, "the Shenzhen Maritime Safety Administration Hazard Emergency Response Program" only involves responsibilities within the Bureau of the relevant

processing department. It does not involve the Shenzhen maritime rescue sub-centers to report to and does not know how to meet the search and rescue sub-centers to implement emergency response work content. As a result, on-site emergency response personnel can not get appropriately way and identification in coordination work, not to mention the calling of the local government emergency resources, which is the root causes of marginalization ofthe on-site emergency personnel in the emergency operation.

In order to successfully complete the rescue mission, we should first establish the organization of the system. When an accident occurs, various components of the system came into effectively overall operation status, to complete the emergency rescue mission and achieve the purpose of mitigation of accident consequences. Setting organization should consider two following issues:
(1) to establish what kind of organization (functional sector)
(2) determine the organization (functional sector) emergency rescue responsibilities of the position and role.

Existing emergency rescue system organizations can be divided into four parts according to the function:
(1) management agencies coordinate and emergency organize various agencies functioning and relations;
(2) command agencies is responsible for the accident site emergency command structure, the effective use of staff scheduling and resource;
(3) support and security agencies to provide emergency support personnel and material resources of the back support;
(4) rescue team conduct on-site rescue.

2.2.3 Emergency rescue operation mechanism system

Ship emergency rescue operation should be under the premise of prevention, implementation of unified command, tiered response, proximity principle, ship's self-help and public mobilization as the basic principles.

Unity of command is the basic principle of emergency activities. It can promise emergency normal activities effectively. Emergency command can generally be divided into centralized command and on-site command, inside or outside the command several forms, no matter what form are subject to the unified command mode, regardless of rank administrative activities related to emergency rescue units and affiliation are the same have to be coordinated in a unified organization and command of the Ministry of operations, curried, in unison. Emergency command structure had to be established before an emergency occurs, and clear provisions in the contingency plan, which will help to ensure that all personnel involved in

emergency activities are clearly aware of their responsibilities and perform well during emergency duties.

Tiered response refers to the response in the primary classification mechanism to expand the emergency response in the process of implementation. Expanding or improving emergency response level is mainly based on the degree of harm to the accident, the scope and ability to control the situation. Expanding emergency is mainly to improve levels of command, which aims to expand the scope of the emergency response, and enhance responsiveness.

Ship self-help is the emphasis ship accidents must be the first time to take emergency measures to control the development of the accident., The crew themselves are the most familiar with the condition of their own ship and cargo, so the ship may be largely positive by self-help to the subsequent rescue for gaining time and opportunity.

Proximity principle is to emphasize the main principle of "first responders" on-site emergency command. Because only a local incident management department is most familiar with the region, the climatic conditions, geographical location, the important factors. Only the nearest emergency response force can arrive at the scene in the most efficient emergency operations; only local administrators can fully deploy a variety functional departments of the region of resources and coordination organization.

Public Mobilization is not just the basis of the emergency response mechanism, but also the foundation of the whole emergency rescue system. Only by strengthening risk prevention awareness and response capacity of the relevant dangerous goods business units, functional departments at all levels and all levels of government can we establish a regulatory maritime emergency rescue system, establish and improve the mechanism of the reaction and the provision of adequate human resources, materials, financial and technical support in all aspects of the guarantee (National Administration for Work Safety Emergency Response, 2010) .

2.2.4 Emergency support system

Quickly and efficiently carrying out dangerous goods ship's emergency rescue work depends on adequate support system, including the supporting of human resources, material, financial and technical support and other aspects.

(1) communication and information support

Establishing a centralized management of communication and information platform is an important basis for the emergency rescue system. When an accident occurrs, all alerts, alarms, exchanges of information, reports, commands and other activities,

should be fast and accurately arrive through the emergency support system. Establishing communication and information security should be at two levels: one is communication device configured to fully mobilize existing communications technology resources, making full use of mobile phones, satellite phones, walkie-talkies and other Very High-Frequency communication tools to ensure that cope with the complex environment of the scene, ensure the smooth flow of information; second is to establish communication links database covering all parties organize emergency rescue force, forming a complete network of emergency response communications, information transfer, and maintenance management.

(2) human resources support

Maritime administration, medical aid, search and rescue and other rescue teams are the backbone of professional teams and emergency rescue. Each emergency response department and its relevant units should establish emergency team of professionals of appropriate scale, all kinds of equipment, frequently carry out the relevant knowledge and skills training for maritime dangerous chemicals and emergency treatment, strengthening exercises, and continuously improve emergency response and on-site rescue capability.

(3) Material Support

Local government and relevant dangerous goods enterprises should do well relief supplies and rescue scene basic living support work. Each emergency response department should renew emergency equipment facilities, be equipped with advanced rescue equipment, etc., establish on-site rescue and emergency equipment information database, and make clear the type, quantity, performance, and storage location.

(4) Financial support

Dealing with incidents needs the financial funds, in accordance with the existing principle of classification, grading burden by different departments.

(5) Traffic support

VTS center should ensure emergency maritime traffic prioritization under emergency situations, priority scheduling, priority clearance rescue channel to ensure safe and smooth traffic. Merchant expropriation procedures should be established by law in emergency situations to ensure relief supplies and personnel in a timely and safely delivered to the rescue scene.

(6) Health insurance

Medical authorities are responsible for the formation of medical rescue teams to carry out medical relief work.

2.3 Maritime chemical accident emergency rescue system

Maritime dangerous chemical accidents have very high requirements on fire control,

leakage control, hazard transfer, isolation, removal and protection and evacuation of personnel, etc. The specific implementation of the emergency treatment needs more professional, well-equipped emergency response teams and relief organizations as well as professional and technical expert group decision support. All relevant departments must earnestly respond to maritime accidents of dangerous chemicals ships in the aspects of human, material and financial resources, transportation, health care, security and other works. And the current emergency response resources and maritime rescue teams for hazardous chemicals professional is lagging behind; it is difficult to fully play a role in emergency rescue. Many port cities do not build chemical accident emergency rescue plan for the sea, and emergency rescue plan had been developed by the majority of the lack of practicality and operability, and can not achieve rapid, coordinated, scientific response to the request.

Dangerous goods ship accident emergency rescue system needs to strengthen and improve the following aspects:

(1) Port emergency facilities.
The competent authorities should address the dangerous chemical shipping companies as well as ports, terminals business unit made more scientific norms and standards to strengthen the emergency response with harbor chemical materials, facilities. Maritime administration agencies should involve in the special inspection of emergency response capacity and construct dangerous chemicals emergency equipment warehouse.

(2) Emergency team building and emergency drills
Primary emergency team is an important foundation of our emergency system, which is the main body to prevent and respond to emergencies. Emergency authorities should integrate existing resources to create a quasi-professional dangerous goods emergency response team. Related business department shall establish a joint group or special emergency rescue team and to be signed bailout social assistance force entrusted with the corresponding capabilities. Local governments should strengthen the emergency response team drills to ensure that in the event of dangerous chemical ship accidents timely and effective mobilization of resources and forces to participate in emergency operations. In the dangerous chemicals Ships centralized sea area, government budget should be increased for emergency rescue, accident increase the amount of disaster preparedness. In addition, it should be led by the Maritime Safety Administration, to mobilize shipping enterprises and institutions to establish funds to support maritime dangerous goods chemical cleanup team. Government should increase investment in the construction of professional rescue teams and their equipment, improve our level of professional rescue team of professional rescue ships in dangerous areas, and effectively improve emergency response capabilities.

(3) Sense of responsibility for the accident of the chemical industry, the formation of mutual help networks accident rescue

In the United States, Canada and Europe, in addition to fire, police, civil defense departments have chemical rescue teams and equipment, the spontaneous formated transport accident mutual aid network, free assist public service agencies and ,, public communities among chemical companies to do the emergency rescue training, drills and rescue work. For example, Germany's chemical transport accident mutual aid network TUIS, US Transportation Emergency Committee TRANSCAER, Canada's aid program TEAP.

At present, the majority of medium and large chemical companies in China have their own teams of full-time fire prevention and air force, especially in the three petrochemical groups of SINOPEC, CNPC, CNOOC, with a greater number of well-equipped full-time team. But in the transportation of dangerous chemicals emergency rescue aspect, the degree of attention is not enough. In promoting the transportation of dangerous chemicals emergency rescue management, we should increase petrochemical production enterprises' incident handling ability and sense of responsibility, and actively involve them in the chemical tankers accident rescue activities, in particular, Large-scale chemicals enterprise groups should express their advantages of team and equipment building in rescue, lead the construction of the chemical ship accident rescue mutual support network.

(4) Strengthening emergency disposal technologies research
Through systematic study of the characteristics of hazardous chemical substances , the consequences of pollution hazards, to explore the emergency response technical principles and develop a variety of emergency situations to set the guarding area and clear monitoring methods and determine the stock standard emergency matter, as soon as possible research diffusion leakage of dangerous chemicals regular and make the specific evacuation programs .

(5) Establish emergency database query systems and expert decision-making system
Establish an emergency database query system, database information, including transport of dangerous chemicals, especially the type of high-risk chemicals, nature, loading dock and emergency resources such as manpower, equipment, materials, and other information; use computer software to develop offshore dangerous goods spill emergency decision-making system, the establishment of hazardous chemicals emergency decision database program, after a comprehensive analysis of the type of dangerous goods, sea conditions, accident hazard rating, and given emergency decision proposal.

(6) Improve maritime dangerous chemicals emergency rescue plan
Emergency rescue plan is based on the analysis of consequences of the accident and the emergency response capacity for major accidents or disasters that may occur, or pre-established emergency response. Preparation of emergency rescue plan is intended to ensure that emergency rescue work can be quickly, orderly and effective carried out when the accident occurs. In so doing, we can minimize casualties,

property damage and environmental pollution consequences and resume normal production as soon as possible after the accident. Dangerous chemicals emergency rescue plan is the guiding principle to carry out emergency rescue.

Maritime Dangerous Goods Ship accident emergency plan is based on the severity of the type of incident that may occur, the nature, scope and consequences of the size of the predicted results, with the actual situation and the development of emergency measures, it has the following requirements:

Comprehensive: dangerous goods emergency plan should include two parts from the geographical contingency, namely land and water; the content should be from including safety and pollution prevention aspects; the measures should include fire, leak handling, water pollution treatment and disposal.

Science: scope and extent of the harm of dangerous goods by ship accidents are decided by the variety, quantity, position, weather conditions, and many other factors. According to the actual situation to decide the regional and limits to take emergency measures to preclude, at the same time to ensure the effectiveness of measures, without causing waste of manpower, material and financial resources, and reduce the loss of accidents to a minimum.

Representative: Due to the risk of chemical species contained in the ship varied in nature, for each chemical accident hazards assessment of the current conditions are not ripe. Therefore, to determine the appropriate screening for the target is necessary.

Operability: Dangerous goods ship incidents are often with sudden and catastrophic, so plan to provide commentary assessment tools, organization, emergency response and emergency measures must be clear, accurate and workable in its implementation, and achieve the desired effect.

CHAPTER 3

DANGEROUS GOODS SHIP ACCIDENTS EMERGENCY RESCUE DECISION

3.1 Foundation of emergency decision

When dangerous chemicals ship accidents happen, if you can get important information in advance about the dangers of chemicals, health hazards, personal protection and other information as well as emergency measures immediately, it is very helpful to take prompt and effective coping strategies and rescue operations and greatly reduce the degree of harm accident.

Chemicals Registration Manager Center of State Work Safety Administration, in accordance with registration of hazardous chemicals relevant content, using dangerous chemicals database, has gradually established dangerous chemicals management information system, to provide supports for emergency rescue work. Chemical Registration Center is dedicated to dangerous chemicals emergency rescue advisory services and emergency response technology research work, summarizing and analyzing the various types of common accidents of dangerous chemicals, collect study abroad on the basis of relevant technical information, organization of professionals, prepared "Commonly Used Dangerous Chemical Emergency Quick Reference Guide", the manual for more than 100 kinds of common hazardous properties of hazardous chemicals, protection and emergency measures have been described, informative, scientific content, it has strong pertinence, practicality and operability (Xin &Wang, 2012) .

3.2 Emergency decision-making process

Emergency response process is a series of orderly and coordinated emergency response actions.

(1) Guard and Monitor
① wind speed, wind direction monitoring: environmental agencies to monitor of wind speed and direction, and provide the information to relevant agencies.
② toxic monitoring: after receiving the accident notification, environmental agencies rush to the scene as soon as possible to set up monitoring sites in real-time monitoring and surveillance information at any time return the emergency command center.

③ scene alert: After the accident, VTS center should keep control of the ships' activities and trends nearby, and without the permission of command center, the ship should avoid staying in the accident site and downwind.

(2) Hazard Analysis
After the accident, the environmental protection department, according to the amount of diffusion of toxic and direction, analysis the scope, report to emergency command center, and consult disposal countermeasures.

(3) Control zone delineate
To carry out emergency rescue, early warning area needs to be established based on dangerous goods type, nature, the amount of leakage and weather, wind direction and other factors and traffic control needs to be implemented on the main channel leading to the accident site.

(4) Evacuation
By the results of the EPA monitoring gas concentration specialized facilities, ERPG according to three levels, it can start to develop evacuation conditions.
(5) Fire fighting and contaminant removal
(6) Forecasts and alerts terminate

Emergency Command Center is based on detection equipment to detect environmental field unit value is below ERPG-1, and after 10 minutes or when there is no harm, timely terminate of evacuation control areas should be assessed, and communicated to the units. Emergency response procedures should be based on the general form of a flow chart shown in Figure 3-1 embodiment, thus the emergency rescue headquarters and emergency response departments, emergency rescue team should coordinate orderly to carry out emergency rescue and provide more intuitive guidance.

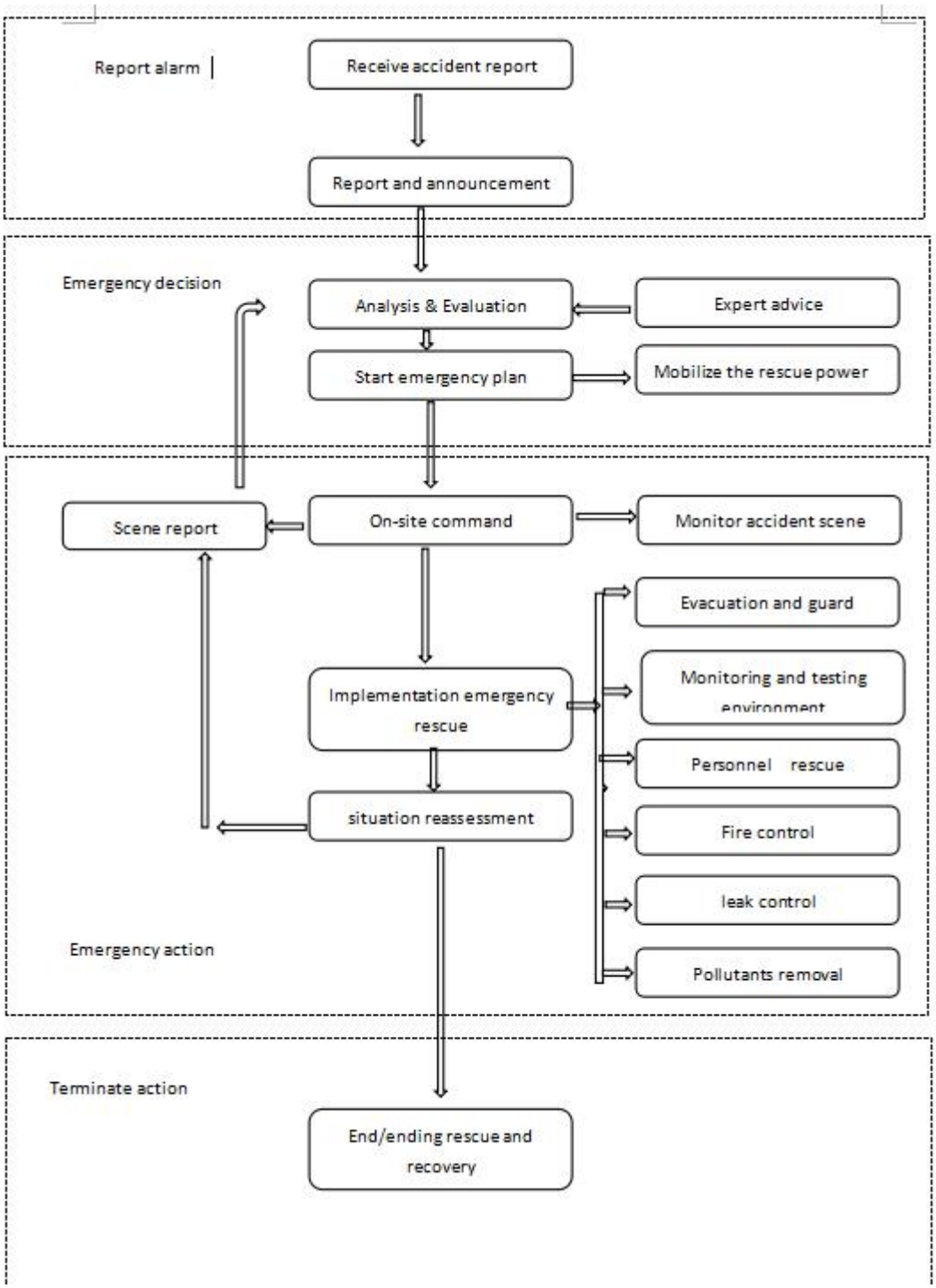


Figure 3-1 Emergency response procedures

3.3 Emergency decision-making key link

3.3.1 Determine the source of the leakage

The source of the leakage under normal circumstances, according to the size of the source of the leak area and length of duration, can be divided into two categories:

Continuous source (also known as leakage holes), as the name suggests, is usually a long time continuous leak of the dangerous chemicals running through a small hole. such as small holes appear on the storage facilities, pipelines and the junction leakage caused by seal failure.

Instantaneous source is also called macroporous leak. It refers to hazardous chemicals make a large number of leak material through a large hole in a very short period, such as large-diameter pipeline rupture, storage tanks burst and the reactor spills due to momentary overpressure explosion.

The hazard of dangerous chemicals leak depends on leak mode, duration and leak quantity. Based on comprehensive three factors, leak can be divided into two ratings: small leaks and large leaks. Leakage amount below 200L, the leak time is short, small leakage rate, belongs to small leak, which is less harmful; leakage amount is greater than 200L, faster leakage speed,and longer time, it is a large leak, and caused great harm. (Li, 2003)

3.3.2 Different levels accident response

In accordance with the controllability severity and scope of accidents, "Dangerous Chemical Safety Regulations" divides the hazardous chemical accidents emergency response level into level I (red alert) response, level II (orange alert) response, level III (yellow alert) response, VI level (blue alert) response.

Level I danger (red alert):
(1)Dangerous goods ship collision, stranding and other dangerous goods caused the explosion, burning, corrosion, leaks, pollution of water bodies and casualties and other incidents. (Biswajit R &Pradip K C, 2012) Oil spill amont more than five tons or ships carrying dangerous goods leak endangers water sources
(2) causing death (including missing) with more than 10 persons of dangerous goods ships accidents.
(3) 10 or more life-threatening safety of dangerous goods ships accidents.

Level II danger(orange alert):
(1)Dangerous goods ship collision, stranding and other dangerous goods caused the explosion, burning, corrosion, leaks, pollution of water bodies and casualties and

other incidents. Oil spill more than 0.5 ton, but less than 5tons.
(2)Death number (including missing) is 3 or more, but less than 10, of dangerous goods ships accidents.
(3) or more, but less than 10, life-threatening safety of dangerous goods ships accidents.

Level III danger (yellow warning):
(1) ships carrying dangerous goods can not carry out normal navigation; they need assistance. It may result in in the leakage of dangerous goods and other events. Oil spill 0.5 tons or less;
(2) causing death (including missing) more than 1, but less than 3persons.

Level IV danger (blue warning):
Ships carrying dangerous goods can not be normal navigation, need assistance, and can easily result in leakage of dangerous goods and other events.

In emergency response, the primary task is to determine hazardous chemicals emergency level. Accurately and quickly determine the emergency level, which can not only win the rescue time, but also can increase the efficiency of emergency. Therefore, the division of the emergency level should break the traditional thinking, Division of the emergency level through the severity of the consequences of the accident has already outdated, we should follow the principle of in advance, fast, objective and accurate. The accident pre-judgment, should consider various factors, such as the position of the accident, the geographical conditions nearby, population density, future meteorological conditions, hydrological status. Onshore dangerous goods accident is great different with ship accidents, it needs individual analysis. Analyzing the emergency level is relatively complex, the main factors to influence the judgment of dangerous goods carrier. Dangerous goods carrier means a ship carrying dangerous goods, dangerous goods ships currently of varying quality, complex source, greatly individual differences, which may increase difficulty of the level of emergency judgment.

3.3.3 Gas diffusion and evacuation

Most dangerous chemicals and vapors are diffusive, irritation, narcotic and toxic, some even virulent, lethal concentration is low, such as phenol TLV (Threshold limit values) for the 5PPM, TLV benzene was 10PPM . People usually come into contact with liquid chemicals and steam, which will lead to different degrees of damage. High concentration of toxic chemical vapors spread to populated residential, commercial, industrial areas will cause serious deaths and social influence. (Sun, 2003).

In a large leakage accident, due to the high risk of such accidents, fast spread and not enough action time, and in the case of most accidents, stopping the leak source and dispose of it, often become impossible. For toxic vapor diffusion, we can not preclude the use of the general method of recovering process, and mainly through leakage of toxic gas emergency hazard area analysis system to calculate the danger zone, delineate warning zone by gas monitoring team, thus, the timely prediction and monitoring of the spread of the gas cloud, monitor their dynamic status, can be given to people for alerting or arranging evacuation.

At ship hazardous chemical spills, in the waters around the ship, must be dealt with in a timely manner and the emergency evacuation of people and other ships must be carried out immediately. According to different physical and chemical properties and toxicity of chemicals, combined with weather conditions, quickly determine the evacuation distance. Due to the fact that chemical spills and atmospheric diffusion rate can be influenced by many factors including its original storage conditions, physical and chemical properties and ambient conditions, etc., We must use specialized tools for quantitative evaluation to the consequences of the accident. Currently popular approach is the use of computer solving mathematical models describing chemical spills diffusion process that is chemical leakage diffusion simulation, so we can get in contamination of the scope and intensity of chemical spills diffusion caused by the change with time, this information can help us determined whether chemicals-related industrial zone layout is reasonable and whether potential leak points of important target surrounding area is safe and what relief measures should take and so on.

IMO simplified diffusion model：(Zhou, 2002).

For bulk chemical vapor accident hazards, the national authorities should refer to IMO "chemical pollution treatment manual" on how to assess hazardous substances oil spill hazards approach. In order to facilitate chemical emergency command staff to evaluate the safety hazards and emergency measures for the chemical vapor decisions, the manual appendix provides a simplified diffusion model and certain hazardous substances rough estimate of the range of programs and data, Chemicals instantaneous release of the IMO simplified diffusion model (see Figure 3.2). Determine the health danger zone in accordance with a value which set out in Table 3.3, in addition we should use measuring apparatuss monitor spills of harmful gases in ambient air. For measuring the oxygen concentration of flammable gases and combustible gas indicator and oxygen detector, its value is shown as the percentage of concentration or LEL (lower explosive limit); for detecting toxic gases mainly are flame ionization detector, photoionization analyzer and infrared spectroscopic and the like.

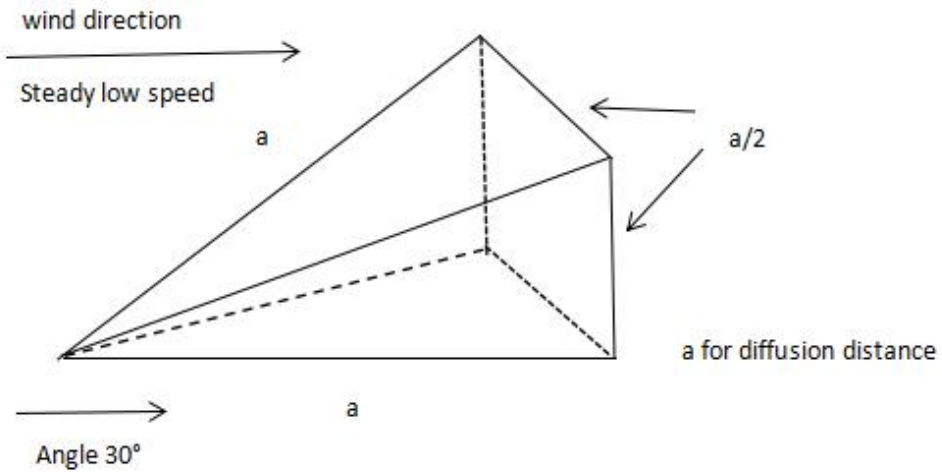


Figure 3.2 IMO simplified diffusion model of chemicals release

Release amount (t)	Ammonia,Vinyl Chloride		Butane,Chloroethane,Ethylene
	Health hazards area	Fire explosion danger area	Health hazards area/Fire explosion danger area
0.1	1000	200	200
1	2000	400	400
10	5000	1000	1000
100	10000	2000	2000

Table 3.3 Dangerous area range value a of part of the material. (unit: meter)

Combined with a variety of dangerous substances recommended range of values and instrument detection results, emergency response personnel can be broadly delineated the scope of the danger area in the following figure 3.3:

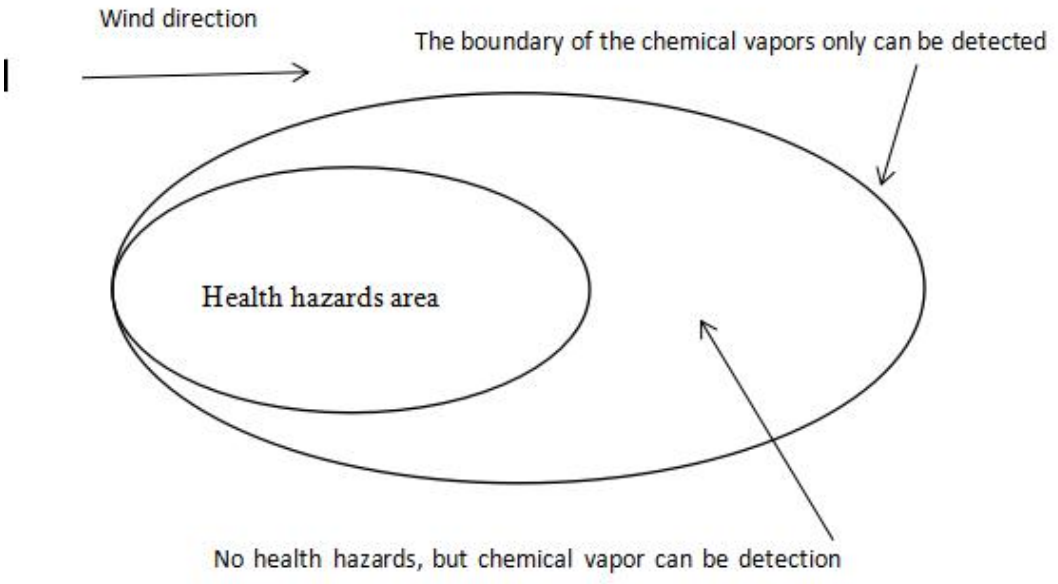


Fig 3.3 Health hazards area schematic diagram

Methods of IMO "chemical pollution treatment Handbook" have advantages of being clear to see, easy to use. But there are also some defects like inaccuracy and classified hazardous area range relatively roughly.

ERG2000 data

ERG2000 Data (the guidebook of emergency response 2000) jointly prepared by the United States, Canada and Mexico(see Table 3.4), which using the rate of release and diffusion models, statistical data from the US Department of Transportation Hazardous Substances Incident Reporting System database, meteorology observation data and toxicological contact data of various chemical substances, draw a comprehensive analysis of those four aspects, so it is very scientific.

	small leak			large leak		
UN No./chemical name	Emergency isolation	Day evacuation	Night evacuation	Emergency isolation	Day evacuation	Night evacuation
1005 Liquid ammonia	30m	0.2km	0.2km	60m	0.5km	1.1km
1008Boron trifluoride	30m	0.2km	0.6km	215m	1.6km	5.1km
1016Carbon monoxide	30m	0.2km	0.2km	125m	0.6km	1.8km

1017Compressed gas	30m	0.3km	1.1km	275m	2.7km	6.8km
1023cyanide	30m	0.2km	0.2km	60m	0.3km	05km
1026Epoxy ethane	30m	0.3km	1.1km	305m	3.1km	7.7km
1040fluorine	30m	0.2km	0.2km	60m	0.5km	1.8km
1045Anhydrous hydrogen bromide	30m	0.2km	0.5km	185m	1.4km	4.0km

Table 3.4 Evacuation distance data of ERG 2000

Emergency isolation zone is taking emergency isolation distance as the radius of the circle, the non-incident personnel shall not enter; downwind evacuation distance that must preclude taking protective measures range, that ship， staff and residents within the range are at risk of harmful contact , you can take effective measures to evacuate, shelter closed windows, etc., and keep communication open in order to obey the command. Because of the small meteorological conditions during the day and at night mixing effect than gas cloud of poison gas cloud is not easy to spread, thus downwind evacuation distance relatively far than during the day. The distinction between night and day and the sun rising land prevail. Using the data in this table should be combined with the actual situation of the scene, such as leakage, leak pressure, leak-release pool area that formed, surrounding sea area or ships as well as wind speed was corrected.

American Industrial Hygiene Association develop ERPG (Emergency response planning guideline) by using exposure to toxic substances allowed, provide three levels of toxicant concentration(Wang, 1999).

ERPG-1: human exposure to toxic gases in the environment for about one hour, in addition to the short-term adverse health effects or inappropriate odor, will not have a maximum allowable concentration of the other adverse effects.
ERPG-2: human exposure to toxic gases in the environment for about one hour, resulting in the body without causing maximum allowable concentration of unrecoverable damage.
ERPG-3: human exposure to toxic gases in the environment for about one hour, and will not cause the maximum allowable concentration for life threatening.

By the results of the EPA monitoring gas concentration specialized facilities, according to three levels, it can start to develop evacuation conditions:
(1)to detect or assess the value is less than the concentration of toxic chemicals harmful concentration, the evacuation operation is not performed.
(2)detect or assess the value between the concentration of toxic chemicals are released and between control areas and shelter in place alert alarm.
(3)detect or assess the value exceeds the concentration of toxic chemicals, the release control zone alert and evacuation alarm, or do the right to shelter in place.

(4) detect or assess the value exceeds the concentration of toxic chemicals released evacuation alert, and perform the necessary mandatory evacuation.

3.4 Emergency rescue disposal measures

Due to the ever-changing nature of chemicals, ship accident treatment has a very high difficulty in carrying out. On-site emergency rescue operations, disposed of programs and measures should be considered for different targets and situations .

3.4.1 Dangerous chemical fire and explosion accident disposal measures

Fighting methods for different dangerous goods on fire or explosion are not the same. Otherwise, it may be counterproductive, causing the disaster to get worse. In addition, because of dangerous goods itself and its products of combustion most of them have a strong toxic and corrosive, easily causing poisoning, burns. Accordingly, dangerous fire fighting is an extremely important and very dangerous work.

August 12, 2015 in Tianjin Port special serious fire explosion accident. The accident on people's lives and property caused a huge loss, a total of 165 people were killed (including 99 firefighters), 8 missing (including 5 firefighters), 798 people were injured were hospitalized.

The heavy causalities of firefighters during emergency rescue are very saddened, and this outcome is directly related with many explosions that occurred. The activity of Several chemicals stored on site is very strong, which is easy to heat and explosion when met water. It must not extinguish the fire with water, otherwise,it will contribute to the fire and explosion, such as calcium carbide meets water or heat will be a violent explosion. In this case, only sand covering can isolate combustion environment. However, due to complex, critical situation of the explosion scene in Tianjin port, firefighters are forced to use water in order to extinguish the fire

Therefore, for on-site rescue, what is most important is to clarify fire substances, and then take appropriate and effective measures to fight the blaze, rescue. Otherwise, the results may be counterproductive.

However, the situation is different at sea. One factor a ship has to consider is the stability. Blindly sprinkler, regardless of whether the water has the effect of extinguishing agent, must take the ship's stability factor into account in the accident, otherwise we can not complete the rescue mission, but even result in the loss of stability and sinking.

Stability is the recovery capability initial equilibrium position after the heeling moment disappears when the ship suffers from heeling moments and is away from its initial equilibrium position. When the stability of the ship is not enough and the ship heeling moment is larger than the restoring moment, it is likely to lead the ship to capsize. When using plenty of water for cooling on fire dangerous goods ship, a lot of water is likely to enter the cabin and impact ship's stability, which is mainly manifested in the following two aspects: First, the use of water fire extinguishing agent will free surfaces; Furthermore, a large amount of water into the upper chamber will directly raise the center of gravity height leaving stability decreases. Below, I discuss these two issues a little, so that we can be fully aware of the special risks and take the right approach and measures to ensure the safety of the ship.

Even when the ship is dangerous in case of fire, we have to use a lot of water to cool the fire, so that the free surfaces in many rescued cabin will come out on board. Free surface cargo impact stability of the ship in cargo transport is presented in the following two aspects: Once the ship heeling occurs, liquid will move to one side. Not only raised the center of gravity, but also produced a far heeling moment when the ship heeling to continue until the restoring moment of the ship heeling moment equals to the ship. Free surface can affect the stability of the ship by the following formula:

$$dGM=\rho KLB^3/D$$

Wherein: dGM is change of initial stability of the ship. ρ is the density of firefighting water. L is the length of the cabin. B is the width of the cabin. K is the moment of inertia coefficient (when the chamber is rectangular when, K = 1/12; when an isosceles triangle, K = 1/48; when a right triangle, K = 1/36)

Suppose, now a cargo catches fire, and the length of the cargo tank is 30 m wide and is 20 meters water density is 1.00, displacement is 20,000 tons free surface will reduce ship's stability by 1 m. So, free surface affects the stability of the ship very greately.

The center of gravity of the ship will increase the fire extinguishing agent

Injecting water in the cabin is equivalent to loading heavy objects on the ship, we assume at the time of firefighting use P tons of water, and its center of gravity height Z, KG0 the original center of gravity height, D is displacement, then the ship's initial metacentric height change is shown in the following formula:

$$dGM=p.(KG0-Z)/(D+P)$$

This shows that positive or negative dGM depends on the center of gravity height of fire fighting water. If the center of gravity height of fire fighting center is higher than the initial height of the gravity center, it will cause the entire ship gravity center height rise and thus the ship's stability will be reduced.

In order to prevent loss of stability that may lead to capsizing or sinking, a rescue ship should be fully aware of the ship in distress to ensure its minimum stability. To prevent greater wreck and marine pollution incidents, we may take the following measures:

1. Conducting timely drainage: Start the ship bilge pump to drain overboard; if the engine room on fire, drain pump can not be used, they should call other drainage equipment.

2. Reducing the blind shot of water: in the course of fighting Firefighters should be at or near the combustion zone fire, water flow accurately shoot on the fire, and try not to blind corner or down the extinguishing agent from high,and improve the fire performance, avoiding excessive water in cabins.

3. Transfusing ballast tanks: When the hull is tilted, we should pour into the opposite side of the ballast tank to restore the balance. In so doing the inclination angle.of the hull will be decreased

4. Mooring fore and aft: When fire fighting ship in the dock when the ship began to tilt, can be used a rope to tie the bow and stern at the dock, so that preventing the inclination.

5. Lashing heavy object: heavy objects on deck of the ship or in cargo holds should be used to plug mats, ropes lashing to prevent sliding of these weights; if available, unloading them with crane to lower the ship to prevent these objects move and exacerbated the inclination angle of the hull, leading to capsize, when the ship tilted.

Therefore, dangerous chemical ship fire emergency response priorities are: the first is the ship's natural circumstances, including the size and age of the ship, hull structure, manning, fire facilities configuration; the second is the basic situation of the goods, master its name, physical and chemical properties, loading conditions; the third is understanding the cause of the fire, the fire situation and casualties. Accurate master of the above information make us take the correct measures of response. (Wang, 2011)

3.4.2 Emergency disposal methods of dangerous goods leak into the sea

(1) The characteristics of dangerous goods spills

Varieties of hazardous chemicals have different physical and chemical properties. Physical properties of solubility, density and vapor pressure and others determine the performance after spillage into the water. Hazardous chemicals in water have four performance styles: rapid evaporation of surface contact with water (Evaporate), floating in the water (Float), rapidly dissolving into the water (Dissolve) and sinking to the bottom (Sink). (Song, 2006).

Solubility, vapor pressure and density changes of temperature are very sensitive. A chemical can exhibit different behaviors simultaneously under different temperature conditions. It may be floating on the water, or may be volatilized or dissolved, or may react with water.

(2) Monitoring the air

After the accident, systematic monitoring of airborne concentrations of chemicals is very important. The main purpose is to trace gas monitoring which areas require personal protective or public that need to evacuate. This usually takes monitoring technology based on a prior assessment of the changing forecasts gas position. The concentration of oxygen and combustible gas levels should both be detected, because hypoxia may affect the normal function of the combustible gas detector. Toxic gases can be detected by the trace-gas analyzers, such as calorimetric tubes, photo ionization and flame ionization detector, PH and starch paper. If there is no monitoring equipment, we should set up the accident safe evacuation area at the scene. Emergency response personnel should be trained to be familiar with these monitoring functions of the instrument. Initial assessment of the situation should be carried out by security personnel.

(3) Controlling and cleaning program of dangerous chemical spills

Once the dangerous chemical spills happen, the primary goal is to protect critical areas and limit further pollution. According to the opinion of the expert team, make sure the control and cleaning measures are taken. After the ship spill occurred, we should first take decisive measures to cut off the source of the spill, spill produce

various valves closed, the cargo remaining in the damaged cargo tanks or transferred to another barge to another ship. According to the site leaks, study and formulate programs plugging in strict accordance with program implementation. If the flammable liquid leaks, plugging measures must be taken to avoid explosion to ensure safety.

Water clearing operations of the hazardous chemicals should be conducted in accordance with procedures to be cast around control facilities, mechanical or manual recycling, spraying the dilution process for substance. The hazardous chemical spills accident is much more complex and more serious than the oil spill accident . Directly using of oil-spill response measures may be ineffective. Methods for reference in the fight should be adopted against the oil spill. On the basis of research of dangerous chemicals goods by water solubility, relative density, volatility other physical characteristics, we can take appropriate emergency measures, respectively, so that emergency measures can be more targeted.

To clear up shipping dangerous goods, the physical and chemical properties and meteorological factors of sea conditions should be taken into account. For more volatile or water-soluble chemicals, it is difficult to recovery, but only estimate pollution diffusion range, as well as response to the danger zone delineated isolation evacuation; for sinking chemicals, according to the depth of the water situation we can take the measures of the salvaging; and float on the water for chemicals, oil spills and disposal methods may be similar, but should be based on the weather, sea conditions and other site conditions, choose a practical manner, taking into account the toxicity of chemicals influence the appropriate level of personal protective equipment and appropriate recovery storage devices.

Choosing effective treatment for leakage accident methods and techniques required meteorological, hydrological and other factors, the cargo's nature and leak amount will also be considered. Common control methods and techniques are shown as follows in Figure 3.5:

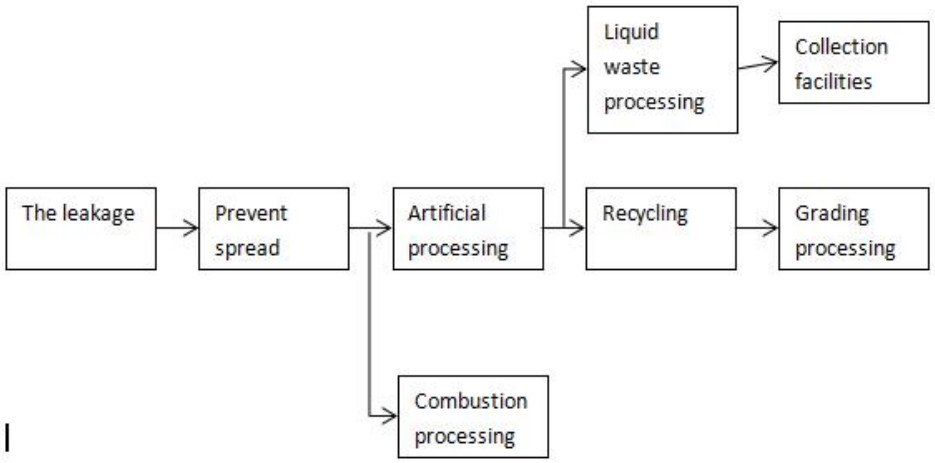


Figure 3.5 Process of the leakage prevention and control

Among them, the general measures to prevent the spread are: collections agents, booms, air curtain method; the general method of artificial recycled recycling adsorbent material recycling, mechanical recycling, dispersants processing, settlement processing and distributed processing (Cheng, 2004).

Depending on the nature of the spill, the typical processing methods are the following: Different properties of hazardous chemicals typical treatment program: Table 3.5

Types	Disposal options
Floating dissolve type	Arranging high-performance oil boom in the drifting direction, according to the leakage area choose to use high performance large weir recycling equipment, spraying dispersants or use the oil absorption material recycling then use suction type recycling equipment .
Floating volatile types	Arranging high-performance oil boom in the drifting direction, according to the leakage area choose to use high performance large weir recycling equipment, spraying dispersants or use the oil absorption material recycling then use suction type recycling equipment or make its natural volatile firstly before use recycling equipment.
Sinking, and sinking dissolved types	Use of large pneumatic or hydraulic device.

Volatile and volatile dissolved types	Calculate steam diffusion range through the diffusion model and its concentration range, establish dangerous area and use the gas concentration detection instrument, in order to determine the fire dangerous area external boundary.
Dissolved and dissolved volatile types	Calculate the pollution area through diffusion model, choose suitable neutralizing agent processing according to the types.

Table 3.5 Typical treatment program of different properties of hazardous chemicals

Another approach is based on the classification and nature of water transport of dangerous goods, emergency measures proposed for each type of dangerous goods, as shown in Table 3.6.

Kinds of dangerous goods	Emergency treatment measures
Explosives	(1)Evacuate personnel to safety area, delimited safety line (2)Confirm the name, type, properties of explosives (3)Seize the timing of the two explosions to rescue, minimize the loss. Matters needing attention ①To avoid activation explosives reactive, acid and alkaline agent is strictly prohibited ②Clipped water flow, reduce water impact force, avoid causing secondary explosions ③ If explosives explosion in container, the water should be concentrated on the open fissure which the first time explosion tore ④Rescue workers should use masking around the body, or take a prone position and low water jet, as far as possible to protect themselves ⑤transfer or isolation the surrounding cargo in time, to prevent the fire area widening ⑥Taking inert materials for leakage liquid explosives rescues, for toxic explosive items, people are fighting to take protective measures to prevent poisoning ⑦The safe disposal of explosives littered, not recycling, not with

	the cargo shipment
Compressed &Liquefied gases	(1)Evacuate personnel and ships to the upper or side wind safety area (2)confirm the kind of liquefied gas, whether its nature is toxic or flammable Matters needing attention ①To take corresponding measures according to the kind of fire. If toxic gas or flammable gas, control measures should be taken after cooling ②Cooling container and the surrounding air and goods with fog water, control fire areas, and prevent further expanded ③Rescue personnel should take effective protective measures to protect themselves, from unnecessary damage ④for water prohibited gases adopt appropriate fire extinguishing agent
Flammable liquids	To evacuate as soon as possible, make other ships and persons away from the scene of the fire, and rescue in the upper position. Confirm the kind, properties, then make the corresponding actions. Matters needing attention ①Fuel oil, Benzene, Ether and other goods lighter than water and does not dissolve in water, should choose foam or dry powder extinguishing or choose water mist extinguishing fire, but spray disable. ②Carbon heavier than water and the goods does not dissolve in water, should choose water as extinguishing agent. ③ Methanol, acetone, which can soluble in water or partially soluble in water, such goods could choose water mist, anti-soluble foam, dry powder but water spray prohibited. ④Goods such as phenol chloride, drug chloride, etc which can react with water should choose CO2, dry powder extinguishing, but water spray prohibited. ⑤ For toxic, narcotic, corrosive goods we need to wear appropriate protective gear, and as far as possible in the upper or side wind position while standing ⑥Pipeline fire we should immediately stop operation, close the valve. ⑦Tank fire we can use fire control facilities of the tanks to put out ⑧Leakage of goods we can select diatomaceous earth, sand for covering or absorbing with inert material.
Flammable solid, spontaneous	Confirm the fire the nature of the goods, take corresponding measures.

combustion substances, and substances which in contact with water emit flammable gases	Matters needing attention ① flammable solid generally choose water fog, foam for fire fighting ②water fog is generally selected for yellow phosphorus fire ③substances which in contact with water emit flammable gases can choose water or foam if a small amount; if there is a large number, dry powder , carbon dioxide, halogenated are used for saving.
Oxidant, organic peroxides	(1)Evacuate personnel to safety area, delimited safety line (2)Confirm the name, type, properties Matters needing attention ① Most of oxidant, organic peroxides can only use water agent,but cannot use soda or acid agent ② Some oxidants can react with water, so we chose powder, baking soda for rescue, saves personnel must wear a mask. ③ Organic peroxide we choose powder, carbon dioxide, water fog, foam for fire fighting, but water spray is prohibited ④The leakage of oxidizing agent or organic peroxides with inert substances, prohibit the use of sawdust, cotton and other combustible materials collected absorption, If the leakage on fire, dry sand, cement, lime can be available covering fire. Matters needing attention (1) Most goods can be used for the use of fog water, foam, dry powder and carbon dioxide to save (2)Cyanide and avoid water substances can only used dry powder, sand, carbon dioxide, but disable the foam, water and acid base fire extinguishing agent (3)Selenium dioxide can only use a lot of water and sand to put out (4)Mercury compounds can only water, disable powder, carbon dioxide, halogenated (5)If there is a leak, it should be timely recovery of leakage of goods. Rescue crew should wear protective clothing, as far as possible using isolated oxygen or air masks at the same time with the use of protective equipment and utensils,which need to focus on disinfection
Radioactive materials	Matters needing attention ①Thorium and uranium use of dry powder, soda ash, lime, sand to put out fire ②Most of the compounds in fire use dry powder, carbon dioxide, spray water and foam as fire extinguishing agent.

	③Rescue personnel should wear protective clothing, such as the human body is contaminated, it is necessary in the radiation protection personnel or medical personnel to guide the antipollution ④ If the packaging is damaged, specialized monitoring staff detect when the content has not yet been released, the operating personnel to deal with packaging repair, when the contents due to leakage or pollution levels should be made immediately designate the area and make a mark, then take measures as soon as possible ⑤After the completion of the fighting, the environment should be test, the protective equipment disinfected under the supervision of the health and epidemic prevention departments, rescue workers also have to thoroughly clean up
Corrosion	Matters needing attention ①Most of the corrosion products on fire can use of dry powder, foam and spray water to extinguish. if the fire is small, carbon dioxide can also be used ② Concentrated sulfuric acid, which has severe reactions with water, can burn, explosion or release of toxic gases, so we use dry powder, carbon dioxide, sand. Forbid the use of water ③ A leak should be collected using as an inert material, then a large amount of water is used to flush out the leak area. For a large number of leakage, acid goods and alkaline dilute solution, alkaline cargo and acid dilute solution ④ Firefighters should wear appropriate protective activities, for goods easily send out erosive steam or poisonous gas, still need to wear contact the respirator and upwind fighting. Fighting personnel and protective equipment should be washed clean

Table 3.6 Emergency measures proposed for each type of dangerous goods

3.5 Personal protective equipment (PPE)

Personal protective equipment (PPE) refers to the designed equipment used to protect public health of emergency disposal site rescue personnel from chemical, biological and radioactive contamination hazards, including protective clothing, protective eye and face protectors, protective gloves and respiratory supplies, aim to prevent human body away from hazards of harmful substances.

In the emergency rescue process, hazardous chemicals enter the body primarily through the respiratory and skin and cause harm to human body. Prevention of chemicals that enter the body through the respiratory is respiratory protective

equipment; prevention chemicals enter the body through the skin personal protective equipment primarily is chemical protective clothing.

3.5.1 Respiratory protective equipment

Respirator filter is divided into two types of filter and isolation. With the filter removing harmful substances from the air, only use in the hypoxic environment (ambient air oxygen volume of not less than 18%) and low concentrations of toxic pollution environment. Isolated formula enables the wearer's respiratory isolation with polluted environment by carrying the gas supply source itself, or the introduced clean air from the environment to maintain the body's normal breathing. In hypoxia, severe toxic dust pollution, the unknown life-threatening workplace use, generally not subject to environmental conditions.

Filter styles can be divided into self-priming filter and supply air filter. Isolation-type is classified into air-supplying style and air-carrying style. Emergency personnel commonly use self-priming filter and air-carrying type. Self-absorption filter is divided into half-mask and full-mask, according to the chemical species protection filter material and it is usually divided into dust, anti-toxic and toxic-dust composition. Gas-carrying type carries air cylinders, oxygen cylinders or oxygen generator, which could only be used by trained personnel

The main factors affecting the respiratory protective equipment selected are assigned protection factor (APF) and harmful factor to the harmful environment. APF represents respirator ability to reduce the concentration of pollutants. The higher the APF is, the higher level of respiratory protective equipment, safety and reliability can be achieved. Different types of respiratory protective equipment APF can be see in Table 3.7. Hazard factor is the ratio of the concentration limit air pollutant concentrations and national occupational health standards, showing the degree of harm harmful environment. Hazard factor indicates that the risk of adverse environmental, select the respirator APF should be higher. If more than one field contains harmful chemicals, hazard factors should be calculated separately, taking a maximum value as the harm factor.

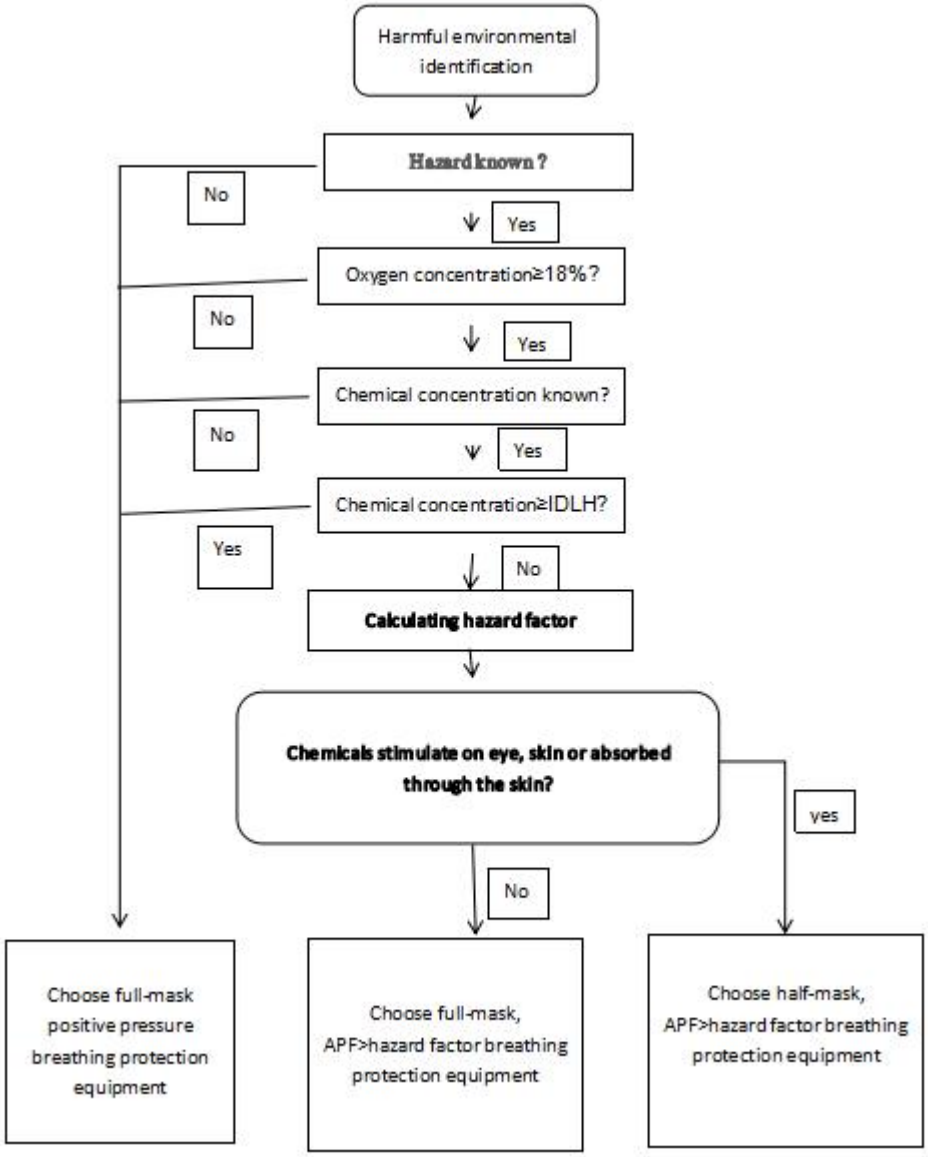
Table 3.7 : Types of respiratory protective equipment and their APF

The type of respiratory protective equipment			APF	
			Positive	Negative
Filter type	Self-priming	Half mask	Not Applicable	10
		Full mask		100
	Supply air	Half mask	50	Not Applicable
		Full mask	200~1000	
		Open mask	25	

		Supply air mask	200~1000	
Isolation type	Supply air	Half mask	50	10
		Full mask	1000	100
		Open mask	25	100
		Supply air mask	1000	
	Carry air	Half mask	1000	10
		Full mask		100

When rescue personnel selects respiratory protective equipment, they should first identify the nature of the environmentally harmful hazard, depending on whether environmental hazards are known, the oxygen content of the environment, whether a known chemical concentration immediately poses danger to life and health (IDLH) and whether the chemical irritates the eyes, skin or is absorbed through the skin and combined with APF value of different types of respiratory protective equipment , according to the principle of “APF must be greater than the harm factor”(General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, 2002) to choose the right type of respiratory protective equipment. Respirator selection process is shown in Figure 4.6

Figure 3.6 Selection program of respiratory protective equipment



3.5.2 Chemical protective clothing

Chemical protective clothing aims to avoid skin chemicals being absorbed through the skin or causing harm to humans through direct damage. It is divided into three types：gas-tight, liquid-tight, and dust-tight. (State Administration of Work Safety, 2008)
Gas tight chemical protective clothing will be completely cut off from the outside world and the human body, and prevent toxic gases or high-pressure chemical vapor droplets being absorbed through the skin. Thus it has a good isolation effect, and can provide the highest level of skin protection. Built-in and built-out types are the two commonly used respirator styles. Gas tight chemical protective clothing is suitable for the following environments:

1) Exposure to chemical type, concentration and other which are unknown

2) Gas leak
3) High-pressure gas, liquefied gas leak
4) High vapor pressure liquid leakage
5) Solid leak of sublimation characteristics .
6) Rapid absorption through the skin causing poisoning, such as phenol and phenolic compounds.

Liquid tight chemical protective clothing is mainly used to prevent damage of liquid chemicals on the human body, for the disposal of liquid leakage emergency personnel wearing. Jumpsuit and non jumpsuit are the two kinds of Liquid tight chemical protective clothing, including anti-permeation and anti-penetration against chemical. Anti-permeation is used for shielding a high concentration of non-volatile toxic liquid, anti-penetrated is for protection under the non-pressure mist state non-volatile chemicals.

Dust tight chemical protective clothing is taken to prevent penetration of dust and mineral fibers, suitable for emergency personnel with floating dust on the dress in the work environment. Dust tight chemical protective clothing protection does not apply to other forms of solid chemicals.

It is necessary to consider not only chemical protective clothing type when selecting chemical protective clothing, but also the materials it is made from. For the presence of flammable and explosive chemicals or electrostatic hazards rescue environment, selecting chemical protective clothing should have anti-static function. For explosion hazard environment rescue, it is important to select chemical protective clothing additional fire-retardant and high temperature capabilities. For rescue environment with frostbite hazard, chemical protective clothing with warm function should also be considered. If more than one chemical is on scene at the same time, the chemicals should be assessed separately for their harm level , and focus should be laid on the more dangerous chemicals.

All personnel involved in hazardous chemicals emergency rescue are threatened in different ways. Their tasks include reconnaissance, detection, rescue of victims, fire fighting, decontamination, emergency command, medical and surveillance. They need to wear different personal protective equipments. When selecting personal protective equipment for the emergency personnel, they should follow principle of “people and safety first, follow the high level not the low level”.

Select a body protective equipment.according to the degree of harmful environmental hazards Identify environmental hazards, determine the extent of the harmful environmental hazards are premise to select the appropriate personal protective equipment. When emergency personnel can not determine the impending environmental hazards, the respiratory tract and skin are to be taken at the highest level of protection, they are recommended to wear full-face positive-pressure

gas-tight type respirator, wear built-in gas tight chemical protective clothing. When an accident involving dangerous chemicals may reach its highest concentration in the environment, it has been identified that can be selected in accordance with the foregoing principles which are the choice of respiratory protective equipment and chemical protective suits, in which case, the main consideration of chemicals in the environment may be if the concentration exceeds the highest expected state IDLH, the oxygen content of the working environment, expect situation of toxic chemicals, corrosive, irritant and if absorbed through the skin and other factors.

Select personal protective equipment according to emergency personnel duties as the reconnaissance, detection and rescue victims of human tasks facing emergency personnel are generally unknown hazardous environment. To take the highest level of protection, it is recommended to wear full-face positive-pressure gas-tight type respirator and built-in gas tight chemical protective clothing. As sense rescue, fire fighting tasks of emergency personnel who are the nearest from hazard, facing the hazardous environments that may change at any time, it is recommended to take the same personnel protection. Decontamination tasks as general emergency personnel in the contaminated area of contaminated personnel and equipment decontamination, the protection level can be lower than sense rescue personnel, it is recommended to wear positive pressure gas-tight type or full cover self-absorption filter respirators wear external dense gas or liquid or dense dust tight chemical protective clothing. To emergency command center, medical emergency personnel and guarding tasks teams, they are generally in a relatively safe area, in order to prevent accidents caused by abrupt changes in risk, they can wear half-mask self-absorption filter respirators and general work clothes.

Dangerous chemical ships accidents personal protective equipment is only on the basis of the proper use and maintenance. In order to give full play a protective role, all users should be organized to accept the products training, under the premise of understanding of protective equipment selection method, protection and use restrictions. It should be ensured the correct and skilled use of the protective equipment be carried out. Each institution equipped with personal protective equipment should establish appropriate management mechanisms that regulate all aspects, including the selection, purchase, personnel selection, staffing training in the use, maintenance, decontamination, discarding, etc. If necessary, it should also needs to provide health checks for those who enter dangerous site, on the one hand to determine its ability to use protective equipment, and on the other hand to facilitate the timely detection of their health status. Dangerous chemicals emergency rescue protective equipment is important guarantee to enhance the dangerous chemical accident emergency response capabilities, and is a prerequisite to avoid and reduce rescue casualties and keep fighting, and the successful completion of the emergency rescue mission. Therefore, it must vigorously carry out emergency rescue work dangerous chemical protective equipment and related fields, which has important significance to the development of safe, low-carbon environment, and the harmonious

society.

CHAPTER 4

CONCLUSION

China’s current dangerous chemicals ship emergency rescue system is still imperfect, and the maritime emergency response rescue vessel is relatively backward due to the lack of professional ship dangerous goods emergency response teams and emergency supplies. The existing emergency response mechanism is not perfect, practical operation still has obvious detachment to the emergengcy plan, which resulting in lacking of capacity in responding to emergencies rescue of chemical tankers accidents. Government and administrations should strengthen their efforts to promote the dangerous chemicals ship emergency rescue system, by carrying out scientific preparation of chemical tankers emergency plan, enacting workable plan to coordinate and conduct emergency rescue work. Practitioners of dangerous chemicals companies and shipping companies engaged in transport of dangerous goods, and the transport authorities should carry out the deep research, provide scientific and technical support to carry out emergency rescue. Based on a wide literature on the basis of related research, the article proposed recommendations to improve maritime chemical tankers emergency rescue system, and based on existing resources and technical conditions, to explore practical maritime emergency rescue plan decision and measures to establish emergency rescue information database in China. Construction elements of emergency rescue system and the basic conditions for emergency rescue decision-making are discussed, and the key link of decision-making in emergency rescue is also analyzed, in the future, the specific emergency rescue measures and technology will be improved.

Emergency rescue teams need timely carry out regular desktop or practical drill, training, and knowledge renewal according to plan requirements, which used to test the operability, flexibility and rigor, and to improve and perfect the emergency response plan. Manpower should be considered to organize establishing” Chemical Emergency Handbook", which is easy to consult and use. The dangerous goods transport enterprises should also consider cooperating to establish a simulation training field. The reasons are three folds: First, it can save money; second, it can maximize using dangerous goods ships and ship's equipment; third it can improve the ability to respond to emergency relief response teams and the actual operation. Specific requirements should be based on the content of the training exercise to set the training month, typically include: accident hazard overall set. In phases, sub-professional situation and each professional emergency response team set tasks and operational requirements, operational goals to be achieved. Organize and supports in each phase should set specific goals to be achieved. Start and end times of each stage of the exercise of emergency, realistic approach taken, etc., should have a real sense. At the same time, exercise should be pre-fiction all sorts of instruments, norms

records, including the case of setting the various orders, directives, notices, and other bulletins.

It is glad to see that the Chinese government has begun to pay attention to the importance of the rescue ship dangerous goods accident. May 19, 2016, “2016 Pearl River Estuary national maritime search and rescue exercise" was successfully held in Guangdong Pearl River Estuary. The exercise scenario is that a passenger ship and a dangerous chemical tanker collided, causing the damage of the hull of the passenger ships. Passengers fell into the water, injured, and the ship had sunk danger; Dangerous chemicals cargo tank exploded and caused a fire because of irritant gases, crew present discomfort reaction, and there is further danger of possible deterioration, which will serious threaten the residents of island near the accident scene . This drill has, for the first time, achieved national maritime search and rescue All the ministerial member organizations directly participatied in the exercise, thus, it made a further run-up linkage mechanism between different ministries and enhanced inter-ministerial coordination of maritime search and rescue and response capability, this exercises was much more authentic, real and more targeted, which will help comprehensively improve the maritime emergency rescue response and handling ability. (National maritime search and rescue exercise of Pearl River Estuary(2016)

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