Risk Identification and Countermeasures for Dangerous Chemical Shipping on the Yangtze River in Jiangsu

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Abstract: Safe transport of dangerous chemicals by ships is a prerequisite and guarantee for the development of the Yangtze River Economic Belt. Through risk identification and analysis arising from the four aspects of operation, i.e., chemical terminals, ships and their companies, waterborne supervision, and port and shipping management, the paper puts forward countermeasures for shaping mechanism of safe transport of dangerous chemicals along the Yangtze River in Jiangsu Province.

Introduction

The Yangtze River is the mother river for Chinese, and it is also the only golden waterway connecting the East, Middle and West of China. The Yangtze River has assumed 85% of the total bulk cargo transport along the River region, and has played an important role in promoting the coordinated development of regional economic and social development. In recent years, with the rapid development of China's economy, the volume of cargo transport and turnover of the Yangtze River have exceeded the Mississippi River and the Rhine, ranking the first in the world. With the gradual increase of cargo transport, the dangerous cargo shipping on the Yangtze River has also increased significantly. Owing to the advantages of waterway transport of dangerous cargoes in its large capacity and low cost, plus the development of integrated river and sea transport system, the number of vessels carrying dangerous cargoes has been rapidly growing. On the basis of the unique features of the Yangtze River transport condition and cost advantage as well as the concentrated layout of industries, particularly petrochemical industry along the Yangtze River, waterway transport has become an important approach for moving petrochemical chemical raw materials and products. In recent years, the volume of dangerous cargo transport, with an average annual rate of nearly 10% of the rapid growth of hazardous chemicals production, has brought about serious challenges to waterway safety and environment protection.

The General Situation of Dangerous Chemical Shipping on the Yangtze River in Jiangsu

The lower reach of the Yangtze River flows through the territory of Jiangsu Province 425 km into the sea, formerly known as the Yangtze River, forming a 1,175 km of shoreline and 369 km of deep-water channel, known as the Golden Waterway in the Yangtze River Delta. Jiangsu, directly accessing to rivers and sea, is an important gateway to the transit of goods and foreign trade for domestic ports and upper reaches of the River. It is not only located in the Yangtze River economic belt, but also the intersection point stated in the national initiative strategy of the Belt and the Road. Thus ensuring safe shipping in this water area is of major and far-reaching impact. The situation of the hazardous chemicals shipping along the Yangtze River in Jiangsu province is as follows:

Volume of Goods

Ships carrying dangerous cargoes are characterized by large capacity, multi-species, and wide distribution. In recent years, the dangerous cargo shipments have continued to maintain a rapid growth between 2001 and 2017 with the average annual growth rate about 20%. The goods
transported in Jiangsu are mainly bulk liquid chemicals. The major trading countries and regions are Europe, America, Southeast Asia, South Korea, Japan etc.

**Terminals and Berths**

In recent years, with the centralized layout of a large number of chemical parks along both sides of the Yangtze River, the number of dangerous goods terminals in Jiangsu has increased year by year. Presently there were more than 240 hazardous terminal berths, among which more than 40 reached 10,000 tonnage capacity, the maximum of which was up to 80,000 tonnage; there were also 4 reservoir areas and 1 petroleum and chemical industry base.

**Chemical Vessels**

According to recent years’ statistics, there were more than 130 enterprises engaged in transport, handling, forwarding, storage etc. in Jiangsu. There were about 400 to 500 vessels carrying hazardous chemicals shuttling in river waters in Jiangsu every day. Vessels carrying dangerous goods were mainly small-sized, and average volume of cargo handling was about 1,000 tons per voyage.

**Accident, Risk and Harm**

Ship-borne transport is featured by its large volume and increasing popularity, but the risk factors existing in this process should not be underestimated. Although the number of accidents occurred in the operation of dangerous chemical products is small, but once it happens, it is often a major accident. Dangerous chemical accidents could cause a wide range of hazards, generally speaking, mainly reflected in the following four aspects. 1) Health Risk. If there were an accident occurred, the leakage of chemicals into the atmosphere exceeded a certain limit and continued for some time, it would make people poisoned, cause disability, death, or other pathological physiology, and seriously endanger people’s health and safety and property. 2) Social Risk. Along the Yangtze River in Jiangsu Province, presently there are 83 regional drinking water intakes, which bears more than 90% of the drinking water supply for 8 cities along regional shoreline. Once a leakage accident occurred, it would pose a direct threat to residents’ drinking water along the river, industrial and agricultural water and social public security, so did a very large negative impact on economic and social development. 3) Property Risk. In the event of hazardous chemical leakage, diffusion, fire or explosion in the process of shipping or cargo handling, it would cause not only direct and substantial property damage to ships, waterway and port facilities, but also the consequences of the accident and long-term impact that were far-reaching; 4) Environmental Risk. The Yangtze River water system is relatively closed, and weak self-purification capacity of the water, chemical spills accident on the waters would cause significant damage to ecological environment.

**Risk Identification**

In recent years, a large number of chemical parks along the Yangtze River have been centrally laid out in Jiangsu Province. As a consequence, the number of dangerous chemical terminals has also increased year by year, and the types of cargoes and shipping volumes have also increased correspondently. Thus transport risks have been increasing significantly. Therefore, it is necessary to identify and analyze explicit and implicit risks that exist in this water area.

**Dangerous Cargo Terminals Risk Identification**

The chemical park planning, environmental assessment, safety assessment etc. shall be carried out prior to launching a new petrochemical project, but this is mainly related to a single project or local impact assessment in the park, and there is a lack of consideration of bearing capacity for overall ecological environment of the Yangtze River. The situation of small and medium-sized petrochemical terminals is uneven in the region. Although many operating conditions of the terminals are able to meet the latest domestic and international standards, it is also found that some of the terminal
operation conditions are poor, especially some small terminals where anti-pollution investment is not sufficient. In addition, human factor is also an important aspect of risk. In some chemical terminals, including some new ones, there is an apparent lack of work experience for terminal staff in hazardous chemicals management and operation. It is the case particularly in some small sized terminals where dock workers lack of professional training, professional knowledge, rule awareness, and professionalism due to which safe operation cannot be assured.

Ships and Enterprises Risk Identification

As far as ships are concerned, dangerous cargo vessels sailing on the Yangtze River are mainly small-sized, although all of them were all surveyed, many of them still have certain level of deficiencies that could not meet the specification requirements. Some of the enterprises overweight efficiency rather than safety and anti-pollution management; lack of investment in safety and pollution prevention facilities, which obviously prevents effective functioning of onboard anti-pollution work and limits shipboard anti-pollution work. Although some of the crew held the certificates of competency, but their safety awareness was still relatively weak, their emergency response ability was not strong and their practical ability needed to be improved.

As far as shipping enterprises were concerned and due to the lack of cost investment, the underlying causes are related with screwed focus on efficiency rather than safety and anti-pollution. This situation exists generally, which greatly limits the ability of ship pollution prevention and safe operation. On small chemical vessels currently engaged in operation, although the basic Safety Management Certificate (SMC) was in place, the Safety Management System (SMS) was not in proper operation owing to crew’s skills and abilities. For survival, some ships applied to be affiliated to a ship management company, while there was a lack of effective shipboard management, which brought about hidden trouble to the safe transport.

Waterborne Supervision Risk Identification

The waterborne supervision of chemical vessels is mainly reflected in four aspects. First, currently the maritime administrations are more mature and complete in ship’s static management, while ship’s dynamic supervision is weak due to the lack of technical equipment, thus could not shift from static supervision to dynamic one in a true sense. Second, due to large quantities of ships, types and volumes of cargoes, the manpower and material resources available for maritime supervision are relatively limited, which directly limits supervision outcomes. Third, with more and more chemical terminals along the Yangtze River, the number of transit ships is significantly increasing. A considerable number of transit ships are not applicable for Vessel Traffic System (VTS) ship reporting requirements, and the administrations could not supervise their dynamic situation within the area. Fourth, in recent years, in order to strengthen supervision on ships, maritime administrations along the Yangtze River required small-sized dangerous cargo ships to be equipped with GPS by local government financial subsidies, but the information platform standards between the provinces vary and marine information resources cannot be mutually shared.

Port and Shipping Management Risk Identification

One of the port and shipping management risks is that there is no special fairway for chemical ships navigating along the Yangtze River and there is no specified ship’s safe passing distance etc. As a consequence, maritime administrations could not carry out special supervision apart from tracking and supervising ships via VTS. The second risk is the lack of special anchorage. At present, there are only eight special anchorages along the Yangtze River in Jiangsu Province which could not meet the needs for dangerous cargo ships to wait for berth and emergency refuge. There are no places for large quantities of dangerous cargo ships to anchor. In existing dangerous goods special anchorages and in consideration of reducing supervisory risk, the administrations do not accept application for anchorage for those not intended to call its terminal. It happened that ships waiting for berth lagged in the vicinity of the entrance channel, which virtually increased the risk of accident. The third risk is the
lack of tank-washing water reception facility. There is an extreme lack of public tank-washing stations and reception facilities, bringing about difficulty in bulk chemical tanker washing and reception of tank washing water, which increases environmental pollution risk.

Proposed Countermeasures

Although China has adopted a series of laws and regulations which were fruitful in respect of the administering waterborne dangerous cargoes, the safety monitoring of dangerous chemical transport and emergency reaction capacity are still relatively weak, which is difficult to adapt to new trends of and requirements for rapid development of dangerous cargo transport. For the purpose of creating a favorable environment for constructing Yangtze River economic belt, the State Council issued the Work Plan on Safe Transport Scheme for Dangerous Chemicals Shipped on the Yangtze River in 2014. In order to fully implement the plan and duly prevent the rising risk of dangerous chemical transport in the Yangtze River, the countermeasures are put forward as follows.

1. At port and terminal level, in view of the lack of coordination in planning and constructing chemical industrial parks along the River in Jiangsu, as stated above, it is urgent to co-ordinate the overall layout of petrochemical industry and standardize the development of chemical parks along the Yangtze River from the national level. It is necessary to carry out unified planning and comprehensive assessment of the safety and ecological security of human living environment for those with potential to be planned as hazardous chemical logistic terminals. To regulate safety management of the port warehousing and cargo handling enterprises, a tool based management system is recommended for constant update and improvement. Meanwhile, there is a need for regulatory authorities to secure concrete project and supervisory processes and carry out effective supervision, with an aim to minimize the missing and omitting items and subjective judgment and ensure statutory regulatory requirements through application of appropriate system, instruments, and equipment. All kinds of small and medium-sized chemical production enterprises along the Yangtze River (including Jiangsu) shall refer to accepted standard of the international petrochemical industry to formulate internal ship selection and control standard, and gradually promote the threshold for inland waterway vessels and standardization of ship’s structure.

2. At shipping enterprise level, the first thing is to enhance their management, and promote the transformation and upgrading of ship type and structure. There is a need to earnestly implement the Promotion Plan on Structure Standardization of Vessels Sailing in Trunk Line of the Yangtze River issued by both the Ministry of Transport and local governments in 2009, and the 12th Five-Year National Plan on Promoting Inland Water Ship’s Standardization issued in 2013, and meet the policy requirement of a total ban on single hull chemical ship sailing in the trunk line of the Yangtze River by 2016. The second is to effectively operate the management system, and to obtain the corresponding inspection certificates and documents issued by maritime and survey agencies following their inspection evidencing the maintenance of a good status. The third is to strengthen the safety management of the crew. It is recommended for enterprises to organize dedicated safety knowledge training among crew, and enhance ship’s inspection to eliminate safety hazards and the implement safety measures. The final is to ensure pollution prevention insurance in place. It is suggested that the enterprises must ensure their ships to be insured against pollution liability, since it will one of the prerequisites for terminal operators to make future choice of ships. Meanwhile, ship pollution emergency plan shall be effectively implemented.

3. At maritime supervision level, it is proposed to strengthen maritime supervision and guidance. Whole process tracking shall be made to ships carrying dangerous cargoes registered only for river transport as well as transit ships in order to perfect precautionary measures. There is a need to strengthen the supervision and management of dangerous goods handling terminals, especially for those located in the upper reaches of drinking water sources to be listed as routine inspection sites to ensure safety of chemical ship’s cargo loading and unloading. Moreover, it is proposed to refer to the practice of Jiangsu Maritime Administration to implement ship-shore interface safety management.
mechanism for dangerous cargo operation by publishing the *Ship-shore Interface Safety Management Mechanism Guidance*, and take the main responsibility for safety production. It is suggested that the maritime administration should accelerate and guide the owner of hazardous chemicals to imitate the practice of ship selection scheme made by international oil majors, using market means to play the role of market allocation of resources and ensure best choice.

In addition, it is proposed to enhance regulatory enforcement. It is suggested to strengthen chemical ships management and dangerous cargo declaration management from ships and rigorously implement examination and approval procedures. It should make declaration personnel aware of the serious consequences caused by false and concealed declaration to further promote their safety responsibility consciousness. Encouragement shall be made to inspect cargo and report any false and concealed behavior. Besides, it is also recommended to carry out the *Identifying Risk, Correcting Violation, and Preventing Accident* activity specially dedicated for dangerous goods transport safety rectification to discover and correct a number of potential risks. Strictly implement practitioners’ access standards and prohibit crew who lack of professional training or have low professional quality from engaging in dangerous cargo transport so as to improve the safety level of waterborne dangerous goods transportation.

**Conclusion**

Although the volume of transport of dangerous chemicals along the Yangtze River is increasing, and it becomes more and more prominent for the development of national economy, the current status of dangerous chemical shipping is difficult to match the safe transport standard. The competent authorities and social industries have been highly focusing on the rise of dangerous chemicals transport risk. Through identification of various risks in relation to dangerous chemical transport along the Yangtze River in Jiangsu Province, the author proposed countermeasures on how to strengthen safe transport mechanism, which has great and far-reaching significance for strengthening prevention and control of risk source, building a comprehensive regulatory system, improving transport equipment and facilities, raising the ability of emergency management, accelerating the security construction, and eventually improving safety level of dangerous chemicals along the Yangtze River in Jiangsu Province and even all along the shipping line of the Yangtze River.

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**References**


