

Main Factors of Improving Containerships' Salvage Efficiency

By

Liang Xinggao Huang Yiwei
Zhejiang Manyang Shipping Co., Ltd.

【Abstract】 The article takes 'Hongyuan 02' for instance and discusses the main factors of a successful salvage when similar or larger containerships encounter marine accidents.

【Key words】 containership, salvage, container, security, high efficiency

Introduction

Contemporarily, as the global crude price remains high and the 'Belt and Road' initiative and 'Maritime Power' strategy are imperatively implemented, the trend of increasing large-scale ships is tending to be the consensus of the shipbuilding industry and shipping circles. Along with the 21000TEU containerships, 300,000-ton crude oil ships and 400,000-ton ore-carriers being put into operations, the age of supermassive-scale ships has come. The more large-tonnage ships, the more severe situation of marine emergency salvage there is. In China, once the large-tonnage ships strand, it is likely that a ship sinks and even the whole harbor's operation paralyzes. On 23 August 2001, Pengyang, a fully loaded 50,000-ton collier ran aground on the reef in Mawan Channel so that the only deep-water channel from Hong Kong to Guangzhou and Shenzhen was severely blocked. On 2 December 2006, Yinchu, a 10,000-ton dredger accidentally sank in Huangpu River near Nanpu Bridge, which poses a threat to ships crossing there every moment. On 8 March 2007, Fenwei, the largest dredger in the world at that time collided with a large containership in the only main channel in the port of Tianjin (the sixth largest port in the world) and almost caused the crisis of the whole-port paralysis. On 10 May 2017, a ship named Shungang 19 loaded with 129 containers dropped 37 of them into the river when reaching the precautionary area of Wusongkou, which led to the entire closure of the globally largest Shanghai Port. The history of containerships can be traced back to 1956. Loading 58 containers (33 ft. each), a ship named 'Ideal X' from Matson Shipping Company (the precursor of Sea-Land) set out from New York harbor to Huston Port, Texas. From then on, the global shipping stepped into the age of containers. Malcom McLean, the creator of this type of shipping, was hailed as the 'the father of containerization'. However, what McLean could never imagine is that the capacity of the largest containership in the world has exceeded 2000TEU after half a century, which is equivalent to the capacity of 370 'Ideal X'. The massive containerships are a great challenge to marine emergency salvage. The width of the hatch in a containership is almost as wide as a cargo hold. This type of hatch design is apparently weak against buckling forces and transverse strength towards the hull. And also, containerships' body has to stand stronger wave impact, whipping stress and longitudinal composite stress than the ordinary ships' due to containerships' flare of the deck and fast speed that the bending moment in the inner structure of containerships grows heavy. Compared with an ordinary cargo ship, a containership's fatigue is more severe. Besides, with the heavy load on the deck but without load-off equipment, containerships are not capable of rescuing themselves but can only be salvaged by outside help. Here comes a consideration: how can we effectively eliminate the negative effect by taking emergent measures while encountering such kind of

accident? This will be the main topic will be heatedly discussed by our professional marine emergency salvage enterprise.

I.General Situation

At 23:00 on 15 December 2016, Hongyuan 02, a containership from Ningbo ran aground on the reef in the eastern ocean which was 5 miles to the south of Shengsi Island in Zhoushan. The ship was damaged, with 20 degrees leaning towards the righthand side and at the risk of containers drifting and ship sinking. It was emergent to take measure.

In the morning of 16 December 2016, Zhejiang Manyang Shipping Co., Ltd. immediately dispatched a group of rescuer to the spot to take emergent measures after accepting a commission. Simultaneously, salvaging experts arrived at the scene and formulating plans.

The one-month salvage (8-day effective working) includes measures such as reducing and lightening loads, anchoring the stern and pumping oil-polluted water. Until 9 January 2017, 660 containers (including all the containers on the deck) were safely shifted to the company yard. 1500m³ oil-polluted water, 35m³ light oil, 145m³ heavy oil were pumped out and 49m³ greasy filth was cleaned. The risk of containers' dropping and drifting and ship's sinking were efficiently avoided so as to prevent the negative effect and secondary disaster from the sinking ship to the international channel and marine ecological environment. The salvage was successful in a short time and removed the potential hazards in Majishan International Channel, which fully displayed the first Asian ore transiting deep water harbor's salvage power and equipment. After salvaging the South Korean Sewol ferry, this manifests the salvaging strength from China to the whole world.

II.The Wrecked Ship

Name: Hongyuan 02

Shipbuilding Factory: Stocznia Gdynia SA, Poland

Date of Completion: 17 November 1997

Principal Dimension: total 188.1m, width 30.0m, depth 16.75m

Type: containership

Gross Tonnage: 23734

Deadweight Tonnage: 13291

Loading Status: 933 containers in total

Water Depth & Mud Content: approx. 13m; silt

Orientation & Location: prow – 68° to the northwest, stern – 248° to the southeast; Dahuanglong and Xiaohuanglong Island to the east; 30°39.991'N/122°30.110'E

Ship Condition: approx. 10° leaning towards the front; approx. 15°~20° leaning towards the right hand side

Drowning Condition: forepeak, 1#, 2#, 3#, 4#, 5# cargo holds were drowned: 1# – 3# cargos were below water surface; half of 4# hatch and 5# hatch was above the water, and sea water flew in through the bulkhead; the cabin was flooded slowly; 2/3 of the deck near starboard and prow deck on the port side were drowned.

0#-95# flank was hanging; 95#-240# flank touched the seafloor; Prow stuck into seabed



Diagram 1: General Situation of the Wrecked Ship



Diagram 2: General Situation of the Wrecked Ship

III.Salvaging Plan

At noon on 16 December 2016, Manyang accepted the salvaging commission and immediately sent the first troop of salvaging ships to the scene, arriving in the early morning the next day. To effectively control the situation, the droppable containers were moved to the deck barge at once. At the same time, experts were sent to the scene for getting information so as to formulate a salvaging scheme. On the basis of the information gained in the scene, there were four problems needing to be solved for salvage:

1. The heavy load with high barycenter on the deck and coldness in winter might influence

the efficiency and lead to secondary accidents;

2. The ship condition was unstable and moving with tides, which hampered the salvage;

3. The ship cargo was fully-loaded, with continuously flooding in 5# flank and cabin, so the risk of drowning still existed;

4. A great amount of fuel was left in the oil tank, which was a latent danger of pollution to the marine ecological environment;

Aiming at solving the four problems above, experts set up the salvage scheme after research and discussion:

1. Load off containers on the deck right away and ensure the salvage to be completed before the coming of the next cold air; Lower the barycenter so as to prevent drop of containers and ship capsizing;

2. Stabilize the starboard and port side while loading of containers so as to prevent tide changes from disturbing salvaging efficiency;

3. Take appropriate measures to reduce the cargo load so as to increase the buoyancy and get rid of the risk of drowning;

4. Pump out the fuel in the cabin so as to prevent pollution.

IV.Problems and Solutions

Problem 1

The wrecked ship was declining at the beginning of salvage. Unspecified hooks and traditional steel slings were used, which not only slowed down the salvage speed but also rose the latent danger in the scene.

Solution 1

The company contacted a professional container yard and consulted them about expertise so as to avoid mistakes. Specified container hooks were prepared as soon as possible and heavy steel strings were replaced by lighter ultra-high-molecular-weight polyethylene ropes. This action could not only improve the efficiency but also lower rescuers' intensity of labor.

Problem 2

The prow was drowned and the stern was floating, which caused the ship turned with waves. It was unproductive for efficiency.

Solution 2

Our company had to stabilize the ship. After model simulation and discussion, experts made full use of triangular properties in the salvage. A triangle is stable, firm and compressive. The prow was stuck in the mud, which could be deemed as a fulcrum. If there could be two more fulcrums, the ship could still have the properties of a triangle. That is to say, the ship could be stable. Two 7-ton and 250-meter anchors were respectively dropped near the starboard and port side of the ship stern, towing both sides, so as to make the whole ship balanced as a triangle. Two anchors on both sides could confront the forces from each other, which stabilize the ship even more.

Problem 3

The accident was in winter so the efficient working hours are limited due to the cold air in the sea.

Solution 3

Our company orderly arranged the ships and made use of resource nearby. To efficiently finish salvage and eliminate negative effects to the channel, the following measures were taken: 1. be fully aware of the situation and transfer salvaging resources (eg. equipment) from Ningbo, Zhoushan and Shanghai to the scene; 2. In the salvaging scene, two floating cranes on both sides

of the wrecked ship could speed up the loading off; 3. Four deck barges loaded in turns. Two of them were loading on one side of two floating cranes and the other two were waiting nearby. The waiting ones were noticed to approach the wrecked ship when one or two loading ones were full. In the scene records, the approximate time of lifting a container was 20 to 30 minutes. During the deck barge was loading the last container and the staffs were lifting the next one, two barges joined. Full-loaded deck barges anchored after leaving the floating crane. Then when the tide was right, containers were transported to the dock of the target company for load-off. Through the efficient cooperation between deck barges and load-off, ships could be guaranteed to return to the scene before finishing reloading so as to save time and maximize the loading efficiency. 4. While confronting severe sea conditions, decks on other salvaging ships were used to the full. Containers were temporarily placed on the decks of other ships. After the deck barges came, floating cranes moved them to the target ship so as to avoid the negative weather effect to the salvage.

Problem 4

The wrecked ship was not kept balance so that the strain and stress were partially focused, which might lead to fracture.

Solution 4

Our company went over the detailed information of the wrecked ship. By reading calculations of ship intensity and relative ones provided by CCS or other professional institutions, the loading-off scheme was worked out. First, 5# needed pumping out water, loading off half of the containers of this cabin. As 1#, 2#, 3# and 4# were flooded and lost buoyancy, 0#-95# flanks were hanging, 95#-240# flanks were on the sea floor with the prow sinking into the seabed, loading off the 5# could balance the buoyancy of the stern. Second, half of the containers in 4# and 3# were loaded off so as to reduce the intensity upon 4# cabin and prevent the risk of fracture. Third, the containers in 2# and 1# were loaded off. Fourth, the rest of the containers in 3# and 4# were loaded off. Last, the rest of containers in 5# were loaded off. In the process of load-off, there were staffs keeping observing the change of ships so as to adjust salvaging scheme according to the actual situation.

Problem 5

A great number of various kinds of containers came from dozens of dealers. The difficulties of stacking and unboxing inspection.

Solution 5

As our company is not professional at stacking of containers, it was a heavy workload and complex division of labor during the process in considerations of the loading-off efficiency and the convenience of dealers' checking goods. Thus, a group of logistic service was formed up. Hanging and moving containers to the dock for temporary stacking, and categorizing them under the gantry machine during the load-off and transportation of deck barges, would not disrupt the salvaging pace but solve the problem of dealers' goods checking and moving.

V.Salvaging Result

1. Prevented the cabin from being flooded and the risk of drowning
 - 1.1 Made the leaning angle from 20° to 4° by load-off. The deck in front of the cabin was lifted to 3-4 meter height instead of drowned under the sea level.
 - 1.2 Battened down the hatches and pumped water out of 3#, 4# and 5# so as to prevent the drowning of the stern and hazards to the equipment.
 - 1.3 Anchored two sides of the stern so as to avoid drifting.
 - 1.4 Avoided secondary accident
2. Salvaged all the containers and reduced the profit loss of the shipowners and stakeholders.

- 2.1 Finished load-off, salvaged the drifting and drowned containers and avoided the danger during navigating due to dropping containers.
- 2.2 Lightering 660 containers. 289 containers were collected and none of them was lost, including 68 forty-foot and 249 twenty-foot containers. 371 twenty-foot containers in 1#-5#.
3. Pumped out oil-polluted water and fuel so as to prevent the marine ecological environment from being damaged.
- 3.1 1500 m³ Oil-polluted water, 35m³ light diesel oil, 145m³ heavy oil and 49m³ oil dregs were pumped out.

VI. Summary

The time span of salvage, including later commercial salvage, was one month (8-day efficient working). During working, Manyang allocated 21 ships including 1000T, 350T and 200T floating cranes and 5000T and 3000T deck barges. Diving equipment, emergency generating-sets, and water pumps were used. 13508 professional staff were dispatched. By overcoming all these problems, 660 containers on the wrecked ship were loaded off, with pumping out water in cargos and anchoring the stern so as to protect the cabin, get rid of the risk of drowning and prepare for the later stages of salvage. To prevent fuel leakage and ecological pollution, staff entered the wrecked ship and pumped out the oil-polluted water under the risk of drowning.



Diagram 3 “Hongyuan 02” refloated

VII. Main Factors of Success

It is undoubted that the “Hongyuan 02” salvage was successful. However, there were many factors, such as the responding speed, resource integration, scientific scheme and the matching support, influencing the result.

1. Responding Speed

Hongyuan 02 met the accident at 23:00 on 15 December 2016. Manyang received the notice at noon of 16 December and dispatched the ‘Pioneer Group’ to the scene at dawn on 17 December. At the same time, relative measures were taken to control the situation, which has shown the fast responding speed and high efficiency.

2. Effective Resource Integration & Orderly Management at the Scene

The salvage was completed with a lot of ships and divers. As the excellent performances are attributed to adequate preparation, such ships, equipment, and staff must come from a non-privately-operated company. Thus, under this condition, it is even more important to speed up resource integration and order the working management at the scene. Otherwise, even though there was a much swifter response to the emergency and complete salvaging scheme, the whole salvage could still have not been so successful. During the salvage, our company effectively utilized ship resources from Ningbo, Zhoushan, Shanghai and many other regions, dispatched 120T, 350T and 1000T floating cranes and deck barges as quick as possible, and kept the working order. These above are one main factor of success.

3. Scientific Salvaging Scheme

During the salvage, as the leaning angle was large and forced direction and track are not in the same direction, the resistance was a lot more compared to the normal load-off of containers, which affected the working efficiency to a great extent. Besides, the drowning status of the wrecked ship (prow stuck in the mud and stern floated above water) was special, so an appropriate loading-off scheme was the focus of the salvage. Hence, our company replace the ordinary hooks with the professional ones and made use of ultra-high-molecular-weight polyethylene ropes to reduce the labor force after asking advice from container yards. And also, the dispatched floating cranes had several times of lifting force than the ordinary heavy-loaded containers so as to guarantee the safety of working staff and improved the success rate and efficiency. To prevent the fracture of the ship, Manyang also invited experts from relative professional institutions like CCS to calculate the ship body intensity and plan the scientific loading-off scheme. In the process of implementation, staff paid attention to the change of ships carefully and adjusted scheme according to the actual situation.

4. Other Matching Support

Apart from the headquarter, the diving unit, the cleaning unit, the loading unit and many other kinds of matching support are established. As the core of salvage, the headquarter is the most important. However, without the cooperation with matching support, there could have not been the success. For example, the loading unit played an irreplaceable role in containership salvage. Although 'Hongyuan02' is a miniature containership with no more than 900 containers, it was still a tough question for non-professional container yard to efficiently load off and appropriately pile up containers. If the matching support could not catch up with the speed, the salvage would be delayed. As there were dozens of dealers of containerships, there would be costly fees for damage because of inappropriate stacks. From this salvaging case, there were 4508 clerks participated in loading process, which covered 34% of the total clerks. Therefore, the support from container yard headquarter was as important as the headquarter at the scene. In addition, diving unit and cleaning unit also played a crucial role in the salvage.



Diagram 4 Company container yard

To sum up, the four points above are the main factors of improving efficiency, saving costs, reducing damage and lost for shipowners and stakeholders while confronting such a salvaging case.