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Measures for the Safe Operation of Anchoring in a Storm

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Abstract. The collision and stranding of ship other shipwreck accidents are mainly caused by the ship dragging. As the water is less in coastal areas, anchoring has less influence on cementing ship, so strong wind is the most important factor for ship anchoring. Therefore, it is very important to study the safety evaluation of mooring in strong wind. In this paper, the measures taken after the ship anchoring is come up with from the analysis on the typical accidents and causes of anchoring security. The safety measures at the time of anchoring are also studied.

1. Introduction

Anchoring is the most common method in the ship operation. Anchoring is needed when loading or unloading cargo at the wharf or waiting for the pilot, port inspection body and quarantine authority to board the ship so as to avoid strong winds and wait for the ship entering the port. The safety of ship in windy weather has been taken seriously by the ocean shipping company ship driver and port authorities. When bad weather, such as strong wind happens, the safety of anchoring is especially important due to the arrival of a large number of ships taking shelter from the wind, which increase the density of ship.

Although the safety supervision by modern high technology is constantly escalating, the dragging accident is not uncommon. Ship trajectory tracking of many ocean vessel are collected through the survey on offshore company and passenger ship, which shows that almost all ships docked at the export port when the accident happens, most of which are caused by dragging[1].

2. Anchoring Accident Investigation and Cause Analysis

2.1. Typical Accident Case

At 23:55 pm on January 5, 2007, wind power in area under administration is northwest wind 7-8 level and reaches 8-9 level at midnight and gust 10 level. A Liberian “HUAYANG”ship owned Shenzhen Huawei Offshore Shipping Transport Co., Ltd was dragging anchor when taking shelter from the wind outside Longkou port. It entered the aquaculture area in the southern part of Longkou Port and the thrusters were entangled with breeding objects and lost its power. After cutting off the breeding objects winding up onto the right propeller, the "HUAYANG" ship left the aquaculture zone on its own under the guidance of fishing vessel and anchored at No.2 anchorage of Longkou port.

At 10 o'clock on the March 4, 2007, a strong extratropical storm surge occurred in the Bohai Bay due to the joint influence of strong cold air and extratropical cyclone. Affected by this storm surge, the weather in Yantai Port and its surrounding waters was north to northeast wind 7 level, which gradually increased to 8 to 9 level, gust is 10 level and the strongest was 11 level and big wave turned into rogue wave. Grounding accident occurred to the Malaysian "MMM GALUESTON "ship when it is leaving for Jingzhou port from Qingdao port and entering Yantai port for shelter. It was grounded on the shoal near Bieshe Kongdong island,Yantai port[2].

On December 1, 2010, when a "Transocean Winner" platform was working in the norald waters 78 meters deep, a length of anchor chain fractured 175 meters from the fairlead [3]. The accident causes the platform deviate from the target position 250-300 meters.

On January 8, 1982, a ship suffered dragging and struck a reef at the anchorage outside latakia port in Syria, causing a major accident. According to the survey, the anchorage is an open sea area and there are rocks down the southwest wind and no barrier in upwind and most of the bottom sediment is sand and silt.

On August 30, 1981, a ship arrived at the Yawosha anchorage of south waterway Shanghai port. It let go port anchor to avoid Typhoon 8114. At 12:45O on August 31, 1981, typhoon increased to 9 levels. Dragging is found at 23:20 and necessary measures were taken. The ship suffered dragging again at 12:00 August second and was aground in the southern section of Changxing Island [4-5].

2.2. Analysis on Accident Cause

According to the analysis on several typical accident cases on anchorage area, the reasons for the accident are mainly the following:

(1) The method of anti-wave dragging is wrong. There is much or less wrong anti-wave in the above accidents. The specific method taken for dropping anchor should depend on the wind, flow conditions and water conditions at that time [6].

(2) The method of operating anchoring is not right. The underestimation on the influence of wind current during the anchoring causes the ineffective control over the movement of ship and results in the stranding or colliding with other ships.

3. Measures Taken after Ship Dragging in Wind Wave

The measures taken after ship dragging is related to the safety of the ship. Measures should be taken timely once the ship suffers dragging to control the movement of the ship. It is necessary to control the direction of navigation channel especially in the subsequent heavy lifting of the anchor [7].

3.1 Measures Taken after the Dragging

When the ship suffers dragging, the watch keeper should immediately report to the captain and notice the mate to drop anchor in the bow. You can immediately drop another anchor in an emergency. Then, if the conditions permit, you can choose heavy toss after dropping the anchor.

3.2 Matters Needing Attention in Heavy Toss after Set Sail.

The first thing you need to consider is whether the heavy toss after set sail is ready. If the wind is too big, you should drop the anchor rashly. It is difficult to drop the anchor in storm. At this point, car is used to against the wind to reduce the stress of anchor until the storm become smaller and then exercise anchoring. During the anchoring, the direction of the bow is very important when the anchor is off the ground. When the anchor is off the ground, the ship will be affected by the wind-drive torque, transshipment torque and rudder force. At this point, the speed of the ship is zero, which means that the transfer torque of the hydrodynamic force is about zero [8].Whether the ship can control the first direction and avoid drifting downstream mainly depend on the rotating torque and the torque algebra of rudder force. As long as the rudder torque greater than the wind torque, the bow can be controlled. The torque of rudder force can be adjusted by the rudder angle and the rudder force has the maximum torque, but the driving torque of wind is closely related to the left bow bearing. Therefore, it is necessary to analyze the magnitude of the two torques to find the control angle. As long as the value of the ship is less than that of the wind-angle anchor, the ship will not lose control.

During the anchoring process, the vessel's head will turn to left and right due to the influence of storms and chains. But as long as the anchor is at the bottom of the water, the ship can advance easily and be controlled with the rudder. Therefore, when the bow is facing the wind in weigh anchor, the wind angle will not be too large. Special attention should be paid to the control of the bow when a length of chain is under the sea. The weight anchor will be stopped and the rudder will be adjusted when necessary, and then the weight anchor will continue. Besides, if you can not completely control the course, the wind direction should be controlled within a certain range. When anchor’s length is

about 2 shackles, dragging anchor can be considered [9].Because when the ship advances in a certain speed, the main engine can reach greater speed, the torque of maximum rudder will increase, thus the course can be effectively controlled.

3.3 Emergency Operation after Weight Anchor

If the anchor is at the bottom and the heading is not properly controlled, the ship will lose control and unable to stabilize the course. At this point, the ship will drift downwards. In this case, emergency operation can be taken according to the environment and the situation of the ship. There will be no obstacle if the air is fresh. If the wind steering torque and steering torque are the same, the ship can be speed up. The speed of the ship will increase rapidly if the ship moves following the wind. If there are obstacles in the lower wind speed, the situation is the most dangerous. Anchor should be dropped immediately if the ship is not drifting downwards very fast and the ship should be controlled with anchor hold. When the ship rapidly reaches the lower wind, it is dangerous to dropping anchor because the speed of the vessel is too fast. Therefore, the ship should be equipped with sufficient manpower at this time to reduce parking time. Anchor should be dropped immediately when the anchor rod is disengaged and the bow is out of control. What operation should be taken depend on the specific situation [10].

4. Safety Measures Taken during Anchoring

4.1 Eliminate a Hidden Danger

The captain and mate should know very well about the installation structure and technical condition of the anchor equipment of this ship. The sign of each chain should be clear. The mate should carefully check the chain, link and the technical conditions connecting the shackle each time when set sail. It is advised to carry a portable test hammer to knock and listen to detect and eliminate hidden dangers in a timely manner. The stowage of goods, inspection of storage, trimming, reinforcement and banding and other work should be prepared in mean time to prevent the goods moving in storm. The stability of bulk carriers, ro-ro vessels, container ships and timber vessels must be well calculated.

The weather forecasts and meteorological faxes should be collected timely for analysis and research. In case of gale warning, or the transfer of anchorage berth or water allowed, long anchor chain should be released as early as possible. When anchoring in open port, the main engine should be used at any time and the ship should maintain a sufficient safety distance with nearby ships and obstacles. Anchorage should be avoided at current turbulence to against typhoons [11].

For the ships operated berthing alongside, if it is necessary to move the anchorage to resist the typhoon, you should take the initiative to discuss with the port party to move it in time. If the captain believes that the anchorage designated by the port side can not guarantee safety, he should propose adjustment advice to the port side to avoid unprepared situation.

4.2 Improve the Stability of Anchored Vessel in Storm

In order to resist typhoons, the brake ribbon of windlass should be tightened after dropping the anchor and the chain cable stopper should be closed and the anchor chain should be fixed with wirerope to prevent the anchor chain from sliding out. When the wind increase to 8 levels, the main engine should be prepared and the whole ship is under voyage duty. The safety rope from the driver's cab to the bow should be lined and the watertight doors and windows should be closed and the moving objects should be tied. The light signal connecting the bow and bridge should be set for emergency purposes [12]. Personnel assigned to the bow should fasten the safety rope, tighten the neckline, cuffs, and trousers to prevent personal accident, and pay attention to the stress of anchor chain and report to the bridge at any time.

The wind area of the ship should be reduced as much as possible, which is an important and effective measure to prevent dragging. The draft of the ship should be increased and the windy area of the ship should be reduced at the same time under the same water conditions. The bow trim should be increased. The wind center should be moved backward as much as possible and the hydrodynamic

center of the ship can be moved forward as much as possible to reduce the deviation of the anchored ship so as to improve its stability.

Take a ship resisting typhoon at the Shajiao anchorage of the Pearl River, Guanghzou as an example. The depth of immersion of the ship is 4.95m deep before draft and 4,46m after draft. Bow trim is intentionally caused, which make the bow draft is half a meter deep than the tail draft. When the maximum wind is 12 levels and yawing is smaller, half-vehicle advance 1 hour when the wind reach the maximum speed can successfully resist the typhoon. Another example is that a ship is a barge-carrier and the body of a ship is like a floating dock. It dropped long and short anchor in Hongkong west anchorage. The right anchor is 3 knots and left anchor is 3 knots. The depth of immersion of the ship is 6.15m before draft and 6.0m after draft. The maximum wind is 13 level and half-vehicle advance 1 hour when the wind reaches the maximum speed. The yawing is no more than 10 degrees in resisting typhoon. Another example is a ship repaired in Hongkong without power. The depth of immersion of the ship is 2.7m before draft and 4.9m after draft. The depth of water at anchorage is 16m. The maximum wind is 12 levels. The ship suffered dragging after hit by a dragging ship. Both the anchor chain is loosening to 9 knots and the dragging still can not be controlled. In the case of no power and external aid, immediately pressure 2000t water to the first and second cargo hold greatly reduce the wind area and the dragging is miraculously stopped. The depth of immersion after pressuring water is 5.2m at the bow and 4.3m at the tail. It proves that increasing the ship draft and reducing the wind area of the bow to make the bow trim slightly is an important and effective measure to prevent dragging [13].

4.3 Attention to Anchoring in Storm

Boldly and properly using the rudder is an effective measure to prevent dragging. In particular, the swing of the ship can be eased if car and rudder are used appropriately on a surging anchorage, which allow the bow move steadily against winds. Easing the tension of the anchor chain is good for preventing dragging, which should be used with caution. When resisting wind with car, sometimes you will find even if the anchor chin reached a certain degree of tightness, but the direction of the anchor chain may not be consistent with the wind. The principle of manipulating the wheel is to make the center line consistent with the wind direction. It is necessary to prevent the anchor chain backwards but also to avoid excessive stress, which requires the watchkeeper at the bow to timely reports on the anchor chain and direction. The successful experience they got is the stronger the wind, the more bolding to use the main engine, and the speed can be larger at the beginning and then lowed again without any hesitation. Secondly, it is very difficult even impossible to maintain the bow of the ship face the wind. So some deviations should be allowed.

Windling anchor must be avoided in storm because rush dragging may be caused and out of control if the anchor is not properly handled. If dragging happened, both the long anchor chain should be loosening immediately to slow down the dragging. If the anchor must be winded, the vehicle should be moved before winding the anchor or operate the vehicle while winding the anchor. The ship pressed downwind by the wind while winding the anchor should be strictly on guard against [14].

5. Conclusion

Good basic anchoring condition must be met if we want to prevent the dragging of anchored ship caused by storm. It includes the correct choice of anchorage, safe and reliable anchoring equipment. But in practical work, good anchorage is rare. There is always such a deficiency in the choice of anchorage. The crux of the problem is how to take the correct anchoring method and safety measures that meet the objective conditions and the specific conditions of the ship under certain objective conditions to ensure the safety of anchored ship. The pilot should provide theoretical basis after analyzing the ship dragging based on the data, wind and wave conditions and surrounding environmental factors and the measures should be taken immediately for the proper operation to avoid or reduce occurrence of a maritime accident.

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