Countermeasures and Collision Avoidance Operations of Emergency Scenarios in Pilotage

Xianliang Liu*

School of navigation, Wuhan University of Technology, Wuhan, China

*Corresponding author: 296276@whut.edu.cn

Abstract. With the development of shipping industry, the complexity of traffic and the demand for pilotage service keeps rising. Necessary emergency measures should be taken to avoid the risks in pilotage. In this paper, the research on typical emergency scenarios of pilotage and corresponding countermeasures are carried out. The pilotage scenarios that need emergency measures are divided into four categories: encountering bad weather, steering engine failure, main engine loss of control, encountering collision risk. The characteristics of these pilotage scenarios and the corresponding emergency pilotage measures are discussed in detail. The research shows that when taking emergency measures in the face of the emergency situation in pilotage, the polit shuold fix out the situation and the ship should be guided out of the danger according to the corresponding emergency process. This paper may be helpful to optimize pilots' handling of various affairs when emergency occurs in pilotage, and provide guarantee for the safe navigation of ships.

Keywords: Pilotage; Collision avoidance; Emergency measure.

1. Introduction

In recent years, under the background of globalization, the world shipping business is developing rapidly. In the process of the rapid development of international shipping, a large number of ships enter the narrow waterway, resulting in complex traffic conditions. As the ship traffic in various places keeps increasing day by day, all kinds of pilotage emergency incidents are increasing. In the face of complex traffic conditions, ships need standardized pilotage services.

In the past decades, the emergency situation and corresponding measures in pilotage have been studied. The ship collision avoidance technology provides technical reference for the emergency operation in the emergency situations[1]. The research of nautical psychology indicates the psychological state that pilots need to maintain in the emergency situations[2]. Various piloting risk assessment methods provide coping strategies for possible risks during piloting[3].

According to the consulted data, the emergency scenarios in pilotage mainly fall into the following four categories: encountering bad weather, steering gear failure, main engine loss of control, and encountering collision danger. Facing these emergency scenarios, pilots need to adopt correct pilotage measures to guide the ship out of danger[4].

This paper carries out research on typical emergency scenarios of pilotage, makes a detailed analysis of various emergency scenarios, summarizes the characteristics of various emergency scenarios, and clarifies the judgment and decision of emergency pilotage and ship operation requirements. This paper may be valuable for the safe navigation of ships.

2. Classification and Characteristics of Emergency Scenarios in Pilotage

Based on the extraction of typical pilotage scene database in the lower reaches of the Yangtze River and the questionnaire survey of active pilots, this paper divides the emergency situations that pilots may encounter into four categories: bad weather, main engine loss of control, steering engine failure and collision risk[5].

2.1. Bad Weather

Bad weather like strong wind and thunderstorm may affect the ship's navigation posture, causing the hull to tilt, making the cargo on board move. The safety of personnel, cargo safety and ship safety are seriously threatened[6].

The safe navigation of the ship will be affected when the ship meets the wind of 4 levels or more in the inland river. The wind of more than 7 may make impact on large ships sailing on relatively wide rivers. Wind and waves also have adverse effects on ship turning and docking, causing great difficulties.

2.2. Main Engine Loss of Control

The main engine is the power source of the ship, providing power for the ship's movement. When the main engine is out of control, the ship will lose its driving power, making the ship stagnant. The main engine tachometer will show the ship stopping at this time. Due to inertia, a ship will glide forward even after losing power.

In the course of navigation, especially in the long and narrow waterway or waterway with large traffic flow, if necessary measures cannot be taken in time, the loss of power may lead to a substantial decline in the rudder efficiency of the ship, resulting in a sudden drastic turn of the ship, which is highly likely to cause collision risk.

2.3. Steering engine failure

The steering gear is an important component of the ship used to change the direction of the ship. When the steering gear fails, the rudder may be stuck at a certain angle, which will be displayed on the rudder angle indicator.

In the course of navigation, especially in the narrow channel or the channel with large traffic flow, if the necessary emergency measures cannot be taken in time, this situation is also very likely to cause the risk of collision, resulting in collision accidents or even pile-up accidents between ships.

2.4. General Collision Risks

When the closest encounter distance between two ships is less than the safe distance and the nearest encounter point time is small, the two ships should be considered to have a collision risk[2]. Generally speaking, when ships are sailing on the ocean, the probability of encountering collision danger is small, but the collision between ships has a great degree of harm to personal safety and property safety. Especially in a narrow waterway or a waterway with a large traffic flow, the probability of collision risk is greater. If the ship can not take the necessary emergency measures, it will make a great impact on the safety of personnel and ships.

3. Corresponding Countermeasures and Collision Avoidance Operations

In the face of emergency scenarios, the pilot should first have a strong psychological quality to calm himself down[7]. Then, the pilot needs to guide the ship out of danger by virtue of his experience and good seamanship. The countermeasures and collision avoidance operations correspond to the four types of pilotage emergency scenarios mentioned earlier.

3.1. Bad Weather

When a thunderstorm comes, the ship will immediately slow down and sound the fog signal. All effective observation means such as visual observation and radar compass should be used to strengthen observation. Special personnel should be sent to observe radar, compass, listen to VHF radio telephone, depth sounding, and timely report to the captain of the ship's dynamics and channel changes in the riverbed. If necessary, the vehicle should be stopped and the rudder should be steered in stages. Sailing ships should anchor early to weather thunderstorms, or stop the rudder and wait for sailing. It is advised that ships choose wide waters to turn around early and select anchorage.

If the ship is sailing in the area of big wind and waves, it should reduce the ship speed to keep the course. If the ship is sailing along the waves, different speeds can be adopted to maintain the rudder effect. If necessary, the ship is advised to avoid the original route.

The pilot must be decisive in piloting and berthing operation under bad air conditions, and the piloting operation must be decisive, timely and accurate without hesitation. At the same time, corresponding plans should be made to coordinate various institutions such as pilotage centers, tug companies and maritime departments to assist the pilotage[8].Appropriate escape methods should be used in the face of a tropical cyclone[9].

3.2. Main Engine Loss of Control

Facing the loss of control of the main engine, the pilot should immediately notify the engine room to repair. If the main engine cannot be repaired, the pilot should use residual speed or start the minimum speed to maintain the rudder effect, release relevant dynamics to seek support, and use the tug to assist navigation or anchor to repair the main engine. The correct operation of the pilot in the successful disposal of the "Pearl Sea" main engine out of control confirms this point.

In the face of the loss of control of the main engine, the ship should avoid emergency vehicles and parking in the complex section, choose the right time to anchor and brake, and use the tug to sail or assist in berthing.

When the main engine of the ship is out of control, it should be handled according to the water area of the ship, which is divided into three categories: ship in port, ship at sea and ship in complex waters, all of which need to report to the port authorities, if outside the port, it is necessary to display signals to warn the surrounding ships, and the ultimate purpose is to find a safe location or safe waters for repair. The disposal process is shown in the figure 1:

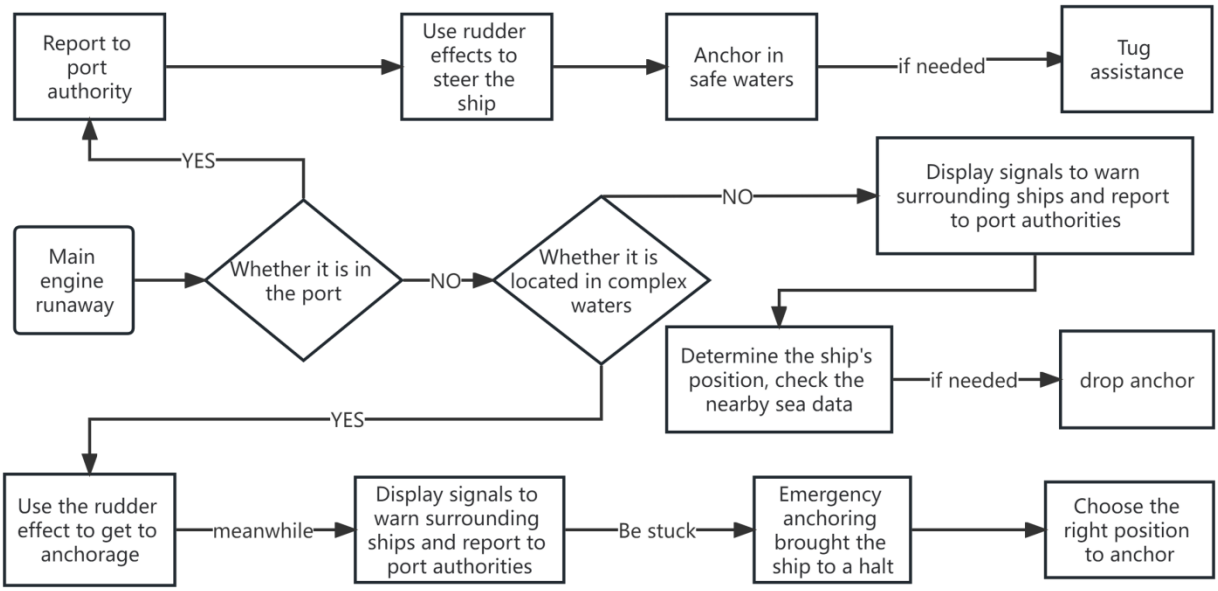


Fig.1 Host loss control handling process

3.3. Steering Engine Failure

In the face of the failure of the steering gear, the emergency rudder should be used. When the emergency rudder fails, taking various ways to brake is a more effective means, which may make the ship avoid the risk of collision. At the same time, relevant information should be released through VHF telephone and shore-based support should be sought. In the face of special circumstances, unconventional operations can be decisively taken to avoid collisions. "Asli" wheel in the face of steering gear failure is based on the situation at that time to take unconventional operations to avoid risk.

Anchoring braking is a common means of ship braking, which can be used to brake when the steering gear fails. At the same time, it may cooperate with the rudder to avoid emergency, or help the rudder to make the ship out of danger[10].

When the steering gear fails, the ship has a different solution when facing crowded waters and open waters. It is necessary to display a signal to warn the surrounding ships and report to the port authorities. Another steering gear should be activated immediately and repaired. If the steering gear is damaged, the tugboat should be summoned to assist. In contrast, the treatment process of crowded waters is more complex. The disposal process is shown in the figure 2:

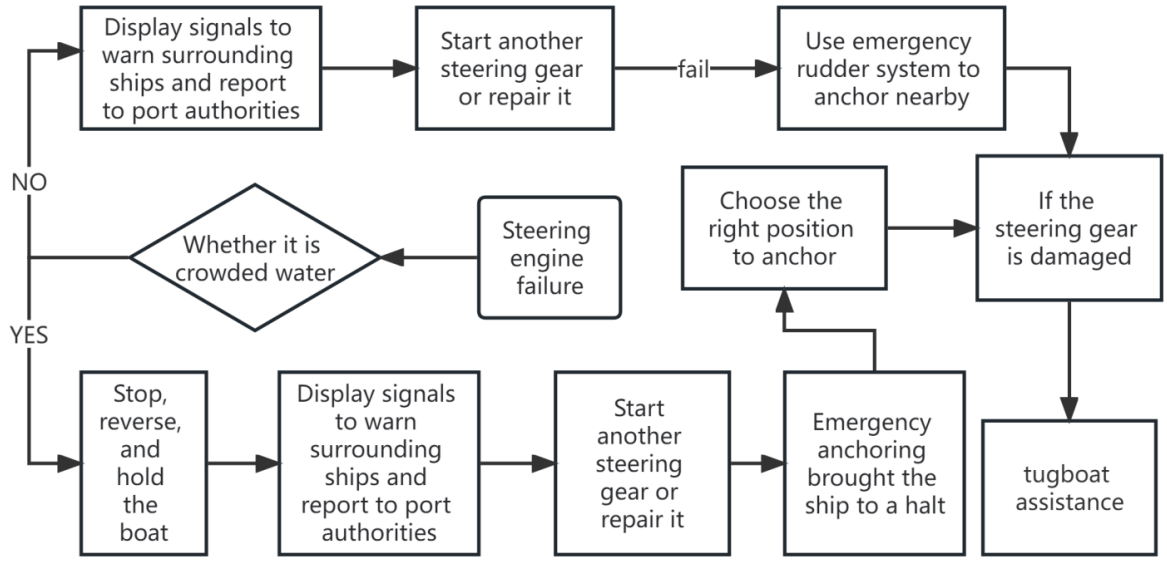


Fig. 2 Steering gear failure disposal process

3.4. General Collision Risks

In the face of collision danger, the pilot should pay attention to the radar dynamics, choose to stop or slow down the ship in time, and take all methods to make the ship avoid collision danger. At the same time, the pilot must remain calm and use collision avoidance rules flexibly.

When conducting collision avoidance, it is necessary to bear in mind the contents of the rules and regulations of the international maritime collision avoidance regulations and prudently manipulate the ship to avoid collision. In exceptional cases, operations contrary to the terms may be used to avoid the risk of collision by all possible means.

When a ship encounters the risk of collision, it shall confirm its identity, make contact and take appropriate actions to avoid collision, as shown in the figure 3:

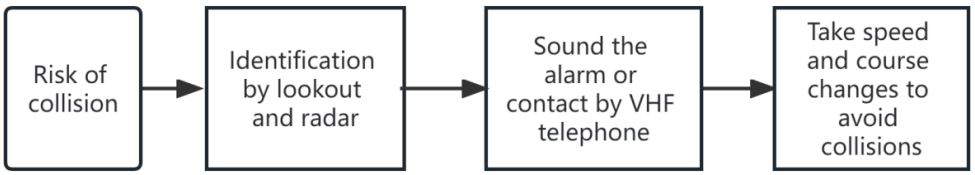


Fig. 3 Handling procedure in case of collision risk

4. Conclusion

Based on typical emergency scenarios in pilotage, this paper extracts and analyzes pilotage cases belonging to the category of emergency pilotage with the help of the classic pilotage case database of Yangtze River Pilotage Center, and summarizes the characteristics of various scenarios, so as to

provide certain objective basis for optimizing and improving the operation in existing emergency pilotage cases and providing pilots with training programs related to emergency pilotage. Specific research results are as follows:

1. Through the screening, statistics and analysis of the case database, it can be found that typical emergency scenarios of pilotage are mainly divided into four categories: encountering bad weather, steering engine failure, main engine loss of control, and encountering collision risk.

2. Typical emergency scenarios in different types of pilotage have different countermeasures. Combined with the pilot's behavior and instructions in the case, the decision and operation of typical emergency scenarios in different types of pilotage are summarized, and the pilot's judgment, decision and ship operation requirements are summarized in the face of different types of typical emergency pilotage scenarios.

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