Functional requirements for VTS systems under the influence of MASS

Introduction

ZHIFEI (LOA 117, design speed 12 knots, capacity 316 TEU) has three navigation modes: Navigation Assistance mode, remote control mode and autonomous navigation mode and realized the functions of independent route planning, intelligent collision avoidance, automatic berthing.ZHIFEI has sailed more than 26,000 nautical miles and navigated in the VTS area for more than 500 times. These data not only verified the reliability of its technology, but also provided a valuable practical basis for future coordination between MASS and VTS.

Management and services for ZHIFEI

The emergence of MASS is a remarkable achievement of scientific and technological progress in the field of shipping. However, the existing relations of production are difficult to fully meet the actual needs of MASS development. In order to promote the healthy development of MASS, China MSA has formulated the relevant management system.

A management group has been set up for the sea trial of MASS, which is responsible for organizing and coordinating all the work of the sea trial of MASS.

The sea trial subject, namely the responsible unit of the vessel, should be a legitimate shipping company, an administrative authority, or an owner of yachts of 24 meters or above. If a shipping company is required to establish a safety and pollution prevention management system according to regulations, it should obtain a company "Document of Compliance" issued by the maritime administration.

The sea trial subject, before the sea trial of the vessel, should complete the risk assessment of the ship and the remote control station, develop a navigation programme based on the risk assessment.The sea trial subject should establish a contingency plan and carry out drills to keep the navigation risk at the lowest level. The sea trial subject shall ensure that the vessel and related systems, equipment, and networks comply with national safety and technical requirements, and data storage meets national requirements.

The sea trial vessel shall hold valid ship registration certificate and ship survey certificate in accordance with the law. If necessary, a valid ship Safety Management Certificate shall be held.

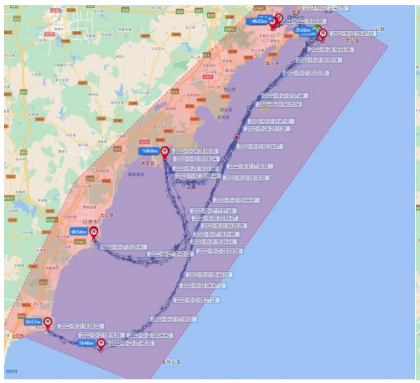
Vessels should pass a safety inspection by the Maritime Administration one month prior to their first voyage.Systems and equipment concerning ship autonomous navigation and remote control functions should be accompanied by marine product certificates or relevant certificates of the design and manufacturing departments.

All crew members, person in charge of navigation, remote control station operators, and other personnel involved in navigation on the vessel are collectively referred to as navigation personnel.The number of navigation personnel (including crew members) on board the vessel shall not exceed the capacity of the vessel's life-saving equipment.

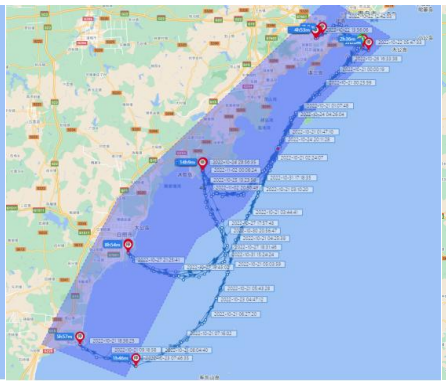
Process of Trail

The sea trial area must be approved by the competent authority, and navigation warnings are issued by the competent authority during the trial period. The sea trial subject shall report the following information to the competent authority before the start of the trial and VTS provides service for the sea trial of MASS, and implement measures such as traffic control if necessary.When the navigation is completed, relevant navigation facilities and equipment should be promptly cleaned, and no obstructions should be left.

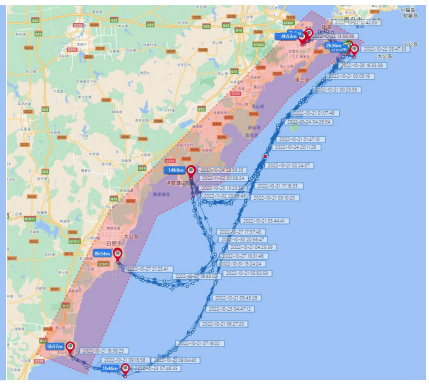
The main communication modes adopted by ZHIFEI are satellite and shore-based communication networks (4/5G). Satellite communication can cover the entire route of ZHIFEI. Due to the limitation of satellite delay, the minimum delay is 600ms, the average delay of service is about 900ms, and the maximum uplink and downlink bandwidth of the current service is 5 Mbps uplink and 10 Mbps downlink, which can guarantee 3 channel video and service data demand when there is no electromagnetic interference or antenna blockage during the voyage.



routes under satellite network coverage



routes under 4G network coverage



routes under5G network coverage

4G signal is greatly affected by the density and height of shore base station, when the base station location is ideal, 4G signal coverage can reach 5-10 nautical miles, and the average delay is less than 200ms. The main disadvantage is that during the ship's voyage, it has to pass through multiple base stations, and the process of switching signals from base station to base station will cause the network to reconnect, which takes about 3-5 seconds.With the increase in the number of 5G base stations, the 5G signal along the coast has been improved, but the coverage area is around 4-5 nautical miles offshore, with the same problems of base station switching and signal along with switching.

Functional requirements of the VTS system

ZHIFEI navigates through the VTS area of Qingdao VTS and Rizhao VTS. Compared with the information interaction between Zhi Fei and the shore-based remote control centre, the information interaction between VTS and ZHIFEI still relies on traditional means of communication, such as VHF, due to the lack of upgraded functions of the VTS system for MASS. After comparison, the VTS system should have the following new functions:

- Enhanced monitoring capability

The VTS system needs to be able to identify and monitor the position and movement of MASS in real time, especially in congested waterways or under complex meteorological conditions. Considering that MASS has

the autonomous collision avoidance function, the VTS system should have the capability to share and validate collision avoidance information with its system for more efficient traffic organization and risk management.

- Better communication capability

The VTS system should have more powerful communication capability in order to obtain the navigation data, equipment status data, and environmental data of MASS in real time, and to meet the needs of advanced assisted navigation and remote control of MASS.

- Higher data processing and analysis capability

The VTS system should have the ability to analyse and process data from different data sources in order to provide more accurate navigational aids and decision-making support, especially through the analysis and processing of the planned routes and real-time navigational data of the MASS to prejudge the routes' intersection areas and give solutions to reduce the risk of collision.

- Stronger cyber security system

VTS should establish a high standard of cyber security protection system to protect data from external attacks.

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