

Brief talk thoughts on the determination of navigation mark technology in offshore wind power plant

Wang Zheng Peng*

Lianyungang AIDS To Navigation Department Of Donghai Navigation Safety Administration

Key words: offshore wind power; navigation mark. Determination of technology; Beacon management station; Case analysis; Clean energy

1. Introduction

Offshore wind power is a highly active and highly developed clean energy in the recent ten years. It is also recognized as a low-carbon and efficient renewable energy with a very broad prospect. At the same time, the navigational markers of offshore wind farms are advancing with The Times according to the rapid development requirements of wind farms^[1]. Through reading relevant literature, the author finds that there are many studies on the location and distribution of navigational markers for offshore wind power^{[2]-[3]}, while there are few studies on how to do a good job in technical determination to promote the service of national clean energy strategy. Therefore, the author discusses in grassroots beacon station as a maritime security in the forefront of starting point, give full play to its geographical advantages and flexible maneuverability, according to the logical order of Jiangsu RuDong H15 # offshore wind farm determination of prophase preparation, medium-term field work, the late maintenance work summary to case analysis, discusses the main techniques of offshore wind farm beacons to test work. Lay the foundation for the determination of the technology of the carrier in the future, and escort the national clean energy strategy with the service^[4]

2、 Definition of technical measurement

The technical determination of navigational mark generally refers to the on-site testing of all or sampling of newly built, rebuilt or adjusted navigational mark to detect whether the technical performance of the designed navigational mark meets the relevant specifications of navigational mark. Among them, the main content of visual navigation mark technology determination includes the position, structure, color and light range, rhythm, cycle; The main contents of the technical measurement of radio navigation mark include the position, name, type, MMSI coding and other display effects of navigation mark, as well as signal transmission time interval and action distance^[5].

3、 the necessity of technical determination

As a navigation mark management and service agency under the Ministry of Transport, the grass-roots navigation mark management station, in addition to continuing to base on its own work, conducts daily 24h network patrol of its jurisdiction through the telemetry and remote control platform of navigation mark, and timely on-site inspection of abnormal navigation mark. It is necessary to actively provide various kinds of technical examination opinions for navigation mark to navigation with the maritime authorities under its jurisdiction, and actively undertake the technical testing work for the acceptance of navigation mark to navigation effectiveness; According to the actual needs of the wind farm owner units, and continuously provide wind beacons technical support and the special navigation mark to

navigation security services, for maritime security people, according to the construction of a national navigation mark to navigation association IALA proposed sign marked, safe and reliable structure, ensure that ships with multiple system under different meteorological conditions to identify beacons, It is of great significance to the safety of wind farm itself, to provide safe and stable power generation, and to ship's safe passage through nearby waters. In addition, on the basis of laying visual navigational markers, AIS navigational markers are added to the fans located in specific positions of the wind farm to warn ships with multiple systems, so as to ensure the safe passage of ships through the engineering waters and promote the stable development of local economy.

4、 Code for effectiveness acceptance of offshore wind power navigation aids

Technical measurement is the main work in the early stage of the efficiency acceptance of navigation mark. Relevant navigational mark managers need to record the results of on-site technical determination, record the visual navigation mark in the visual mark technical determination table, write the navigation mark with technical determination table, and summarize and issue the technical determination report. Preparing the PPT report of the evaluation meeting of experts on the effectiveness of navigation mark lays a foundation for the technical determination work in the future, but also brings convenience to the expert evaluation.

The acceptance of the effectiveness of navigation mark is a general evaluation of whether the effectiveness of navigation mark meets the relevant standards and approval requirements by the authority of navigation mark management through on-site technical measurement and expert evaluation. It is generally carried out in the form of expert forum for the acceptance of navigation mark. The expert forum is generally composed of navigation mark management organs, owner units, local maritime administration and some expert representatives. The acceptance procedure of effectiveness of navigational mark mainly includes the following four aspects :(1) pre-acceptance of effectiveness; (2) application for effectiveness acceptance; (3) effectiveness acceptance examination; (4) effectiveness acceptance method. According to the work order, the acceptance method of the effectiveness of navigation mark is composed of three parts: the inspection data in advance, the on-site technical determination and the comprehensive summary and evaluation afterwards.

Therefore, this paper takes the basic management station of navigational markers as the stationary point, and conducts the main work in the early, middle and late period of the acceptance criteria of efficient service navigational markers as a case study.

5、 Case analysis

5.1 Introduction to Jiang Su Rudong H15# Offshore wind power project



Figure 5-1 Geographical location of the engineering area

Jiang Su Rudong H15 Offshore wind power project is invested and constructed by Jiang Su Rudong Offshore Wind Power Co., LTD. Figure 5-1 shows the geographical location of Jiang Su Rudong H15# Offshore wind Power Project area, which is located in the east side of Zhugensha, Rudong Sea area of Jiangsu Province. The planned sea area is about 32km², and the center of the site is about 47km offshore.



Figure 5-2 Jiang Su Rudong H15# offshore wind farm

Figure 5-2 shows the location of electronic chart scope of Jiang Su Rudong H15# Offshore Wind Farm Project. As shown in Figure 5-2, the wind farm is approximately in the shape of a trapezoid, with a north-south width of about 5.7km and an sea-floor elevation of 0-10m. The planned installed capacity

of H15# offshore wind power project is 200MW and 200,000 kW.

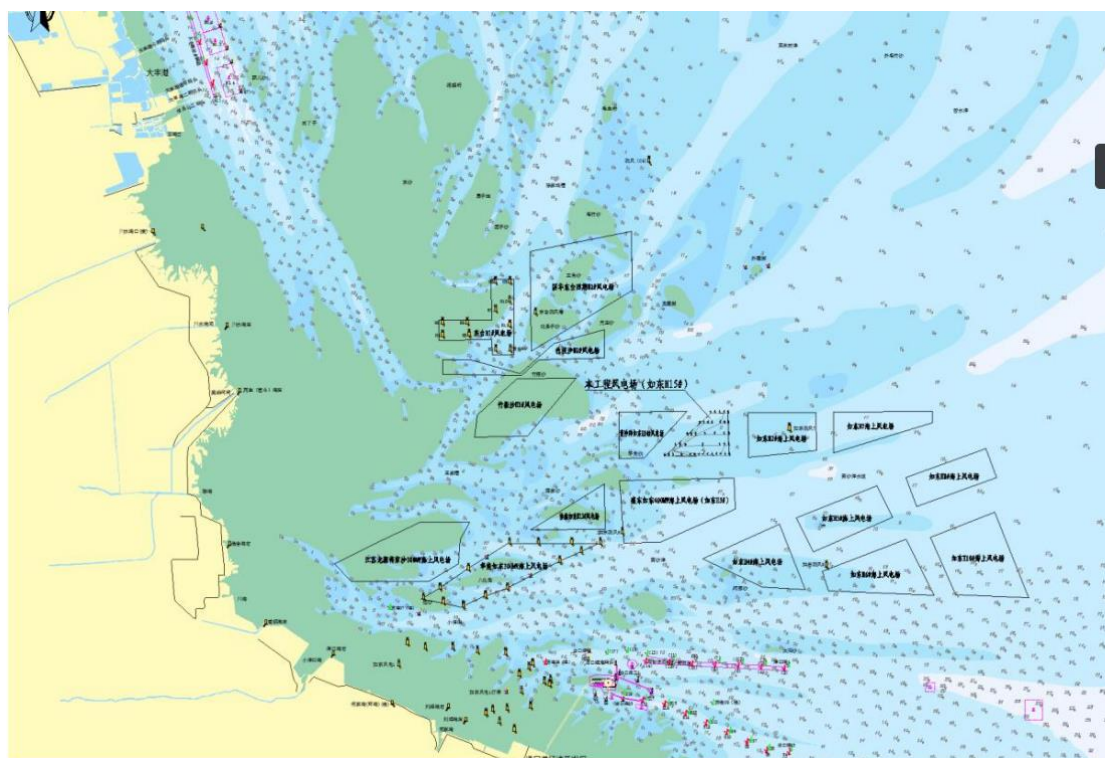


Figure 5-3 Layout of nearby wind farm

As shown in Figure 5-3, there are also Huangshayang Rudong H14# Wind farm, Jiang Su Rudong H13 Wind farm, Rudong H2# offshore wind farm, Rudong H3# offshore wind farm, Rudong H4# offshore wind farm, etc. near Rudong H15# offshore wind farm project.

When completed, rudong H15# offshore wind farm plan project will generate 920 million kilowatt-hours of electricity per year. Compared with coal-fired power plants of the same size, it can save about 300,000 tons of standard coal, 680,000 tons of carbon dioxide and 110,000 tons of ash and slag per year. It is of great significance to optimize energy structure, reduce coal consumption and boost green economic development in Jiangsu Province.

5.2 Jiang Su Rudong H15# Offshore wind power Plant engineering technical parameter table

附件

协鑫如东 H15#海上风电场工程营运期专用航标技术参数表

序号	名称	类别	位置 (CGCS-2000)	灯质或编码	灯高	射程	构造	备注
1	如东 H15 风电 1 号灯桩	专用标	32°47'39.8"N 121°30'13.7"E	莫(C)黄 12s 同步闪光	11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
2	如东 H15 风电 2 号灯桩	专用标	32°49'07.4"N 121°32'09.2"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
3	如东 H15 风电 3 号灯桩	专用标	32°50'37.8"N 121°34'08.3"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
4	如东 H15 风电 4 号灯桩	专用标	32°50'37.4"N 121°35'36.5"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
5	如东 H15 风电 5 号灯桩	专用标	32°49'06.3"N 121°35'38.1"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
6	如东 H15 风电 6 号灯桩	专用标	32°47'38.3"N 121°35'39.6"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
7	如东 H15 风电 7 号灯桩	专用标	32°47'38.6"N 121°34'12.5"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
8	如东 H15 风电 8 号灯桩	专用标	32°47'39.1"N 121°32'23.0"E		11m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期
9	如东 H15 风电 9 号灯桩	专用标	32°48'00.5"N 121°30'54.1"E		28m	5nm	黄色圆柱形钢管, 顶标为黄色 X 形, 高 1.5 米	营运期

10	如东 H15 风电 1 号灯桩 AIS 航标	专用标	32°47'39.8"N 121°30'13.7"E	MMSI 待定	/	/	名称: RD H15 FD 1; 航标类型: 专用标; 发射模式: 自主连续; 播发间隔 3 分钟	营运期
11	如东 H15 风电 3 号灯桩 AIS 航标	专用标	32°50'37.8"N 121°34'08.3"E		/	/	名称: RD H15 FD 3; 航标类型: 专用标; 发射模式: 自主连续; 播发间隔 3 分钟	营运期
12	如东 H15 风电 4 号灯桩 AIS 航标	专用标	32°50'37.4"N 121°35'36.5"E		/	/	名称: RD H15 FD 4; 航标类型: 专用标; 发射模式: 自主连续; 播发间隔 3 分钟	营运期
13	如东 H15 风电 6 号灯桩 AIS 航标	专用标	32°47'38.3"N 121°35'39.6"E		/	/	名称: RD H15 FD 6; 航标类型: 专用标; 发射模式: 自主连续; 播发间隔 3 分钟	营运期
14	如东 H15 风电 9 号灯桩 AIS 航标	专用标	32°48'00.5"N 121°30'54.1"E		/	/	名称: RD H15 FD 9; 航标类型: 专用标; 发射模式: 自主连续; 播发间隔 3 分钟	营运期

Figure 5-4 Technical parameters of Rudong H15# offshore wind farm

Jiang Su Rudong H15# wind farm is equipped with 9 traditional light pile visual beacons and 5 AIS physical radio beacons to mark the position and range of the fan, providing a strong guarantee for the safety of the fan itself and the navigation safety of passing ships. Technical parameters of special beacons in the specific operation period are shown in Figure 5-4, which includes the name, category, orientation, light quality period, light height, range and structure of all beacons in Rudong H15# wind Farm.

5.3 Preparation before measurement

As shown in figure 5-5, navigation mark at the grass-roots level administrators first according to the local maritime bureau approval by the maritime administrative licensing decision, query beacon design documents (including drawings), navigation mark technology resume and pre-acceptance, construction information summary report (including the construction and completion of images and light quality video) for a comprehensive understanding of relevant information and requirements. Choose a sunny day with good visibility in advance as the date of technical determination. Understand the navigation

law of the navigation area and basic information of the channel. Determine the scope and content of technical measurement, select the test vessel, and prepare the measurement equipment and instruments in advance. Finally, through the 24h telemetry remote control platform of the navigation beacon, the telemetry position of the wind farm navigation beacon installed for efficiency acceptance was monitored, and the position was compared with the documents approved by the local maritime safety Administration to check the working current and voltage and judge whether the navigation beacon can work normally. Finally, the navigational markers that do not meet the acceptance standards of technical determination are recorded, and the accuracy of their positions is determined by repeated monitoring in the later stage, which foils the convenience of on-site technical determination.

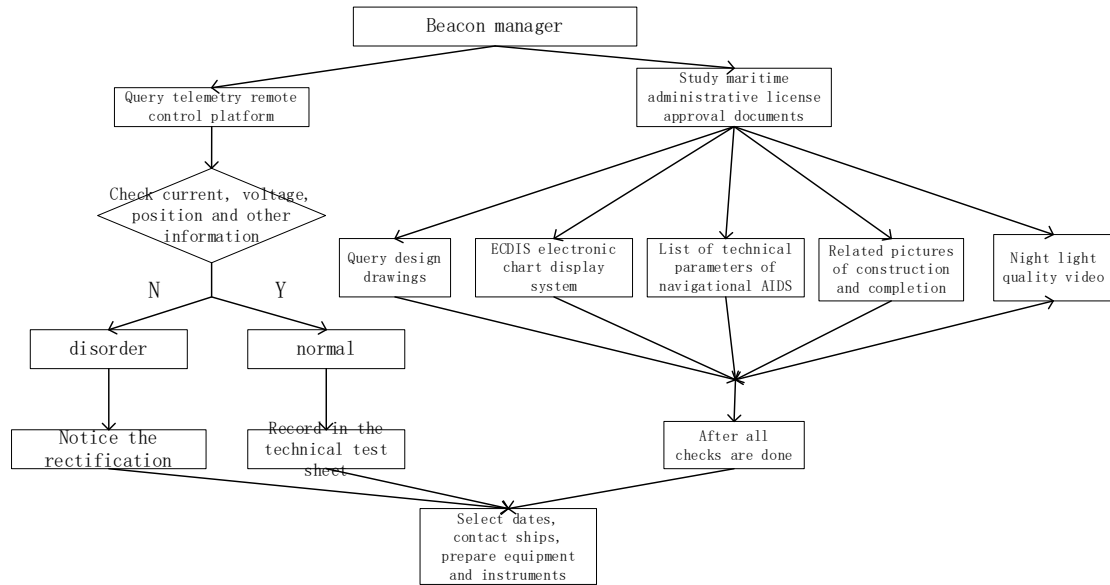


Figure 5-5 Preparations

5.4 On-site work in measurement



Figure 5-6 Remote light pile



Figure 5-7 close light pile and AIS

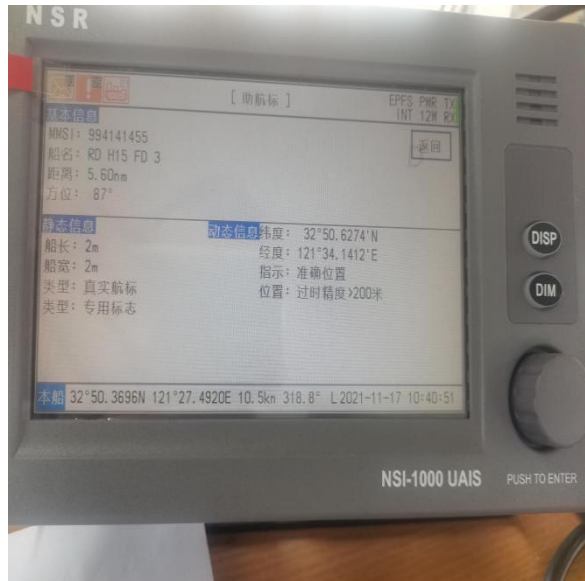


Figure 5-8 Shipboard AIS information

Before the operation, the relevant navigational beacon administrators, navigational beacon user representatives, and professional and technical personnel who need to climb should wear life jackets, wear safety belts, wear safety helmets, and check the necessary instruments before the on-site technical inspection. In the process of checking, as shown in figure H15 wind far as, for example, of the 3 lights piles with the naked eye visual way in no less than 1 nm revealing itself in the stadia, comparing with the standard color chip to observe whether the color is bright, logo shape is not incomplete, the main structure are in good condition, used to determine whether they meet the relevant acceptance criteria. Staff on-site determination through the climbing lanterns pile technology, according to design requirements and specifications, using Trimble refused tianbao JUNO handheld GPS instrument to measure wind electric pile location verification, use multimeter to the modulator work current voltage measurement comparison is normal, the night through the use of tiger kok stopwatch to beacon light qualitative cycle measurement and video recording, Judge whether its night range meets the requirements of 5 nautical miles, whether the average cycle is accurate, whether the recognition effect meets the requirements, and accurately record in the visual navigation technology determination table. Figure 5-7 shows a recent photo of No. 3 beacon. It can be seen from the photo that the beacon is equipped with AIS beacon. In the determination process, it should first observe whether the NINE-digit code (MMSI) of AIS navigation beacon is consistent with the administrative approval document, and record the inconsistency in time. For the AIS signal stability of this beacon, shipborne AIS should be used to observe, accept and record and analyze each AIS radio beacon. It is used to judge whether AIS beacon signal is stable and work continuously. AIS navigational beacon collects the working state information of navigational beacon through the controller and forms the message, which is sent to the AIS base station through addressing. Its related dynamic and static information is received by the AIS of the berth, and its record table is shown in Figure 5-8.

5.5 Maintenance summary after measurement

测试的RTU遥测信息

单位:	连云港航标处	全部	标名或RTUID:	H15#	查询				
状态:	全部航标	正常	异常类型:	全部	电压异常	漂移	超时	无遥测数据	导出
遥测遥控方式:	全部	属性:	测试	非代管	测试	非代管			

单位	航标名称	航标编号	设备编号	测测位置	灯工作状态	蓄电池电压	工作电流	遥测方式	上传时间	状态	报警信息	连续报警	查看
连云港航标处	RD H15 FD 6 (AIS)	1111.994141457	994141457	32°47'38.29"N 121°35'39.80"E	灭	8.29	0	AIS航标	2022/3/21 15:17:30	正常	0	查看	
连云港航标处	RD H15 FD 4 (AIS)	1111.994141456	994141456	32°50'37.46"N 121°35'36.35"E	灭	8.12	0	AIS航标	2022/3/21 15:19:32	正常	0	查看	
连云港航标处	RD H15 FD 1 (AIS)	1111.994141454	994141454	32°47'39.73"N 121°30'14.08"E	灭	8.09	0	AIS航标	2022/3/21 15:12:31	正常	0	查看	
连云港航标处	如东H15风电9号灯桩	1111.1432148	1432148	32°48'0.51"N 121°30'54.16"E		6.588	0	一体化北斗	2022/3/21 15:06:06	正常	0	查看	
连云港航标处	如东H15风电7号灯桩	1111.1432146	1432146	32°47'38.69"N 121°34'12.53"E		6.58	0	一体化北斗	2022/3/21 15:14:48	正常	0	查看	
连云港航标处	如东H15风电8号灯桩	1111.1432147	1432147	32°47'39.70"N 121°32'23.40"E		6.592	0	一体化北斗	2022/3/21 15:12:31	正常	0	查看	
连云港航标处	如东H15风电2号灯桩	1111.1432141	1432141	32°49'7.51"N 121°32'9.13"E		6.448	0	一体化北斗	2022/3/21 15:10:44	正常	0	查看	
连云港航标处	RD H15 FD 9 (AIS)	1111.994141458	994141458	32°48'0.32"N 121°30'54.07"E	灭	8.06	0	AIS航标	2022/3/21 15:17:33	正常	0	查看	
连云港航标处	如东H15风电6号灯桩	1111.1432179	1432179	32°47'38.45"N 121°35'39.49"E		6.54	0	一体化北斗	2022/3/21 15:14:48	正常	0	查看	
连云港航标处	如东H15风电1号灯桩	1111.1432140	1432140	32°47'39.76"N 121°30'13.74"E		6.504	0	一体化北斗	2022/3/21 15:10:10	正常	0	查看	
连云港航标处	如东H15风电5号灯桩	1111.1432144	1432144	32°49'6.37"N 121°35'38.35"E		6.564	0	一体化北斗	2022/3/21 15:13:36	正常	0	查看	
连云港航标处	如东H15风电3号灯桩	1111.1432142	1432142	32°50'37.68"N 121°34'8.22"E		6.528	0	一体化北斗	2022/3/21 15:09:54	正常	0	查看	
连云港航标处	如东H15风电4号灯桩	1111.1432143	1432143	32°50'37.47"N 121°35'36.31"E		6.464	0	一体化北斗	2022/3/21 15:04:02	正常	0	查看	
连云港航标处	RD H15 FD 3 (AIS)	1111.994141455	994141455	32°50'37.57"N 121°34'8.62"E	灭	7.91	0	AIS航标	2022/3/21 15:17:35	正常	0	查看	

连续报警2至4天 连续报警5至7天 连续报警7至14天 连续报警14天以上

海区: 测试RTU总数1674 (正常299, 异常1370)
连云港航标处: 测试RTU总数420 (正常230, 异常190)

Figure 5-9 Rudong H15# offshore wind farm lamp pile telemetry remote control platform

After the end of the on-site measurement, the technical requirements for the maintenance of navigational mark will be followed: floating visual navigation mark shall be implemented in accordance with the provisions of the Maintenance Regulations for coastal floating visual navigation mark ; Fixed visual navigation mark shall be implemented in accordance with the provisions of Maintenance of Fixed Structures for navigation mark in Maritime Areas. According to the relevant requirements of the design and specifications of the administrative license approval documents, the overall objectives and indicators of the maintenance of navigation mark are investigated online and offline in the later stage to determine whether the normality rate of navigation mark is not less than 99.0% and whether the normality rate of navigation mark is not less than 99.5%.

In the later period, the grass-roots navigational beacon administrator will record the data through the 24-h real-time monitoring of the telemetry and remote control platform of navigational beacon, as shown in Figure 5-9. navigation mark such as position, coloring, structure, lighting and radio signal are inspected for their integrity through online patrol. Conduct regular site inspection, local maintenance or parts replacement of the structure, facilities and equipment of navigation mark through site inspection. Use the beacon workshop to carry out the overall replacement or maintenance of the beacon regularly implemented in the full life cycle of the beacon (i.e.the service life of the fan), including lifting replacement of buoys and repair and repair of fixed signs, etc. Emergency response should be carried out within a certain time for the telemetry and remote control platform alarm beacon.

After the trial operation of the test navigation mark for a period of time, the visual navigation mark will be recorded in the visual navigation mark technical determination table after the acceptance of the test items of navigation mark . The AIS navigation mark technical determination table will be issued for the navigation mark installed with AIS on the lamp pile, and the technical determination report will be summarized and issued. Prepare the PPT of expert review report on the acceptance of navigation mark. The acceptance team of navigation mark effectiveness evaluates the overall navigation mark effectiveness of navigation mark by all experts through reviewing engineering data, verifying the effectiveness of the determination of navigation mark technology, as well as the introduction of relevant units and the feedback of users, and forms the concluding opinions on the acceptance of navigation mark effectiveness.

Through on-site technical determination condition check, some H15 # offshore wind farm beacon for effectiveness evaluation, and to inspect the relevant approval documents, data, navigation mark performance acceptance of the expert group thinks by accurately, light quality, and the normal, bright color, good structure, coding, accurate, clear display, main performance in accordance with the sea beacons performance acceptance specification, the requirements of the relevant The effectiveness check result is qualified.

6、summarized

Located in some of the east China sea in jiangsu lianyungang beacon navigation security center some beacon station will continue to provide technical support for project dedicated beacons, prepared to performance acceptance and determination of technical work, accumulate experience, communication and coordination with the local maritime departments actively, promote the development of maritime supervision and fusion navigation security integration. To ensure the high-quality development of China's offshore wind power industry, fulfill the function of navigation support, expand the economic scope of beacon enabling, provide more effective navigational support for the safe navigation of ships, better serve the development of local economy, and boost the construction of a strong maritime province.

The distribution of navigational markers for offshore wind farms is of great significance to environmental protection, optimization of regional energy structure, promotion of industrial upgrading and acceleration of sustainable development of local economy and society. navigation markperformance acceptance of wind turbines through will own safety guaranteed, prompting power at the same time also promoting regional stability control waters ship navigation safety, more service national clean energy strategy with "four elements" of qualified beacons on cloth, can make the ship more quickly identify, the waters of navigation safer, TongGang is more efficient.

References:

- [1] Jiang J Y. Study on the distribution of navigational markers during construction of Zone A of Changle Offshore Wind Farm in Fujian province [D]. Dalian Maritime University,2020
- [2] Chen Zhuobo, Lin Wenhuan. Discussion on the maintenance and management of navigational markers of Yangjiang Offshore Wind Farm [J]. Pearl River Waterway,2019(08):47-48.
- [3] Jiang Aiwen, Li Qiang. Research on navigation mark setting scheme of offshore wind farm [J]. Fujian Transportation Science and Technology,2019(02):131-133.
- [4] Zheng Decai, LI Qizhen. China Maritime,2021(12):59-62. (in Chinese)
- [5]JT/T 759-2009, Code for Acceptance of Maritime navigation mark Efficiency [S].

Author's Biography

Name: Wang Zhengpeng

Working Unit: Rudong Beacon Management Station, Lianyungang Beacon Office, East China Sea Navigation Support Center

Address: Rudong Beacon Management Station, Changsha Town, Rudong County, Nantong City, Jiangsu Province

Telephone: 15351809557

E-mail: 1010112783@qq.com