Autonomous Ships in China: Policies and Regulations

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Abstract: The Chinese government and relevant industries have actively dealt with the challenges posed by autonomous ship technology and issued many important policies and regulatory documents. This paper studies the research and development policies, norms, standards and regulatory actions for autonomous ships in China. It is found that the current legal system of China is generally applicable to autonomous ships, but some rules ought to be amended and supplemented. In view of the problems with the application of China's maritime management legal rules and main system of maritime law to autonomous ships, this paper also offers certain relevant actions.

Keywords: autonomous ships polices regulations

0. Introduction

The technology of autonomous ships has evolved considerably in recent years. The world's first 10000-ton intelligent ship was certified by London Classification Society and put into service in December 2017. Norwegian shipping companies, Wilhelmsen Group and Kongsberg Group, established the first autonomous shipping company in the world in joint venture——"Massterly", fully operational in August 2018. Japanese shipping company, Nippon Yusen Kaisha （NYK） published in its official website that they had successfully conducted the globally first maritime autonomous surface ship test according to relevant temporary guides from International Maritime Organization (IMO) in September 2019. In April 2020, Silver Origin, a cruise ship owned by Royal Caribbean Cruises Ltd of the Netherlands, successfully carried out the world's first remote control sea trial of a cruise ship.

In China, Asia's first, world's largest autonomous ship offshore test site ——Zhuhai Wanshan Intelligent Ship Offshore Test Site announced the opening, and the China Classification Society(CCS) awarded the test site service supplier certification on 1st December 2018. On December 15, 2019, JIN DOU YUN 0 HAO, China's first autonomous cargo ship, successfully completed the first autonomous cargo transportation on Dongao Island in Zhuhai . In May 2020, the construction of China's first autonomous container merchant ship, named ZHIFEI, began in Qingdao.

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In order to meet the challenges emanating from the technological development of autonomous ships, the international community and States have all been actively exploring, making and perfecting relevant regulations and standards. In terms of the rules and standards of international conventions, the IMO has constituted a working group on maritime autonomous surface ship (MASS). Defined and classified, MASS started combing and analyzing the relevant regulations and applicability of MASS, and prepared a trial guidelines for its operations. Moreover, the International Association of Classification Societies issued 12 proposals on ship network security. International Standardization Organization, International Electrotechnical Commission, International Telecommunication Union and so forth have all been initiated to make relevant standards for autonomous ships.

As a large shipping country, China has also devoted full attention to the development of autonomous ships, issuing relevant policies, regulations and guidelines to support the autonomous ships successively in recent 5 years. Meanwhile, the statutory rules are also under intense review. This essay introduces and discusses the research and development policies, regulations, standards and legal reactions related to Chinese autonomous ships.

1. Research and Development Policies and Current Relevant Standards of Autonomous Ships in China

1-1. *Rules for Intelligent Ships 2015* by CCS

On March 1, 2016, *Rules for Intelligent Ships 2015* (*The 2015 Rules* in short) drafted by CCS officially came into effect. *The 2015 Rules* is the first rule of intelligent ship in the world.[1] It is an open rules, adopting goal-based standards method. In terms of function, *The 2015 Rules* divides the intelligent ship into six parts: intelligent navigation, intelligent hull, intelligent machinery, intelligent energy efficiency management, intelligent cargo management and intelligent integrated platform, and regulates the general requirements, functional notation, plans and documents, survey and test of each function in six chapters. CCS has also successively formulated *Guidelines for Surveys of Intelligent Machinery of Ships 2017*, *Guidelines for Surveys of Intelligent Integrated Platforms 2018*, *Guidelines for Surveys of Intelligent Energy Efficiency Management of Ships 2018*, *Guidelines for Surveys of Intelligent Cargo Management of Ships (Oil Tankers) 2018* and *Guidelines for Requirement and Security Assessment of Ship Cyber System 2020* to supplement and crystallize *The 2015 Rules*.

On March 1, 2020, *Rules for Intelligent Ships 2020* (*The 2020 Rules* in short) came into effect. Under the framework of the original rules, two more functions (remote control and autonomous operation) were added, and the corresponding general requirements, additional requirements for different functional notations, provision and performance of equipment, and survey and test requirements were provided in detail.

1-2. *Inspection Guide for Unmanned Surface Vehicle 2018* by CCS

Inspection Guide for Unmanned Surface Vehicle 2018 (The USV Guideline in short*)* compiled by CCS formally came into force on January 1, 2018. *The USV Guideline* proposes requirements in respect of class survey, general objective and function requirement, communication system, control system, vehicle body, marine engine,

[1] Ma Jinxing, 'Artificial Intelligence Ship Leads Reform of International Maritime Regulation System', China Ocean News, 2019-10-08.

electrical engineering, navigation and signal equipment, and endowing different additional marks on account of different navigation mode (autonomous voyage, remote control) and distance from the shore. On August 1, 2018, the first change notification of *The USV Guideline* came into effect, adding classification characters, additional marks and examination requirement.

The USV Guideline only applies to the design, building and examination of vehicles greater than or equal to 5 metres but less than 20 metres length, vehicles beyond such scale could be executed by reference. *The USV Guideline* covers each stage including drawing review, product inspection and post construction inspection and consider respectively on account of the 3 parts of autonomous surface vehicle. That comprises communication system, control system and platforms (containing vehicle body, marine engine, electrical engineering, navigation and signal equipment) to conduct risk assessment and propose specific safety technical requirements.

1-3. *Guidelines for Autonomous Cargo Ships 2018* by CCS

On October 1, 2018, *Guidelines for Autonomous Cargo Ships 2018,* drafted by CCS, became effective. The guideline applies goal-based standards method. Toward covering technical requirements of autonomous ships of degree 3 and 4[1], the guideline provides goal, functional requirements, prescriptive requirements to achieve functions and survey and test requirements. Chapters include: situation awareness, navigation control, machinery installations, mooring and anchoring, electrical installations, communication and signal equipment, hull construction and safety, fire-fighting, environmental protection, ship security, remote operation center, cyber security, etc.

1-4. *Intelligent Ship Development Action Plan 2019-2021*

Intelligent Ship Development Action Plan 2019-2021 (Ship Development Action Plan in short*)* was jointly issued by the Ministry of Industry and Information, the Ministry of Transport and State Administration of Science, Technology and the Industry for National Defense on December 27, 2018, which provides comprehensive instructions for the development plan of intelligent ship, ranks the establishment of intelligent ship standard system as action objective and key task, and explicitly proposes to research and study Construction Guidelines for intelligent ship code and standard system.

Ship Development Action Plan analyses and judges current development with intelligent ship and indicates that global intelligent ship is still explored and developed at a primary stage. Hereon, China shall accelerate the development of intelligent ship industry and seize the development highland of global intelligent ship industry. *Ship Development Action Plan* clearly puts forward to, after 3 years, form top development project of China intelligent ship, preliminarily establish intelligent ship code standard system, break through core technologies including navigation intelliSense and autonomous berthing and disdocking, etc., finish developing relevant key intelligent equipment system, realize typical sites pilot demonstration of remote control and autonomous voyage and other functions, expand the demonstration and promotion of typical intelligent ship "One Platform + N intelligent application", preliminarily form the

[1] In order to facilitate the regulatory scoping exercise of MASS, the Maritime Safety Committee of IMO divides MASS into four autonomy degrees: 1.Ship with automated processes and decision support; 2.Remotely controlled ship with seafarers on board; 3. Remote controlled ship without seafarers on board; 4. Fully autonomous ship.

intelligent ship comprehensive test and verification capability of virtual and reality combination, shore and sea integration; furthermore to keep China's development of intelligent ship up with advanced global standards..

1-5. *Action Plan for Promoting Intelligent Transformation of Ship Grand Assembling and Construction 2019-2021*

On December 27, 2018, the Ministry of Industry and Information Technology (MIIT) and the State Administration of Science, Technology and the Industry for National Defense jointly issued the *Action Plan for Promoting Intelligent Transformation of Ship Grand Assembling and Construction 2019-2021* (*The Transformation Action Plan* in short). *The Transformation Action Plan* provides a comprehensive guidance for the development planning of intelligent transformation of ship assembly, and sets a main goal of initially establishing a technical innovation system and standard system for ship intelligent manufacturing, to speed up the improvement in shipbuilding technology.

The Transformation Action Plan puts forward 15 key tasks in five aspects and stipulates five key columns. The five aspects include: overcoming the key common technology and equipment weaknesses of intelligent manufacturing; consolidating the foundation of intelligent manufacturing; promoting the full three-dimensional digital design; accelerating the construction of intelligent workshop; and promoting the digital integration and service of shipbuilding. The five key columns include: key research and development of critical basic technologies for ship intelligent manufacturing; key research and development of weak equipment for ship intelligent manufacturing; key construction of shipyard information infrastructure; key construction of ship intelligent manufacturing standard system; and key emphasis on promoting full three-dimensional digital design.

1-6. *Guidance on the Development of Intelligent Shipping*

On May 9, 2019, the Ministry of Transport and other seven departments jointly issued *Guidance on the Development of Intelligent Shipping* (*Intelligent Shipping Guidance* in short), which clarified the overall requirements, main tasks and safeguard measures for the cultivation and development of intelligent shipping.

According to *Intelligent Shipping Guidance*, by the end of 2020, the top-level design of intelligent shipping development will be basically completed; by 2025, a number of key technological challenges restricting the development of intelligent shipping will be tackled to become a global intelligent shipping development and innovation center; by 2035, the core technology of intelligent shipping will be comprehensively mastered, and the technical standard system of intelligent shipping will be relatively perfect; by 2050, a high-quality intelligent shipping system will be formed. *Intelligent Shipping Guidance* defines ten main tasks, covering top-level design, technology application and innovation, safeguard measures, regulations and supervision mechanism, personnel training and other aspects.

1-7. *Guidance for the Construction of Standard System of Intelligent Ship (Draft for Comments)*

In September 12, 2019, the MIIT of PRC released *Guidance for the Construction of Standard System of Intelligent Ship (Draft for Comments)* (*Intelligent Shipping Guidance* in short). On April 30, 2020, the equipment industry department of MIIT and standards and technology department of the State Administration for Market Regulation issued a new version of *Intelligent Shipping Guidance.* Both Guidelines stipulate the overall

requirements, system framework, construction content and organization implementation of intelligent ship standard construction.

According to the new *Intelligent Shipping Guidance*, the construction goal is divided into two stages, each stage has different objectives. The first stage is from 2020 to 2021: It is required to form support for basic common standards such as definition of terms, classification of intelligent ships, and attain breakthroughs in the application standards of key technologies of intelligent ships. Equally, intelligent ship design, intelligent ship borne systems and equipment, and intelligent ship test and survey standards should meet the needs of real ship construction. The second stage is from 2022 to 2025, which requires the basic commonness of intelligent ships, application of key technologies, intelligent ship design, intelligent shipborne systems and equipment, formation of intelligent ship testing and verification standard system, improvement in shore-based service and operation management standards, and the further improvement in standard system.

The new *Intelligent Shipping Guidance* divides the framework of the standard system into three levels: the top level of the standard system, seven parts and 38 specialties and fields. The construction content includes seven parts :(1) basic common standards; (2) key technology application standards; (3) intelligent ship design standards; (4) intelligent shipborne system and equipment standards; (5) intelligent ship test and verification standards; (4) shore based service standards; (5) operation management standards.

Through the above contents of policy documents, specifications and guidance, it can be realized that the relevant departments of the Chinese government attach great importance to the development of intelligent ship, stressing the need to have the top-level design, focusing on the common research and application of key technologies. The test field, ship inspection specifications, standard system construction or other aspects are all fully guaranteed. To a certain extent, the formulation of policies, norms and standards is ahead of the development and design of autonomous ships.

2. The Legal Status of Autonomous Ships under Chinese Law

At present, there is no special law on autonomous ships, whether domestic legislation or international treaties. In addition to China's participation in international conventions on marine pollution prevention , safety and civil liability(e.g. UNCLOS 1982、MARPOL73/78、STCW、SOLAS、MLC、OPRC 1990、CLC、BANKER CONVENTION, etc.), the management class law is mainly related to *Maritime Traffic Safety Law of the People's Republic of China, Marine Environment Protection Law of the People's Republic of China, Regulations of the People's Republic of China on the Prevention of Vessel--Induced Sea Pollution, Regulations on registration of vessels, Regulation of the People's Republic of China on Seamen, Regulations of the People's Republic of China Governing Survey of Ships and Offshore Installations and Vessel Inspection Administration Regulation*, etc.; The law relating to the civil liability of ship operation is mainly *Maritime Code of the People's Republic of China*. Does China's current law apply to autonomous ships? This essentially depends on whether the relevant "ship" concept in Chinese law applies to autonomous vessels.

2-1. The Application of Maritime Management Laws to Autonomous Vessels

The international working group on unmanned vessels of CMI, describes unmanned vessels as "those which are capable of controlled movement over water without any crew on board". According to this definition, the following four elements can be summarized: (1) on the water; (2) movable; (3) movement is controlled; (4) no crew. According to the way of control, autonomous ship can be divided into remote-controlled autonomous ship

and self-controlled autonomous ship (fully autonomous ship). The remote-controlled autonomous ship is a shore-based controller that controls the movement of the ship remotely, while the fully autonomous ship moves itself without manual intervention in accordance with pre-written procedures. Compared with ordinary ships, the more controversial issue is whether the absence of a crew member on board affects the formation of a "ship".

Article 50 of the *Maritime Traffic Safety Law of the People's Republic of China* stipulates that "ship" means "all kinds of displacement or non-displacement vessels, rafts, seaplanes, submersibles and mobile platforms". "Vessels" as defined in section 56 of the *Regulations on Registration of Vessels* are "all types of motor, non-motor vessels and other marine mobile devices, other than life craft rafts and craft rafts of less than 5 meters in length"; Article 29 of the *Regulations of the People's Republic of China Governing Survey of Ships and Offshore Installations* stipulates: "vessels refer to all types of displacement or non-displacement vessels, boats, seaplanes, submersibles and mobile platforms". The above definition of "ship" does not include the requirement of carrying a crew. Therefore, from the perspective of literal interpretation, whether it is a remote-controlled autonomous ship or a fully autonomous ship, whether or not the crew is on board. Accordingly, "autonomous ship" should belong to the adjustment object of the above laws and regulations.

In the questionnaire issued by CMI, question 1.1 asks that would an unmanned cargo ship in excess of 500 gross ton constitute a "ship" under your national merchant shipping law? Apart from Croatia, which gave a negative answer, 18 other countries, including China, considered it to be a ship.[1] Reasoning from the above analysis, since the autonomous ship constitutes a ship, China's current maritime management law should apply to autonomous ship. However, at the same time, we should also pay attention to the problems with the application of domestic maritime management laws for autonomous vessels, including but not limited to: limitation of ship manning requirements; restrictions on ship manning requirements; crew qualifications, crew disability compliance; difficulties in obtaining the nationality of the ship; and lack of specific technical rules for ship inspection.

2-2. Application of Civil Liability Law to Autonomous Vessels

Maritime Code of the People's Republic of China(CMC) is the most important source of civil liability related to ships, among which article 3 stipulates: "ships as used in this Law" refers to ships and other marine mobile devices, with the exception of ships used for military and government services and small vessels of less than 20 gross tons. The legislative plan of the standing committee of the 13th National People's Congress (NPC) was released on September 7, indicating that 47 types of legislative items need to be submitted for deliberation when conditions are ripe for urgent work. However, the definition of "ship" has not been changed in the draft amendment to the maritime law initiated by the Ministry of Transport. Therefore, like maritime management laws, there is no requirement for the crew to be equipped in the definition of "ship" and autonomous ships meet the definition of ship in *CMC*.

3. Thoughts on the Reaction of Chinese Maritime Management Legal Rules to Autonomous Ships

[1] Summary Of Responses To The CMI Questionnaire. https://comitemaritime.org/work/unmanned-ships/.Date of visit：2019.11.13.

After the above analysis, although the autonomous ship belongs to the ship, the current direct application of the maritime management law will cause some discomfort. At present, most of the vessels in the trial navigation phase are remote-controlled autonomous vessels. Fully autonomous vessels are difficult to commercialize on a large scale for a long time. Even some people believe that we may never see fully autonomous ocean freighter.[1] For a long time in the future, it is more likely that there will be a situation where remotely controlled autonomous vessels coexist with manned vessels. Therefore, this paper mainly proposes the countermeasures for the Chinese maritime management legal rules for remote-controlled autonomous ships, and appropriately reserves space for the development of fully autonomous ships.

3-1. Crew and Crew Duties

In the traditional shipping field, cargo ships are equipped with crew sailing. Chinese domestic law also requires ships to be equipped with a sufficient number of crew members. For example, Article 6 of the *Maritime Traffic Safety Law* stipulates that "ships should be equipped with qualified crew members sufficient to ensure the safety of ships in accordance with the standard quota". This raises a question: from the perspective of system interpretation, does the clause mean that the provision or ability to equip the crew is a component of the ship?

We should look at this issue in combination with the two qualifications of "standardized quota" and "sufficient to ensure ship safety". "Standardized quota" means that the number of crew members varies according to different situations, as stipulated in Article 6 of the *Minimum Safe Manning Rules for Ships*: "The minimum safe manning standard for ships shall be considered in consideration of the type and tonnage of the ship, technical conditions, main propulsion power, flight area, voyage, sailing time, navigation environment and crew duty, rest system and other factors." Considering the special type of ship the autonomous ship is, the advanced technical level, and no need to take into account the advantages of the crew's rotation, it is understandable to reduce the number of crew members when determining the manning of the autonomous ship until the crew is not present. "Ensure the safety of the ship" points out the purpose of the crew, and this is the advantage of the autonomous ship. According to statistics, it is generally believed that about 80% of marine accidents are caused by human factors. According to the "Annual Report on Maritime Casualty Accidents of 2019" recently issued by the European Maritime Safety Administration, 65.8% of the total of 4104 accidents analyzed during the investigation were attributed to mistakes. [2] Autonomous ship technology eliminates interference from human factors, and is more conducive to ensuring the safety of ships.

At the same time, due to the absence of the crew, the provisions of the Crew Regulations on the qualification of crew members, crew duties, crew training, etc. are also not applicable. For the shore-based controllers of remote-controlled autonomous ships, whether they belong to the crew, there is no international conclusion.

From the perspective of international law, the current STCW Convention applies only

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[1] Wo Shen admiralty. Opinion: Why do we never see a completely autonomous ocean freighter? https://mp.weixin.qq.com/s?__biz=MjM5NTQ3MzYxMA==&mid=2650708166&idx=1&sn=550b5f8b6db5ad738fefb0150b99e6bb&chksm=befdc963898a407594a5dde0fd08e736bc2d6d4e6d9213f3378ddf08d08c81633cc41c07420d#rd. Date of visit: 2019.11.13. The views in this article are derived from: CDR David Dubay, USCG Maritime Security, Russia, Arctic.

[2] Annual Overview of Marine Casualties and Incidents 2019, published in the maritime service network CNSS, Date of visit: 2019.11.11.

to crew members on board ships, but it may also be revised to cover shore-based control personnel. [1] The IMO Maritime Autonomous Navigation Ship Inter-Working Group meeting held in September 2019 discussed the definition of the crew in the STCW Convention. The Working Group believes that if the shore-based controller is identified as a crew member and the STCW Convention is applied, the terms of the ship must be discussed again. Eric Van Hooydonk believes that for shore-based control personnel who assume overall responsibility for autonomous ship navigation, the definition that the "captain" has the highest level of position in the ship's navigation is broad enough to cover shore-based control personnel. At the same time, Hooydonk mentioned that, on the one hand, shore-based control personnel are exempted from the burden of the international environment, physical health, safety risks, discipline, long-term work on board and away from home, family and social life. Therefore, it is difficult to find effective reasons to incorporate it into the adjustment of maritime law; on the other hand, shore-based controllers also need to have good judgment, communication, decision-making ability and necessary nautical knowledge and information technology knowledge like traditional captains to take responsibility for transportation, collision avoidance, pollution prevention and so on.[2] Some scholars believe that even in traditional ships, although the captain is responsible for the overall navigation, the captain is not always in the cab. However, the captain does have an important security role on the ship because the coastal state has the object of the enforcement of criminal liability. The shore-based control personnel of the autonomous ship can be identified as the captain, but the issue of the criminal liability must be resolved.[3]

At the domestic law level, the International Maritime Committee issued a questionnaire to investigate whether the shore-based controllers constitute the "Captain" (question 1.4.1) and the "Crew" (question 1.5) of the domestic law. According to the survey results, only 3 out of the 19 countries surveyed (including China) defined the "captain" as a person on board, and the maritime law associations in 6 countries indicated that they believed that the chief shore-based controller might constitute the captain. The Maritime Law Association of 10 countries (including China) replies that they have the definition of "crew" in its domestic law, and apart from Brazil which stipulates that the crew is clearly required to be on board, the Maritime Law Association of 8 countries (including China) considers that the definition of the crew cannot cover the shore-based controllers. It is obvious that the definition of "crew" and "captain" in domestic laws is quite large, which results in different legal status of shore-based control personnel in various countries.

Domestic scholars also have inconsistent views on this issue. Some scholars believe that the concept of the crew is composed of "equipped for the ship and employed in the ship",[4] the shore-based personnel have a big difference with the crew in terms of working conditions and environmental risks. It is not appropriate to directly define the shore-based personnel as crew members in the sense of the Convention, but more appropriate to define

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[1] Allen, Craig H, 'Determining the legal status of unmanned maritime vehicles: formalism vs functionalism'(2018) 49 *Journal of Maritime Law and Commerce* p 489.

[2] Eric Van Hooydonk, 'The law of unmanned merchant shipping - an exploration' (2014) 20 *Journal of International Maritime Law* p 413.

[3] Robert Veal, Michael Tsimplis, 'The integration of unmanned ships into the lex maritima' (2017)2 *Lloyd's Maritime and Commercial Law Quarterly* p 318.

[4] Wang Xiufeng, 'The analysis of the Legal Concept of Seafarers'(2010)11 *Social scientist* p 85.

them as the general management personnel of the shipping company.[1] Professor Wang Guohua of Shanghai Maritime University believes that if the autonomous ship is controlled by the shore-based control personnel, the shore-based control personnel bear the same responsibility as the crew. Based on the principle of "rights being equal to liabilities", the legal status of the crew should be recognized to some extent.[2] In addition, giving the shore-based control personnel the legal status of the captain requires them to have a good boat skill comparable to that of the captain, and could also promptly respond to the danger and urgency of the collision of the autonomous ship.[3]

Of course, even if the shore-based controller is identified as a crew member, the shore-based controller is quite different from the crew on the traditional ship. The two are in different jobsites, and the risks they face, the skills they need to master, the consequences of negligence or fault, etc. are also quite different. Therefore, the provisions of the Crew Regulations on the qualifications, duties, training and other aspects of the crew cannot be directly applied.

Therefore, this paper proposes to add the exemption clause in the "Ship Minimum Safe Manning Rules". As long as the autonomous ship can technically meet the safety standards stipulated by domestic and foreign laws and it is enough to ensure the safety of maritime navigation, the "minimum safe manning" is no longer required.

The obligations of the crew in the Crew Regulations cannot be directly applied to shore-based controllers. For the common parts of shore-based control personnel and traditional crew members (such as the duties of managing and driving ships), reservations shall be applied, and for differentiated parts such as qualifications and training, additional provisions shall be made separately.

3-2. Ship Registration and Nationality

Article 5 of the *Maritime Traffic Safety Law* stipulates: "a ship must hold a certificate of its nationality, or a certificate of its registration, or a ship's license." Article 3 of the *Regulation on Vessel Registration* stipulates that "only when a ship which has been registered according to law and acquired the nationality of the People's Republic of China can sail under the national flag of the People's Republic of China"; Article 49 provides that "those who sail under the flag of the People's Republic of China while pretending to be the nationality of the People's Republic of China shall be confiscated by the ship registration authority according to law." The provisions of the preceding paragraph shall be applied to vessels of Chinese nationality that sail under the flag of a foreign country while passing themselves off as foreign nationality, further emphasizing that vessels shall be registered according to law and acquire nationality. As mentioned above, an autonomous ship meets the relevant definition of ship, so it absolutely could and should be registered as a ship which can obtain nationality for navigation in accordance with the law."

Article 38 of the *Regulation on Vessel Registration* stipulates that "shipowners who apply for ship nationality shall submit relevant materials in accordance with article 15 of the *Measures of the People's Republic of China for the Registration of Vessels*". Article 15

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[1] Zheng Shijiang, 'On the Legal Status of Unmanned Vessels and the Application of the Convention'(2019)05 *Legal system and society* p 207.

[2] Wang Guohua, Sun Yuqing, 'The legal conflict and coordination of unmanned cargo carriers'(2019)01 *Chinese navigation* p 79.

[3] Wang Guohua, Sun Yuqing, 'The responsibility related to unmanned collision'(2019)02 *Journal of Shanghai Maritime University* p 126.

of the regulations on the registration of ships respectively stipulates the technical certificate required by the shipowner to apply for the nationality of a ship for international and domestic navigation. According to the *Maritime Administrative Licensing Discretion Benchmark* issued and implemented by the Ministry of Transport on January 10, 2017, the issuance of the ship's nationality certificate shall meet four requirements :(1) the ship has registered its ownership subject to law; (2) the ship has the seaworthiness in technical conditions and passed the inspection of the ship inspection institution; (3) the ship does not have any circumstances that cause dual nationality or more than two ports of registration; (4) the registrant of the nationality of the ship shall be the owner of the ship. The last two conditions are the restrictions on the behavior of the ship owner and shall not be discussed. According to the first two conditions, if an autonomous ship needs to obtain the nationality of a ship, it shall not only register the ship according to law, but also have the seaworthiness in technical conditions, pass the inspection of an authorized institution and issue the relevant technical certificate. Currently, China's inspection standards for ships include *Technical Rules for Statutory Survey on Seagoing Vessels Engaged in Domestic Voyage* and *Technical Rules for Statutory Survey on Seagoing Vessels Engaged in International Voyages*, but the inspection standards for autonomous ships are absent. Though CCS has issued *Rules for Intelligent Ships, the USV Guideline* and *Guidelines for Autonomous Cargo Ships*, they cannot be seen as legal basis used for statutory survey.

Article 7 of the *Regulation on Vessel Registration* stipulates that "seafarers of Chinese nationality who are required to hold certificates of competency must hold corresponding certificates of competency of seafarers of the People's Republic of China". Therefore, it seems to be one of the necessary conditions for a ship to acquire Chinese nationality that the ship must have crew members who hold Chinese certificates of competency.[1] What this paper argues is pursuant to the crew on board a ship to hold certificates of competency requirements, also when no crew on board a ship, there is no need for the corresponding certificate of competency. Hence, the provisions is not about the number of crew on board a ship, which means that it is not necessary for a ship to have a Chinese nationality. Meanwhile, as mentioned in the *Maritime Administrative Licensing Discretion Benchmark* above, the seafarer is not regarded as a necessary condition for obtaining nationality.

To sum up, this paper suggests that China promulgates specific technical rules of statutory survey on autonomous vessels as soon as possible to avoid limiting the development of autonomous vessels.

4. Thoughts on the Reaction of Main Systems of *Chinese Maritime Code* to Autonomous ships

Chinese maritime code mainly regulates ship and maritime transport relations, which is the most important source of domestic law for civil liability related to ships. This part will analyze the applicability of the main system of *Chinese maritime code* to autonomous vessels and put forward some suggestions.

4-1. Seafarers

Article 31 of the seafarers in chapter III of the *Chinese Maritime code* stipulates that "the seafarers are all the officers of the ship including the master", which clearly stipulates that the seafarers are the staff working "on the ship". If this clause is strictly applied, the

[1] Wang Xin, Chu Beipin,'Legal barriers confronted by unmanned ships under trialing and reaction'(2017)03 *Chinese Journal of Maritime Law* p 62.

shore-based controller cannot be regarded as a crew of the ship if he is not on board. At the same time, however, shore-based controllers do perform the duties of the crew, such as the master's duties of "managing and steering" a ship, as stipulated in article 35. Since shore-based controllers do not work on the ship, they do not encounter the special risks at sea faced by the crew of traditional ships. Although they do perform the duties of the crew, it is worth exploring whether they can be equally protected as the traditional crew, or to what extent they should be protected.

According to this paper, the location and risk faced by shore-based controllers may be influencing factors of salary, but the captain's identity of shore-based controllers should not be affected. According to article 4 of the *Regulation of the People's Republic of China on Seamen*: "the master of the ship referred to in these regulations shall be the person who, in accordance with the provisions of these regulations, is qualified as a master and is responsible for the management and command of the ship." If shore-based controllers obtain appropriate certificates of competency and actually perform the duties of a master in the management and navigation of a ship, they shall acquire the status of a master. Therefore, article 31 of the maritime law should be amended: "seafarers shall be all personnel on board, including the master, and shore-based personnel who actually perform the duties of management and navigation."

4-2. The Contract of Carriage of Goods by Sea

The contract of carriage of goods by sea in Chapter IV of the *Maritime Code* maintains that the obligation of the carrier is "prudent handling to make the ship seaworthy". However, as the technology of autonomous vessels has not yet matured, it is uncertain what kind of standard should be adopted to confirm that the ship belongs to the "seaworthy" status. For instance, for fully autonomous vessels, what criteria should be used to determine whether the preset program is sufficient to properly complete the preset navigation task? In addition, it is also worth exploring the applicability of the exemption from liability for the management of the captain and crew, and the negligence of the navigation of the ship.

For the fully autonomous ship, there is no so-called captain and crew, so it is not necessary to give the carrier this exemption. As for the remote-controlled autonomous ship, the shore-based controller can be identified as the captain, so the carrier may be entitled to exempt from navigation negligence. However, on the one hand, the liability exemption system for maritime negligence is an ancient and special system. With the development of science and technology, people more often have disputes about it. *Hamburg Rules* and *Rotterdam Rules* have abolished the liability exemption for maritime negligence. According to statistics, China's judicial cases in the past 30 years, registered carrier claims of nautical fault exemption in 18 cases, while nautical fault exemption success is only 7 cases, including 1 case for bad weather and driving errors caused by many factors such as accidents. Only 1 out of the above 7 cases the carrier is Chinese ship owner.[1] Alternatively, with the development of science and technology, nautical fault exemption has a tendency to be abolished in the legislation, the application of the exemption is rarely strict in practice. Autonomous ship as a high-tech that should apply the exemption and comply with the trend. On the other hand, although shore-based controllers can be identified as the captain, their actual work place is not on the ship, and the instruments and equipment directly controlled by them are not on the ship. If there is a maritime accident, it is more

[1] ZHANG Yizhen, JIANG Zhengxion,'Reflections on Abolition of Fault Exemption System in Chinese Maritime Code' (2019)05 *ECUPL Journal* p 165.

likely to be caused by the product defect of the autonomous ship itself. For such high-tech products as autonomous ship, the product defect is closely related to "seaworthiness", and the carrier is more likely to fail in ensuring the "seaworthiness" of the ship hence, cannot enjoy this exemption.

Therefore, legislation or amendment should be made as soon as possible to confirm the "seaworthiness" standard of autonomous vessel, and cancel the exemption of captain and crew management and ship navigation of autonomous vessel carrier.

4-3. Collision of Ships

According to the relative regulations of Collision of Ships in Chapter 8 of the *Chinese Maritime Code*, in the relationship of collision of ships if one party of the collision is the ship regulated in the General Provisions of the *Code*, the other party can be extended to any ship that is not used for military or public purposes. Therefore, regardless of whether an autonomous ship is acting as a ship or as the other party that collides with the ship, the relevant provisions of the *Code* on ship collisions are always applicable to autonomous ships.

When considering the collision problem of autonomous ships, it must first be clear that even if the autonomous ship technology develops rapidly and can be commercialized on a large scale, the manned ships will not be completely eliminated. For a long time into the future, what will happen is a situation where autonomous ships coexist with manned ships. Under this premise, there are two situations worth considering in the collision of autonomous ships. One is the collision between autonomous ships and manned ships, and the other is the collision between autonomous ships. At the same time, as a highly intelligent technology product, for autonomous ships, in addition to applying the provisions of this Chapter on the fault liability of ship owners, if there is a problem with the quality of the autonomous ships, the regulations of no-fault liability of producers and sellers in *Chinese Tort Liability Law* may also apply.

Based on the premise stated earlier, the liability for collision between ships should be determined according to different situations: 1. When a collision occurs between an autonomous ship and a manned ship, the autonomous ship applies the principle of strict liability, and the manned ship applies the principle of fault liability, both parties bear joint and several liability for losses of any third party; 2. In the event of a collision between an autonomous ship and an autonomous ship, both parties shall apply the principle of strict liability to the loss of the third party, and shall bear joint and several liability; for loss of both parties, the two parties shall bear the responsibility according to the proportion of fault; 3. In the event of a collision of an autonomous ship, the producer, seller and owner of the autonomous ship shall bear joint and several liability, and they shall be liable for compensation according to their respective fault proportions; 4. The owner and operator of the autonomous ship shall have the right to limit their liability for maritime claims, and the responsibility of the producer and seller of the autonomous ship shall be subject to the provisions of the *Tort Liability Law* and shall not enjoy the right to limit their liability for maritime claims in the *Chinese Maritime Code*.

4-4. Salvage at Sea

According to Chapter 9 Article 174 of *Chinese Maritime Code*: " Every master is bound ,so far as he can do so without serious danger to his ship and persons on board, to render assistance to any person in danger of being lost at sea" As the salvor, the autonomous ship is not equipped with crew member. Since there is no crew member on the ship, is it necessary to apply the relevant provisions on lifesaving?

Question 3.3 of Summary of Responses to the CMI Questionnaire raised a similar question. The majority of MLAs stated that whereas the mere fact that the ship is unmanned does not discharge the master from providing assistance to persons in distress, the fact that the ship in unmanned may de facto limit the scope of the duty since it would be limited to what is inter alia technically possible; the designer of unmanned ships should have foreseen the situation that unmanned ship at sea has to provide assistance to person in distress. Japan and the United Kingdom, which have a positive attitude, believe that as the obligation is channeled to the master rather than the ship, and the master is the one who can provide assistance, eliminating the obligation of shore based remote controller.[1]

The purpose of salvage at sea is to do its utmost to deal with marine risks, reduce human and property losses, and prevent environmental pollution from expanding. For this purpose, autonomous ships, as a type of ship, should fulfill their rescue obligations within the limits of the technology. There are various methods for autonomous ships to fulfill their salvage obligations. For example, they can use the sensors on board to detect and monitor the situation of the victims and the ships, and provide information support for the salvage agencies. They can also be equipped with life-saving appliances such as small remote-controlled lifeboats and launch them if necessary to fulfill the obligation of assistance. In short, the autonomous ship should not be absolutely exempted from the obligation of salvage at sea, but the manner of performance can be appropriately changed.

As a rescued party, the relevant provisions on property relief and prevention of marine environmental pollution can be applied to autonomous ships. However, the party signing the salvage contract by the salvage party may no longer be the master, but may be the shore-based controller of the remote-controlled ship or the ship owner himself.

4-5. General Average

The premise for general average is that when the ship, goods or other property is involved in a common maritime adventure, the sacrifice or expenditure is intentionally and reasonably made or incurred by the master for the common safety and the purpose of preserving from peril. For remote-controlled autonomous vessels, the master's duties are transferred to shore-based control personnel, and it is still easy to judge whether it is "intentionally and reasonably" to take measures. The question is, how to judge that it is "intentionally" taking measures for a fully autonomous ship? If this judgment cannot be made, does the general average system no longer apply to fully autonomous ships? This paper suggests that when designing a fully autonomous ship, the relevant program sections of the general average shall be designed, and the starting conditions of the program shall be set as proof of the common average measures.

4-6. Marine Insurance

Compared with traditional ships, maritime perils of autonomous vessels have also changed. For traditional ships, human factors are the main cause of maritime accidents. However, the number of human-caused accidents on autonomous vessels will decrease due to the decrease or absence of crew. Correspondingly, due to the high dependence of autonomous ship on network information technology and automation technology, the network risk could become extremely serious. For example, a hacker might be able to hijack an autonomous ship by breaking into a ship's control system, rather than controlling a traditional ship by controlling its crew. However, the nature of hackers' control of autonomous ships through the Internet is currently highly controversial, and the results of

[1] See note 2 above.

a fact-finding may include piracy, theft, capture, seizure or detention.[1] This will make the insured of the autonomous ship get confused, and also discourage the insurance company, which is optimistic about the profitability of the autonomous ship industry, from signing the insurance contract to avoid related risks. But just as Inga Beale, Lloyd's chief executive points out, the problem does not lie with insurance companies, but rather with regulators and international law assenting that the technology is safe. If after research, sea trial and market integration, regulators accept that the technology of autonomous ship is safe, insurance companies can have enough courage to take risks in the development of autonomous ship technology.[2]

In recent years, the international community and China have equally devoted attention to ship network security. In December 2015, the International Association of Classification Societies (IACS) established the Cyber System Panel to supervise network security. At the beginning of 2016, The Baltic and International Maritime Conference (BIMCO) issued the world's first guidance on the cyber security of ships. In May 2017, the IMO Maritime Safety Committee at its 96th session adopted and subsequently issued a circular letter entitled *Guidelines on Maritime Cyber Risk Management*. In July 2017, CSS issued *Guidelines for Requirement and Security Assessment of Ship Cyber System*[3]. On May 1, 2018, *Guidelines for Survey of Intelligent Integral Platform* formulated by CSS came into effect, which specified detailed requirements on network and data. It can be noted that the network security of autonomous ships has a certain institutional guarantee, and the technical risks of autonomous ships borne by insurance companies would be correspondingly reduced.

Thereupon, this paper suggests that the nature of the intrusion into the autonomous ship through the network should be studied and confirmed, and the corresponding insurance program should be set up to share the network risk in the development process of the autonomous ship. An insurance company, of course, can also require that the autonomous ship network security system meets the standards as a precondition of insurance, such as requiring the design of autonomous ship's network security management system and the cybersecurity management of the company to fit the *Rules for Intelligent Ships*, *Guidelines for Survey of Intelligent Integral Platform*, *Guidelines for Requirement and Security Assessment of Ship Cyber System* and so on.

5. Conclusion

With the rapid development of autonomous ship technology, international organizations as well as countries are actively exploring and formulating relevant rules and regulations to cope with the challenges. The Chinese government and relevant industries also commit great attention to the problem of autonomous vessels. According to *Guidance for the Construction of Standard System of Intelligent Ship (draft for comments)*, the Chinese government has set the goal of basically forming a standard system for intelligent vessels by 2025.

Under the current Chinese law, autonomous vessels are generally applicable to the relevant legal system of ships. However, due to the lack of corresponding considerations

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[1] WANG Guohua, SUN Yuqing, Pirates in the 21st century: legal impediments to the navigation safety of unmanned ships(2018)04 *Chinese Journal of Maritime Law* p 108.

[2] Stephanie Guerra, Ready about, Here Comes AI: Potential Maritime Law Challenges for Autonomous Shipping(2017)30 *U.S.F. MARITIME LAW JOURNAL* p 84.

[3] On March 1, 2020, *Guidelines for Requirement and Security Assessment of Ship Cyber System (2020)* takes effect, revising the 2017 Edition.

at the beginning of the legislation, some specific legal rules are difficult to apply to autonomous ships, and along with other problems such as the lack of relevant standards and inspection norms. For maritime management legal rules, on the one hand, flawed provisions should be amended to capture autonomous ships into the legal system of ships, such as the relevant provisions on "minimum safe manning". On the other hand, existing legislation on autonomous ships should be improved, such as formulating specific inspection technical rules of statutory survey on autonomous ship. For the most part regarding maritime law, it is necessary to keep up with the legislation trend of autonomous ship in the international community, study the liability of autonomous ship carrier, the principle of attribution of ship collision, salvage at sea, relevant network risk insurance and piracy, and improve relevant provisions.

In general, as an emerging technology, the Chinese government has formulated favourable policies, guidelines and norms to encourage the development of autonomous ship technology. It is becoming increasingly essential that, both the international community and governments should shore up the development of autonomous ship technology with respect to legal system, providing legal safeguards , and enabling some space for fault tolerance and innovation for the development of autonomous ship.

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