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Partnership



■ Edited and Printed by CCS 2016.4 / The 20th issue in total



CCS boosts the green shipping

Over the years, on the road of energy saving and emission reduction, as the technical backbone for China shipping industry and shipbuilding industry, CCS always works together with the industries.

CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

The second issue in 2016

(The 20th issue in total)

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Content

Dynamics

- 01 The Director of Panama Maritime Authority Visited CCS and Signed New Authorization Agreement
- 01 CCS and BKI Signed Bilateral Cooperation Agreement
- 01 CCS Held Meeting with the Mission of the People's Republic of China to ASEAN
- 02 CCS Stockholm Office Formally Established
- 02 CCS Attendance and Presentation at ARF Workshop on Green Shipping
- 03 CCS Attended the 6th Beijing International Offshore Engineering Technology and Equipment Exhibition
- 03 Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (2016) issued by CCS
- 04 CCS Issued the Guideline for Polar Vessels
- 04 CCS Issued the Guidelines for Direct Calculation of Ore Carrier Hull Structure Strength (2016)
- 04 CCS Issued the Guideline for Certification of Submarine Production System

Survey

- 05 The Research Mother Vessel ZHANG JIAN with 11,000m Operational Depth
- 05 Product Oil Tanker GUANG HUI 328
- 05 The Oceanographic Research Ship XIANG YANG HONG 03
- 06 The Reservoir Area Working Ship XIN SAN XIA HAO
- 06 Semisubmersible Tug Boat ZHAO SHANG ZHONG GONG 3
- 07 Ro-ro Passenger Ship TONG TAI ER HAO
- 07 Container Ship BO DA 28

Technology Tendency

- 08 The Technical and Rule Requirements for Construction Technics of Carbon Fiber Ships

Standard Research

- 10 The Six Function Module Requirements of CCS Rules for Intelligent Ships
- 13 CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (2016)

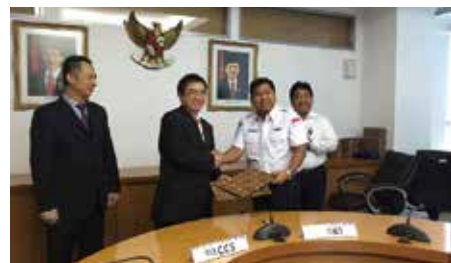
The Director of Panama Maritime Authority Visited CCS and Signed New Authorization Agreement



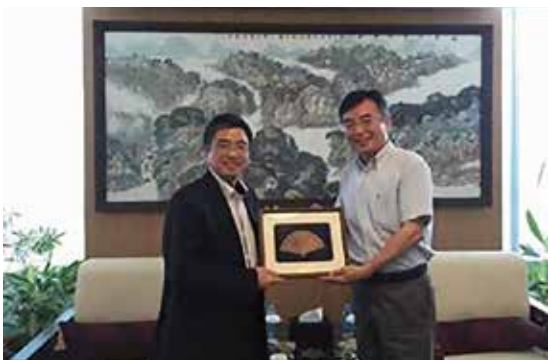
On March 18, 2016, CCS President Sun Licheng held a meeting with the Director of Panama Maritime Authority (PMA) Jorge Barakat, who was on a visit to CCS, and had deep and friendly exchanges on strengthening the future cooperation. They signed a new authorization agreement authorizing CCS to carry out statutory survey of Panamanian ships. The new agreement covers the authorization scope of all the international conventions and regulations accepted by Panama's government.

CCS and BKI Signed Bilateral Cooperation Agreement

China Classification Society (CCS) and Biro Klasifikasi Indonesia (BKI) signed a bilateral cooperation agreement in Jakarta. BKI President Rudiyanto and CCS Vice President Mo Jianhui attended the signing ceremony. The signing of this cooperation agreement indicates that the two sides will enter a new era of cooperation in newbuilding, ships in service, product survey, offshore engineering and other areas.



CCS Held Meeting with the Mission of the People's Republic of China to ASEAN



Recently, CCS held a meeting with the economic and commercial counselor's office of the Mission of the People's Republic of China to ASEAN in Jakarta, Indonesia. CCS Vice President Mo Jianhui, the economic and commercial counselor of the mission Tan Shufu attended the meeting. CCS introduced to the mission its business in ships, offshore equipment, containers, large steel structure and other areas, in particular the internationalization of CCS and CCS serving the national "Belt and Road" strategy and assisting high quality production capacity such as china shipbuilding, offshore engineering to go out. During the meeting, the two sides also discussed on strengthening the production cooperation in China-ASEAN marine area to implement the "Belt and Road" initiative.

CCS Stockholm Office Formally Established

On March 22, 2016, CCS Stockholm office was opened, this is the 11th branch of CCS in Europe. The ambassador of China to Sweden Chen Yuming, economic and commercial counselor of the embassy Han Xiaodong, the client representatives from Sweden and Finland, and the representatives of Chinese-funded organizations attended the opening ceremony. Stockholm office is the 86th survey service point in CCS global network, it aims to strengthen the technical exchange and cooperation between CCS and maritime institutions, shipping, shipbuilding and marine equipment enterprises.

CCS has set up office in the second largest city of Sweden Gothenburg as early as 21 years ago. The Stockholm office will be in charge of the business in north and central Sweden and Finland. Together with the Gothenburg office and Bergen office in Norway, the service area of CCS will cover Nordic countries and Baltic states, with the aim to provide high quality



and more efficient survey services to customers, and to further strengthen and promote the technical exchange and cooperation between CCS and maritime institutions, shipping, shipbuilding and marine equipment enterprises, thereby achieving mutual benefit and win-win results.

CCS Attendance and Presentation at ARF Workshop on Green Shipping

On March 29 and March 30, the ARF Workshop on Green Shipping co-sponsored by China and Malaysia and organized by Zhejiang Maritime Safety Administration was held in Hangzhou, China. CCS sent experts to attend the workshop.

The workshop comprises three key topics, i.e., "emission reduction measures and countermeasures against greenhouse gas from shipping", "effective implementation of the Rules on Energy Efficiency of Ships" and "control of air pollutants from ships". About 50 representatives from maritime authorities, classification society, shipping companies, shipbuilding enterprises, scientific research institutes, institutions of higher learning and the like made in-depth study and discussions by focusing on the "Green Shipping" topics organized and designed by the Maritime Development Strategy Research Center. At the workshop, CCS representatives delivered two speeches titled *Application of LNG in Marine Industry: Status and Perspectives* and *CCS: How to Respond to Greenhouse Gas Emission from Shipping*. Meanwhile, other representatives made active discussions from the perspectives of

latest changes of international conventions and regulations, empirical experience of different countries in promoting green shipping, latest international R&D and application, specific methods for shipbuilding and ship operations, effectively promoting information sharing and cooperation in green shipping field of all member countries and international organizations.

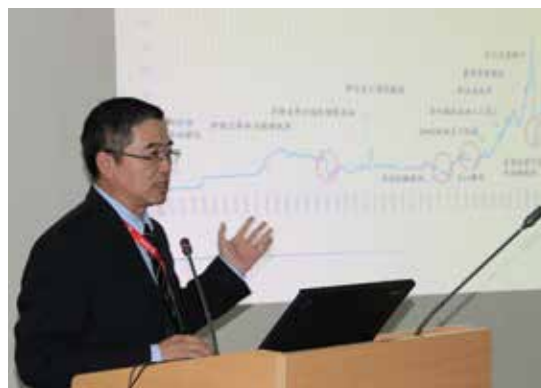


CCS Attended the 6th Beijing International Offshore Engineering Technology and Equipment Exhibition

On March 29, 2016, the 6th Beijing International Offshore Engineering Technology and Equipment Exhibition opened at the new venue of China International Exhibition Centre (CIEC), Beijing. CCS attended the exhibition and introduced its service capability of survey and evaluation covering the full area of offshore engineering equipment and the full life circle of offshore facilities, nicknamed “two full”. CCS mainly introduced ECA technical service, the South China Sea environment database and its application, technical service for tanker converted FPSO, risk-based RBI service and other new offshore engineering service products, showcasing CCS’ leading offshore engineering technology and service ability.

During the exhibition, CCS had successfully hosted CCS offshore engineering forum with the theme of “Going towards the world hand in hand”, building a communication platform for industries. CCS vice president Mo Jianhui delivered a speech on the forum, explained comprehensively the ideology of CCS following the industries’ situation

and working together with the industry to get the win-win result. Combined with the five development concepts of innovation, coordination, green, openness and sharing, the forum discussed how to grasp the opportunity of the Belt and Road strategy and bring to full play the advantages of China offshore engineering manufacturing, finance, marine equipment industries and other related industries while facing challenges, improving capabilities and looking ahead to build the China made 2025 brand of offshore engineering.



Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (2016) Issued by CCS

Recently, CCS issued the *Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (2016)*. The 2016 version updates and substitutes the original 2006 version. This new version incorporates new IMO IGC new regulations as amended by IMO MSC.370 (93) and ensures timely implementation of the new IGC Code on liquefied gas carriers with independent tanks.

The new Rules reflect the new research results and new technology achieved by CCS on type A and B diamond independent tank liquefied gases carriers and type C independent tank liquefied gases carriers, and add supplemental requirements to these tanks, including the supplemental

requirements for the hull structure, tank structure, scantling for support structure and direct calculation, and the requirements for temperature field analysis when necessary and thermal stress analysis of the liquefied cargo tank support structure and attachments. In the aspect of technical requirements for independent liquefied gas carriers, important technical contents have been added, defined and improved in the rules, increasing the coverage, applicability and operability of the rules. The new rules is significant in guiding the research, design and construction of our countries’ type A and B diamond independent tank liquefied gases carriers and type C independent tank liquefied gases carriers.

CCS Issued the *Guideline for Polar Vessels*

Recently, CCS issued the *Guideline for Polar Vessels*, which formed the complete vessel standard system together with the prior rules for ice strengthening and cold protection.

With the unique geographical location and environmental conditions in polar waters, there are additional risks that may endanger safety of vessels sailing in the polar waters because of ice and/or cold climate and other not-to-be-underestimated conditions, for instance, crash between vessel and ice can affect the structural strength of vessels; cold climate may result in problems causing reduction of vessels' stability, frozen pipelines, failures of navigation

equipment and decline in implementation capability of crews. The goal of the *Guideline for Polar Vessels* is to provide technical guidance for implementation of ice class rules and cold protection rules of CCS, and the *International Code for Ships Operating in Polar Waters* issued by International Maritime Organization(IMO), so as to ensure safety of navigation in the polar waters.

The main content of the *Guideline for Polar Vessels* includes: survey and certification, hull structure and equipment, ship stability, mechanical and electrical equipment, safety equipment and operation in polar waters. This guideline has come into force on April 1, 2016.

CCS Issued the *Guidelines for Direct Calculation of Ore Carrier Hull Structure Strength (2016)*

Compared with the 2014 version, the *Guideline for Direct Calculation of Ore Carrier Hull Structure Strength (2016)* has expanded the evaluation scope of tank direct calculation to the whole tank area and engine room area, adopting the equivalent design wave loads and condition, the buckling assessment approach based on closed formula method and fatigue strength analysis method and adjusting the model boundary and load. The impact of ore aquifer on the structure strength and the requirements for full ship finite element have been added, and the applicability research and real ship verification have been carried out combining with CSR rules and GBS research result.

The main contents include: setting the applied area of the guidance, ship type

definitions, symbols; setting the wave load and calculated condition; the modeling requirements, analysis scope, hull girder adjustment and allowable criteria for tank direct calculation; refining the position, modeling requirements and allowable criteria for the detailed stress assessment network ; the definition, attribution, buckling capacity and strength criteria for buckling strength assessment; the modeling requirements, condition definition, load calculation and stress criteria for direct calculation of the full ship; the modeling, load, hull girder adjustment and allowable criteria for the direct calculation of the engine room; the supplemental requirements for tank direct calculation under the requirements of the ore aquifer; the supplemental requirements for fatigue strength assessment of the ore carriers' hull structure.

CCS Issued the *Guideline for Certification of Submarine Production System*

Recently, under the background of deep sea development and in order to provide better service to the industry, CCS developed the *Guideline for Certification of Submarine Production System* on the basis of the advanced experience obtained from the application, research and survey of submarine production systems. The guideline is composed of 11 chapters, covering comprehensively the certification survey requirements for the submarine production system and equipment.

The main content includes: the survey and certificate requirements of the subsea production system; the function requirements of the subsea production system; the technical requirements of design, manufacture, test and survey for subsea wellhead; the technical requirements of design, manufacture, test and survey for subsea tree; the technical requirements of design, manufacture, test

and survey for subsea manifold and pipeline components; the requirements of design, manufacture and survey for subsea connection system; the design, anticorrosion, manufacture and test requirements for cross-under pipe; the special requirements for subsea control system and equipment test; the requirements of function, performance and test for umbilical; the function and design requirements for subsea equipment's infrastructure.

According to the guideline, CCS can provide following services: the design and review of subsea production system and control system; the identification of the original products; the identification and survey of subsea production equipment, control equipment, separating equipment and supercharging equipment; manufacturing process survey; FAT; EFAT; SIT; SAT; installation and recycling, etc.

The Research Mother Vessel ZHANG JIAN with 11,000 m Operational Depth



As the first ship designed for scientific exploration of deep-ocean trenches in China, it is jointly invested by Tehe Ocean Technology Group Limited and Shanghai Rainbowfish Ocean Technology Co., Ltd., built by Zhejiang TianShi Shipbuilding Co., Ltd. and surveyed by CCS. This ship is 97 m in length and 17.8 m in width with a displacement of 4,800 t and a draught of 5.65 m. The speed of it is 12 knots and the range of it is 15,000 nm. With a ship complement for 60 people, it has an endurance of 60 days before needing resupply. Its major mission is to explore and investigate deep-ocean trenches; with the goal of exploring the limit depth of 11,000 m of Mariana Trench, it is planned to carry on the test of unmanned bathyscaph and lander in this year.

Product Oil Tanker GUANG HUI 328

This ship is the fifth in the ten product oil tankers built by Rizhao Kingda Shipbuilding Heavy Industry Co., Ltd. for Shenzhen Brightoil Shipping Group Co., Ltd. It is 90 m in length, 15.2 m in width and 7.2 m in moulded depth; the scantling draught is 5.6 m, the dead weight capacity is 4,200 t and the gross tonnage is 2,882 t. CCS is in charge of its construction survey.

This double-engine double-screw ship is equipped with bow thruster and thermal fluid system. Being capable of unrestricted services, this ship is mainly used in offshore area to transport heavy oil, petroleum products and light diesel oil, and also as oil supply ship. The main hull is divided by ten transverse watertight bulkheads into the following areas: forepeak, bow thruster compartment, twelve cargo holds (left and right), pump room, engine room and afterpeak. The fore peak can be used as water ballast space. The cargo hold is structured in



double bottoms and double skins. There is a hose crane on the middle of the main deck, the arm length of which is 26.5 m and the load capacity of which is 2 t.

The Oceanographic Research Ship XIANG YANG HONG 03



As the largest and most advanced research vessel in State Oceanic Administration, it is designed by CSSC and classed in CCS. CCS is also in charge of

the drawing inspecting and construction survey. The ship is 99.8 m in length, 17.8 m in width and 8.9 m in moulded depth. With a gross tonnage of 4,813 t and complement for 80 people, it sails at the speed of 15 knots. Equipped with dynamic positioning system, onboard control and support system, onboard testing and detection system and onboard computer network system, this up-to-date electric-driven oceanographic research ship of 4,500 tonnage is suitable for unrestricted services around the globe around the clock. As a multidisciplinary, multifunctional and multi-technology outcome, it can meet the needs of multi-discipline research in abyssal oceanography with scientific function in comprehensive detection and experiment of ocean dynamic environment, geological environment, ecological environment and submarine resources and energy. At present this ship is already put into service and listed into China marine research vessels.

The Reservoir Area Working Ship XIN SAN XIA HAO

Built by Chongqing Zhongjiang Shipbuilding Industries Co., Ltd. for Chongqing Migration Bureau, the reservoir area working ship XIN SAN XIA HAO is mainly used to cruise the three gorges reservoir region and receive guests. This ship is designed and constructed in strict accordance with CCS Rules for Inland River Green Ships. CCS is also in charge of the drawing inspecting and construction survey.

As the first vessel in the upper Yangtze River who applies “Green Ship” notation, XIN SAN XIA HAO is 91.81 m in length, 16 m in width and 3.8 m in moulded depth. With a draught of 2.6 m, a complement for 80 crew and 93 passengers and an engine power of 2×1100 kw, it sails at the speed of 29km/h. The ship not only has excellent operational performance and economical speed, but also meets the requirements of EEDI 1, COMF (NOISE) 1 AND COMF (VIB)



1, providing a more comfortable working and living environment for crew and passengers. Overall, it's a technologically advanced and energy-efficient new-type ship, which can both cruise the reservoir area and receive guests.

Semisubmersible Tug Boat ZHAO SHANG ZHONG GONG 3



This ship is a stationary semisubmersible tug boat working offshore. It's 152.5 m in length, 60 m in width and 11.5 m in moulded depth. With a complement for 20 crew and unrestricted services, its navigational draft is 7.5 m and operational draft is 20.5. The displacement (during sailing) of it is 67,159.4 t and the gross tonnage is 34,201 t. CCS is in charge of its construction survey.

This barge is mainly used to carry and launch ships, ship blocks, platforms and oceanengineering modules. When they are built, they will be loaded by slide way or gasbag onto the barge, and then the barge will be transport them to near waters and dive, so that these ships or platforms can float as

are launched. Besides, this barge can be used as regular semisubmersible barge or deck barge to transport and load large pieces at sea like cranes, large structures, oceanengineering steel structures, ships, platforms and caissons; or used in offshore engineering operation and port construction. Sometimes for the purpose of loading large structures that are wider than the width, the aftercastle can be dismantled if the water is under 20 m depth. Seal the blast hole of the water ballast space under the aftercastle and the pump room, and then dive. After loading the structures, the barge should lift till the towing draft, and then mount the aftercastle back. When towed to the destination, operate in reverse to unload.

Loading capacity of the barge depends on towage properties and loading conditions. The typical loading capacity is designed as the following: if the ship is docked in Haimen Base and is launched in the typical way of diving, the loading capacity will be 20,000 t; if the barge dives to load and then lift to transport, the loading capacity will be 25,000 t; if the barge loads regular deck goods and transport, the capacity will be 38,000 t.

Ro-ro Passenger Ship TONG TAI ER HAO

Surveyed by and classed in CCS, this ship is mainly used to transport passengers and vehicles between mainland and island in Dalian Area. The ship is 49.2 m in length, 9.8 m in width and 2.8 m in moulded depth. With a draught of 2.05 m and a complement for 11 crew and 330 passengers, its full-load displacement is 574.1t.



Equipped with double engines, double screws and twin rudders, the ship has an engine power of 1,202 kw. In the condition of full-load draught and orderly sea, it sails at the speed of 12 knots with an endurance of 500 nm. For safety reasons, the ship is not allowed to go if the winds reach Grade 7 on the Beaufort scale.

With a combined framing system, the ship is constructed in steel double bottom, single skin and single deck. The three-tier closed passenger cabin above main deck is used to carry passengers; the open main deck is used as vehicle deck to transport vehicles, on which securing devices are set to fix vehicles. The allowed maximum load for vehicles is 127 t and maximum unit weight is 30 t; the allowed number for parking vehicles is 4 for 2.5m×8.0m trucks or 8 for 1.8m×4.4m cars. The bow door is set as vehicle ramp to pass passengers and vehicles, which is controlled by two electric windlasses in the forecabin.

Container Ship BO DA 28

As one in a series of 558 TEU ships built by Ningbo Boda Shipbuilding Co., Ltd., BO DA 28 is 119.9 m in length, 21.8 m in width and 7.3 m in moulded depth. With a draught of 5.2 m and a complement for 21 people, it goes in offshore area. Its gross tonnage is 6,629 t, dead weight tonnage is 8,180 t and engine power is 2,560 kw. This series is all surveyed by CCS.

The ship is a diesel-driven stern-engine steel container ship with single deck, single screw, single rudder and bulb stern and bow. Forecabin deck and poop deck are equipped with; there is two-level deckhouse on the forecabin deck and three-level deckhouse on the poop deck. Double-bottom tank and side tank are set as water ballast tank; also three cargo holds are set. In addition,



considering the fact that the ship mostly sails in Indonesian internal waters and the features of the channel, the wheel house is set on forecabin deck and the thrust unit is set in the bulb to decrease draft and increase mobility on the condition of compliance with national rules and guidelines.

The Technical and Rule Requirements for Construction Technics of Carbon Fiber Ships

By Zhang Xilong & Lin Ziwen

At present, research on ships made of carbon fiber is prevalent in the domestic shipbuilding industry. This article is the introduction of the current design and construction specifications, production technics and design technology of carbon fiber ships.

Carbon fiber has many excellent properties, such as low density, high performance, no creep, high temperature resistance in non-oxidizing environment, good fatigue resistance, small thermal expansion coefficient and anisotropy, good corrosion resistance, good X-ray permeability, good electric conduction and heat conduction performance, good electromagnetic shielding, etc. Its specific heat and electrical conductivity is between that of non-metal and metal. The young's modulus of carbon fiber is more than 3 times that of the traditional glass fiber; and 2 times that of Kevlar fiber, it does not dissolve or swell in organic solvent, acid or alkali and has an obvious corrosion resistance. Carbon fiber has a wide application range and is commonly used for the body and wings of the plane, the racing car body, the racket and ball arm. These are the areas which have relatively high requirements for strength weight.

The introduction of carbon fiber in shipbuilding industry is also based on the premise of meeting strength safety and the consideration of lightening the hull weight as far as possible. The writer has seen a 40 feet sailing ship in Jia Hang shipyard, the hull was only 4 mm thick by visual measurement and this was unimaginable in previous domestic rules. The weight is exactly the main factor to consider for competitive sailing ships. Take the 40 meter ship CKS is planning to build for example, compared with ships of the same

horsepower and same size in the group, the speed of this ship can reach 38 knots. This is really magnificent considering that the speed of ships operating on Hong Kong-ZhuHai-Macao line is only 28 knots.

Currently, using the compound material combined with excellent resin (generally vinyl ester resins or epoxy resins) and with carbon fiber as reinforced material for hull material is a development trend. Both the strength and stiffness are significantly improved compared with traditional glass steel material. For example, according to the material attribution reference as contained in appendix 3 of the *Rules for Classification and Construction of High Speed Ship (2015)*, the young's modulus of carbon fiber is 3 or 5 times that of the traditional glass fiber material, i.e. the stiffness is significantly increased. Stiffness is exactly the weakness of traditional glass steel material.

Carbon fiber also needs to be combined with resin generally, becoming the composite material after being solidified and being used as the hull structure. Laminated core material may also be used. At present, the vinyl resin which is combined with carbon fiber is vinyl ester resins and epoxy resins.

Compared with traditional unsaturated polyester resin, vinyl ester resins has better water resistance and mechanical properties, the carbon fiber ship which takes vinyl ester resins as vinyl resin often adopts traditional vacuum molding technology, which is suitable for large vessels (such as the two ships of CKS). Recently, related contents of vinyl ester resins has been added to the work approval certificate of DSM.

Each performance indicator of epoxy resins is very high, in terms of the affinity of carbon fiber and vinyl resin, epoxy Resins and carbon fiber are

thought to be perfect match, they are used a lot in aviation area, which is one of the hottest topics in academic circles at present. But epoxy resins is very expensive, the technology is different with hand lay-up molding and vacuum molding. It used to adopt prepreg, the solidifying process need to be pressed or heated after the hull molding, the hull structure adopt hot air autoelave, it is expensive and the equipment is complex, the temperature and stress need to be controlled precisely, which is little used in China, only some racing ships for export or top-class yachts could be used. Moreover, most epoxy resins adopted are imported.

At present, there are many different kinds of laminated core materials, the use of PP, PU, PVC foam and Balsa wood on 100T HiSIBI ship is common, and it may be the ship type which use compound material the most at present. And various kinds of imported materials such as Tycore, Netcore, etc. have also emerged recently.

At present, carbon fiber is not used a lot as reinforced material in Chinese shipyard, it is often used on the public service ship which has high requirements for speed. The 100T customs ship of HiSIBI use loom to make the grid cloth from the original silk bought by the shipyard; the 19 meter maritime surveillance ship of SUNBIRD adopts the mix of carbon fiber and fiberglass to make the grid cloth. Due to the gap between China and abroad in the basic research of high performance fiber, they seem to use carbon fiber only as the traditional grid cloth, and it feels like the good steel is not used on the critical part. And as a company, the first thing to consider when adopting new materials is how to meet the specification, rather than the research and development, therefore, the use of carbon fiber has not break through the framework of specification.

In addition, the production and design is the weakness of the domestic fiberglass ship yards. Despite that there are specifications for overlap and connection width in the *Rules for Materials and Welding*, and the shipyard also submit the *Shell Expansion Chart* for approval, but in fact the *Shell Expansion Chart* cannot reflect the actual position of the connection or overlap in each layer, the shipyard manager do little design to the production of specific layer position.

In order to further reduce the weight of the hull, the design for this kind

of ship prefers to adopt fine design and finite element engineering analysis.

The so-called fine design of composite material is a design method that carries out detailed study of the loads of the hull parts to fully develop the design ability of composite materials. Because composite material can adopt the method such as orthogonal type fiber cloth, multi axial fiber cloth, fiber cloth combined with fiber felt, fiber materials combined with interlayer structure and so on, the layer design for each part will apply to a definite kind of fiber and load. This part involves a lot of basic research, which is the weakness of domestic design company. But the design ability is exactly the difference between composite material and metal material.

At present, compared with isotropic metal materials used by the hull, the characteristics of the finite element for composite materials is anisotropic. The *Rules for Classification and Construction of High Speed Ship (2015)* added the finite element strength direct calculation method for high speed ships of composite material, setting the rules for modeling method, modeling condition, load and operating condition, and criterion, and giving the material property for composite materials layering, thereby conducting accurate performance evaluation of each component and providing guidance for the fine design of ships made of compound material.

It is worth noting that the finite element code which is provided by the *Rules for Classification and Construction of High Speed Ship (2015)* is not the traditional stress criterion, but a reference to GL, adopting the so-called "maximum strain criterion", which includes the axial tensile/compression maximum strain criterion and the shear strain criterion. This is a big change. The reason for this might be what the composite material expert Eric Greene has mentioned in his *Ship Composite Materials*, i.e. resin assumes the main function of stress transfer in composite materials. The shear strain is a very important parameter, the lamination of materials may be the main failure which leads to the structure defect. When there is overload, ships of compound material will not have the crack and extension like those of metal material, the overall collapse of the structure is caused by the interlayer lamination of structure. But in theory, there are lots of other criteria in addition to the stress and strain criterion.

The Six Function Module Requirements of CCS Rules for Intelligent Ships

By He Ci

With the development of the concept of intelligent ship and the intelligent ship technology in recent years, intelligent ships have become the general trend of global shipping. Nowadays, the research on intelligent ships is going on around the globe with the aim to reduce the difficulty of ship control and management, to reduce human error, to improve the safety of equipment and operation, to optimize navigation, to control fuel oil consumption, to reduce cost and to improve profit.

As early as the 1980s, Japan started developing “artificial intelligent ship” with the function of “intelligent navigation”; Korea started the project of intelligent ship 1.0 in 2009 and the first intelligent ship was launched in 2011, the project 2.0 is currently underway; British Rolls-Royce proposed the concept of unmanned ship and had started to carry out relevant research work

Considering the development direction and trend of intelligent ships in the future, and with a view to leading the industry development and making shipping safer, more environment-friendly, more economic and reliable, CCS developed CCS Rules for Intelligent Ships based on the computer technology, navigation and communication technology, advanced sensor and control technology and other development and research achievements of international intelligent ship technology, as well as taking the application experience and development status of intelligent ships at home and abroad into full account. The Rules took effect on March 1, 2016.

The development of intelligent ship technology has just started in our country. However, according to strategic requirements of China Made 2025, top-level design and research of intelligent ships had been started.

CCS Rules for Intelligent Ships define the intelligent ship as follows: ships which can automatically sense and obtain information and data of ship, marine environment, logistics and port by using technological means of sensor, communication, internet of things and internet, and can realize intelligent operation in navigation, management, maintenance and cargo transportation based on computer technology, automatic control technology, big data processing and analyzing technologies.

The Rules are composed of six functional modules: intelligent navigation, intelligent hull, intelligent engine room, intelligent energy efficiency management, intelligent cargo management and intelligent integration platform.

If all the functions meet the requirements of CCS Rules, the notation of intelligent ship can be awarded:

i-Ship (Nx, Hx, Mx, Ex, Cx, Ix)

Letters inside the brackets are notations of intelligent ship functions, corresponding respectively to the following:

N-- Notation for intelligent navigation function ;

H--Notation for intelligent hull function ;

M--Notation for intelligent engine room function ;

E--Notation for intelligent energy efficiency management function ;

C--Notation for intelligent cargo management function ;

I--Notation for intelligent integration platform function;

x--Notation for optional function supplement.

If the ship has one of the intelligent functions, the corresponding notation for intelligent function can be awarded.

The requirements for each intelligent ship function module in CCS Rules are as follows:

1、 intelligent navigation

Intelligent navigation shall have the following basic functions:

- Analysis and processing of meteorology, economic efficiency and logistics information;

- Design and optimization of route and speed based on analysis result.

In addition to the basic functions, intelligent ships should have automatic navigation function in open waters, or, as supplement to intelligent navigation, the capability to pull in and off terminals and the advanced automatic navigation capability in narrow waters and complicated environment.

2、 intelligent ship hull

Intelligent ship hull shall have the following basic functions:

- To establish and maintain ship hull database;
- To provide assistance in decision-making on safety and structural maintenance of ship hull in ship's full life circle based on ship hull database,;

In addition to basic functions, intelligent ship hull shall be able to provide decision-making assistance in ship operation as the supplemented intelligent function based on the automatic collection and supervision of the data related to the hull.

3、 intelligent engine room

Intelligent engine room shall have the following functions:

- supervise the operation condition of main engine, auxiliary engine and shaft in engine room;

- Analysis and process of the operation and health condition of mechanical equipment based on data collected by condition monitoring system;

- Propose corrective suggestions to assist decision-making in ship operation based on analysis and assessment results.

In addition to basic functions, maintenance plan can be made according to actual conditions as the supplemented function based on analysis and assessment results on the operation and health conditions of mechanical equipment.

4、 intelligent energy efficiency

Intelligent energy efficiency shall have the following basic functions:

- On-line supervision of navigation and energy consumption condition and automatic data collection;

- Assessment of energy consumption, navigation condition and loading condition according to the data collected.

- Provide data assessment and analysis results and assist in decision-making based on big data analysis, numerical analysis and optimization technology;

In addition to basic functions, real time supervision and intelligent assessment and optimization can be realized as the supplementary functions by means of speed optimization and solutions such as the optimized allocation based on optimized trim.

5、 intelligent cargo management

Intelligent cargo management shall have the following basic functions:

- Cargo tank and cargo monitor and alert function and decision-making assistance;

- Cargo protection system monitor and alert function and

decision-making assistance;

- Optimize cargo allocation through collection and processing of parameters of cargos, cargo tanks and cargo protection system.

In addition to basic functions, intelligent cargo management system should be capable of automatic loading and unloading as supplementary function.

6. intelligent integration platform

Intelligent integration platform shall have the following basic functions:

- Integrate at least the data of intelligent navigation, intelligent engine room and intelligent energy efficiency management;

The platform should be open and shall be able to integrate the existing onboard information management system and the subsequent newly-added systems to realize overall monitoring and intelligent management of the ship;

- Provide automated and standardized analysis reports through statistics analysis and assessment;
- Provide comprehensive forecast and early warning for navigation, safety, economical efficiency and other related targets according to user preferences;
- Provide trend prediction for ship control and management by using past operation status and relevant parameters;
- Provide good decision-making assistance, improve ship performance, and reduce human errors. Provide integrated management and control plans for accident response, risk reaction plan, environmental protection measures, accident detection and prevention, economical efficiency improvement, resource management and communication based on assessment prediction results;
- Ship-shore data interaction.

In addition, the Rules have also make requirements for computer system and software development, material submitted, test and

inspection and personnel allocation corresponding to each intelligent function.

Considering the constant development of intelligent ship technology, the Rules stipulates principle requirement for the application of new technology. If the systems and equipment using the new technology can reach the same level of safety required by CCS rules as testified by risk assessment and tests, design of these systems and equipment could deviate from CCS rules' requirements. In addition, the Rules provide the risk assessment method and basis for approval of new technologies.

Intelligent ship has become the inevitable trend for the development of shipbuilding and shipping. Nowadays when the ship is becoming more and more intelligent and onboard systems and equipment are becoming more and more complex, ship owners, design institutes, ship yards and equipment manufacturers are thinking about the direction of intelligent ships, there is also an urgent need for corresponding rules and regulations to regulate the future onboard intelligent systems. CCS Rules for Intelligent Ships filled in the gap. It is the first classification rule that covers the life cycle of intelligent ships from design, construction and operation.

The content of the Rules is clear in logic and is systematic and applicable; the six functions of “intelligent navigation”, “intelligent ship hull”, “intelligent engine room”, “intelligent energy efficiency management”, “intelligent cargo management” and “intelligent integration platform” cover the intelligent systems onboard ships.

In addition, the Rules are based on the existing rule system and can be integrated with existing CCS rule requirements. Meanwhile, the Rules are developed in an open manner so that it can accommodate continuously new application achievements to improve and detail the existing technical requirements.

CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (2016)

CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk is revised based on the 2006 version. The main revised content is as follows:

1. Incorporate new rules of IMO IGC as revised in IMO MSC.370 (93) (including correct error of “MSC 93/22/Add.1/Corr.3, 5 November 2015”)

2. Incorporate the content of annual and intermediate survey as revised in IACS UR Z1 Rev.5

3. Supplemental regulations for A-type and B-type prismatic independent-tank liquefied gas ships have been added, as well as those for C-type independent-liquid-cargo-tank gas ships, including scantling and direct calculation requirements of hull structure, liquid cargo tank structure and support structure, as well as temperature filed analysis and thermal-stress analysis of support components and attachments of liquid cargo tanks.

CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk 2016 consists of 3 parts:

1. The first part “The General”, which describes the relationship between this guideline and *IGC rules*, CCS rules for classification of sea-going steel ships and CCS rules for *materials and welding*. In addition, this chapter indicates chapters that are applicable to different ship types;

2. Part 2 “*Supplementary regulations of classification*

survey, hull structure and liquid-cargo-tank structure” the classification and survey part incorporates in part the stipulations of IACS UR Z1 Rev.5; Chapter A4 and appendixes include supplementary regulations for technical requirements of hull structure and liquid-cargo-tank structure.

3. Part 3 “international rules for the structure and equipment of ships carrying liquefied gas in bulk”, including the latest content of *IGS rules* and additional CCS terms and explanations.

CCS Rules for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk 2016 will take effect on Jul.1st of 2016, and will replace the 2006 version and the first amendment issued in 2016.

