

# Partnership



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M.V. Guanghai, ocean-going passenger ship firstly surveyed and certified by ZC for initial classification in 1961.

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Co-organized by China Ship Survey

Add: CCS Mansion, 9 Dong Zhimen  
Nan Dajie, Beijing China.

Postcode: 100007

Tel: 58112221 58112218

Fax: 58112902

Websit: [www.ccspline.com](http://www.ccspline.com)

E-mail: [ccsinfo@ccs.org.cn](mailto:ccsinfo@ccs.org.cn)

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# Introduction to CCS

**F**ounded in 1956, China Classification Society (CCS) is the specialized organization of China to provide classification services. CCS aims to provide services for the shipping, shipbuilding, offshore exploitation and related manufacturing industries and marine insurance by furnishing reliable classification requirements and providing independent, impartial and integral classification and statutory services to ships and offshore installations, for the promotion and safeguarding of the safety of life and property at sea and for the prevention of pollution to the marine environment.

CCS is one of the thirteen full members of the International Association of Classification Societies (IACS), and chaired IACS Council respectively in 1996-1997 and 2006-2007. Its highest class notation has been included in the Classification Clauses of the Institute of London Underwriters (ILU). Up to now, CCS has been authorized by the administrations of 29 countries or regions to perform statutory surveys for the ships flying their flags; especially, CCS has been recognized by the United States Coast Guard (USCG) and the European Union (EU), which demonstrates our qualification and competence to the international community. CCS is also the associate member to the International Association of Dry Cargo Shipowners (INTERCARGO) and the International Association of Independent Tanker Owners (INTERTANKO).

Moreover, CCS has been extensively engaging in certification, audit, supervision, inspection, assessment, testing, consulting, training and many other services. As one of China's earliest bodies to launch management system certification, CCS has been authorized to carry out certification of 25 different categories of products in such areas as renewable energy, transportation and infrastructure. CCS is also among the first authorized users of IAF-MLA/CNAS mark, which is entitled to equivalent effectiveness and mutual recognition internationally. In addition, CCS is the only body designated by the Chinese Government to carry out container inspection and the Designated Operational Entity for the UN Clean Development Mechanism. As one of the first A-class equipment supervision bodies in China, CCS has been playing a leading role in supervision for large bridge engineering projects, supervision for manufacturing and installation of large port equipment and system and supervision for manufacturing and installation of large heavy lift equipment.

Headquartered in Beijing, CCS has about 3300 employees and established over 60 branches/offices both at home and abroad, forming a global service network. By providing high quality technical services, CCS is lending a significant support to the clients in safety management, energy saving, environmental protection and risk management.





## “HAI YANG SHI YOU 201”- Deep Water Pipe-laying Vessel



The 3,000-meter deep water pipe-laying ship “HAI YANG SHI YOU 201” inspected by CCS Nanjing Branch, was delivered on April 28, 2012. Currently, the ship

has sailed to South China Sea for operation.

“HAI YANG SHI YOU 201” is the marine engineering project co-operated by China National Offshore Oil Corporation (CNOOC) and Jiangsu Rongsheng Heavy Industry Co., Ltd. The project launched in May 2005, with construction started in September 2008, is one of the major national science and technology projects in the eleventh five-year plan and an important part of related subjects of “863 Plan”.

As the first self-designed deep water pipe-laying crane ship with DP3 dynamic positioning in China, “HAI YANG SHI YOU 201” is one of the important equipments for the deep water project listed in CNOOC deep water development strategy. The key technologies involving ship design and construction have been listed into the major national science and technology projects in the eleventh five-year plan and the “863 Plan”. The ship is an key project in the high-tech development plan as well as the supporting

ship for deep water drilling platform marine “HAI YANG SHI YOU 981”. Meanwhile, it is the first special-purpose ship with “S” type deep water pipe-laying capability in 3,000-meter (in DP2 Mode), and 4,000DWT heavy offshore engineering crane (in DP3 Mode).

“HAI YANG SHI YOU 201” can operate on non-restricted waters globally except for the Arctic. Its successful construction and pipe-laying test will play an important guidance role in speeding up China’s oil and gas exploration in deep water. Its integral technical level and comprehensive operational capability takes a leading position among the international engineering ships of the same type, representing the highest level of international offshore engineering equipment manufacturing. It has a significant influence and meaning to the long-term development of CNOOC and China to boost oil and gas development.

“HAI YANG SHI YOU 201” was jointly drawing-approved and surveyed by CCS and DNV, with its statutory certificate issued by CCS. Related departments in CCS Headquarters, CCS Plan Approval Center and CCS Nanjing Branch has attached great importance to the project, and gathered elites in the management, plan approval, and survey areas. The high-level service of CCS has been well received by the shipyard, the shipowner and related parties. Meanwhile, CCS has further cultivated her plan approval and ship survey staff, improved survey level and accumulated valuable experience for further development in the future.

## M/V “SHENHAI” LNG Carrier



LNG carrier is a “three highs” product internationally recognized by high tech, high challenge and high value-added, is called “the lustrous pearl in the crown” in

global shipbuilding industry. CCS serves national energy strategy, which has provided six carriers including China first LNG carrier M/V “DA PENGHAO” with construction and inspection services, has finished construction and inspection of M/V “SHENHAI” which was the sixth LNG carrier. So the inspection experiences to LNG carrier have been accumulating; field inspection team of LNG carrier has been expanding; and capacity to inspect LNG carrier has been promoting.

## 180,000 DWT Bulk Carriers in Series



The 180,000 DWT bulk carriers in series are the new ship type independently developed by China in compliance with CSR requirements, and their main technical parameters

are superior to those of the same ship type developed by Japan and South Korea in the same period, reaching the international advanced level. It has earned the reputation of the “Chinese ship type” of 180,000 DWT bulk carriers and has very high economic benefits. This means CCS and Chinese industry are joining hands to put into practice the target on

“speeding up improvement of self-innovation capability and advanced shipbuilding capability, enhancing new ship type development and strengthening core competitiveness” as described in the medium and long term development plan for Chinese shipbuilding industry.

The rules applied to the 180,000 DWT bulk carriers are the Common Structural Rules (CSR) launched by IACS. The birth of the rules has enabled CCS, one of the major developers of the CSR, to become a “vanguard” in terms of bulk carrier rules. From project research & development to construction, CCS fully took part in the process and took practical action to finish rule calculation, plan approval and on-site inspection, and consequently the quality of this batch of bulk carriers won high praise from the industry.

## M/V “CSB BRILLIANT”-VLOC



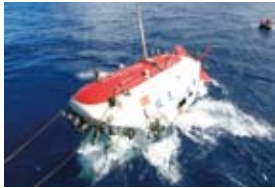
As the third 300,000DWT VLOC delivered to China Shipping (Group) Company, “CSB BRILLIANT” is NO.7 300,000 DWT VLOC in series built by Dalian Shipbuilding

Industry Co., Ltd for CSC. It is dual-classed by CCS and DNV, with its statutory survey performed by CCS. The 300,000 DWT VLOC is one of the key new products launched by Dalian Shipbuilding Industry Co., Ltd. in 2012. The VLOC, delivered on April 27, 2012, with the gross tonnage of 151,825GT, the power of main engine being 252,000 KW, 330 meters in length, 52 meters in width, is one of the ultra-large ships with the highest level of modernization and the most advanced equipment in the world, and meets the latest requirements of SOLAS, ICLL, MARPOL and other related international conventions.

As the implementing unit for ship survey, CCS Dalian Branch pays more attention to controlling ship quality in ship construction process, and always tracks various technical conditions in the process of ship operation. To fully grasp the condition, problems, technical characteristics and related performance of this ship type after its first voyage, CCS arranged two surveyors to return a visit on board after the first VLOC in series accomplished its first navigation. After learning about and checking ships in details, CCS immediately reported the ship condition to the shipowner, the shipyard and the project team of CCS after the visit, requiring them to modify mistakes and pay special attention to them in future construction and survey.

Strict control during the construction process and active return visit after the ship’s first navigation not only embodies the proactive, meticulous and considerate service of CCS, shows CCS’ serving capability, but also accumulates survey skills and experience in large-sized VLOC and lays a good foundation for improving the survey work for the ships in series and follow-up ships.

## M/V-“JIAOLONG”



The design of JIAOLONG, China's first manned deep-sea submersible with proprietary intellectual property right, is independently completed by Chinese technical engineering personnel, and its assembly, commissioning and sea trial are fully accomplished by ourselves. Before the birth of Jiaolong, only four countries in the world, i.e. USA, Japan, France, and Russia have the capability to build the manned deep-sea submersible. The utmost operational depth of the deep submersibles built by these countries is 6,500 meters, while that of Jiaolong is 7,000 meters. It has such functions as exploring deep sea, high precision topographic survey at sea bottom, etc. Its operational range

can cover 99.8% of global sea area in theory. Among all of the manned submersibles engaged in scientific investigation research of the same type in countries all over the world, Jiaolong is the one that can submerge deepest.

As one of the participants in Jiaolong project, CCS strives to serve national oceanic economy and the strategy of building a strong ocean country, actively carry out technical research and rules development for deep sea equipment, and provide classification service for Jiaolong, the manned submersible with the international advanced level. Jiaolong is the first manned submersible classed by CCS reaching the international advanced level. CCS will join hands with different parties of the industry to go into deep sea. By assisting major national projects, CCS has not only shown her strength and mien, but also established a strong foundation for better serving national deep sea strategy.

## “HAI YANG SHI YOU 681”



“HAI YANG SHI YOU 681” is one of the best deep water multipurpose service ships in the world, the ship is 93.4 meters long and 22 meters wide with the draft more than 9.5 meters. This high-end diesel-battery hybrid vessel integrates the functions of deep sea anchoring, traction, location and platform supply, and it can provides the services of traction, deep sea anchor-handing, fresh water, duel oil and balk cargo supply and platform protecting. It also provides the functions of exterior firefighting, oil skimming and ROV autonomous underwater vehicle. This ship can store, withdraw and release autonomous underwater vehicles and handle the anchor in the deep sea 3000 meter away from the coast. It was built according

to the requirements of CCS environmental protection, comfort and dynamic positioning(DP-2) with good handing and performance. It also embodies the idea of green vessel and fills the blank of large-scale multipurpose deep-water service boat in our country. The technical level and performance ability of this ship ensures its leading position among international ships of the same kind, and it represents highest level of building ocean engineering equipments in today's world.

“HAI YANG SHI YOU 681” was designed by famous Rolls-Royce in Europe. Wuchang ship building industry corporation built it for China offshore oil service corporation. The design drawings were reviewed by CCS Shanghai draw review center, Wuhan branch office took charge of field inspection.

“HAI YANG SHI YOU 681” will head for the South China Sea, support the project of “HAI YANG SHI YOU 981”, serve for China national offshore oil development strategy.

## Scientific Survey Vessel-M/V “KE XUE”

Scientific survey vessel M/V “KE XUE” is national major scientific and technological infrastructure construction project in the period of 11<sup>th</sup> five-year plan, which was one of the most advance scientific survey vessels in the world. As the “warship” of scientific survey vessels in the next 10 to 20 years in China which has the ability to observe whole bathy in the global navigation, and was called “moving lab on the sea”.

The overall length, molded breadth and molded depth are separately 99.80m, 17.80m and 8.90m; Its cursing ability can reach 15,000 nautical mile, and holding force can reach 60 days.

M/V “KE XUE” uses the internationally advanced POD electric propulsion system. It equips with 2 bow thrusters, 360-degree view Bridge, unmanned cabin, one-man bridge, DP1 dynamic positioning and integrated navigation system. It can realize 0-15 knots continuously variable transmission, 360-degree pivot turning when it is in low velocity, and it can be handled flexibly. “KE XUE” equips with 7 ship borne scientific detection and experiment systems, including water body detection system, atmospheric exploration system, submarine detection system, extreme deep-sea environment detection system, remote sensing information



confirmation system, ship borne testing system and net system. It carries high-precision Veripos GPS navigational system, fully bathymetrical multi-beam detection system, multi-channel digital earthquake system, remotely-operated vehicle (ROV), TVG and many other internationally advanced detection systems. It has multi ocean environment observational and inspectional abilities of high-precision and long-term dynamic environment, geological environment, ecological environment, living beings and chemistry.

The M/V “KE XUE” will become the support and sharing platform to research and detect China Major Program for the Fundamental science.

## M/V “YANGTZE GLORY”-VLCC



M/V “YANGTZE GLORY” is the third VLCC which is constructed by NJTC that involved in six VLCCs as the same type. During the construction of this series of ships, CCS Qing Huangdao branch has strengthen project management and has perfect management procedure; has coordinated all parties timely has controlled the quality strictly; has provided ship-owners with timely technical support and service; make sure the quality of the ship’s construction and delivery due, and good service of surveyors have gotten pretty good feedback from shipyards and ship owners.

# Breakthrough in Distribution Law Regarding Ship Energy Efficiency Research

By Li Dayi

Nowadays, “Green shipping” is a new competitive index both in shipping and shipbuilding industry. How to improve ship energy efficiency and reduce environment pollution has already become a realistic and major imminent subject for the shipbuilding and shipping industry to deal with.

With regard to this, China Classification Society(CCS) carried out in a timely manner the “Research of Energy Consuming Distribution and Evaluation System of Ship Energy Consuming Equipment and System”. This research is the key research project of CCS “Green Ship Plan (G-VCBP)”, undertaken by CCS Technology R&D Center. Against the background of the global “green” trend, and on the basis of systematic collection, summing up and organization of the detailed data of ship energy-consuming equipment and system of the three main domestic ship types (oil tankers, bulk carriers and container ships), this research project aims at the current basic technology for green ships, provides a comprehensive analysis of ship energy consuming unit, establishes typical ship energy consuming model, draws up the rule of energy consuming distribution of the three main ship types, establishes ship energy consuming evaluation system to give energy-saving room and potential, and sums up the method to calculate ship energy consuming distribution.

Currently, the research and development of energy conservation and emission reduction are lacking fundamental technical support. In response to this situation, the “Ship Energy Consuming Distribution and Energy Saving Instructions” summarized the rules of energy distribution for three main ship types (as Picture 1) (oil tanker, bulk carrier and container ship) and the energy saving potential based on a series of research. It gave a baseline for effective use of ship energy and listed the current mainstream energy conservation technology

and sensitivity analyses. It also proposed an innovative scientific and integrated calculation method for ship energy consumption distribution, taking into account the reality of ship energy system.

The software of “Calculation and Analysis System for Ship Energy Consuming Distribution” has been developed in order to facilitate the readers of the Instructions to carry out independently the calculation of ship energy consuming distribution. The ship energy consumption calculation method and the baseline for effective use of ship energy have been embedded in the software. The seven major function modules of ship energy consuming distribution calculation, outcome analyses of energy consumption distribution, efficiency calculation of energy use, evaluation of energy use efficiency, calculation of green technology energy saving potential, statistics of energy consumption for main ship types and the database of energy consumption for domestic ships have been developed according the needs of customers. This software can satisfy the needs of ship designers, shipping companies, industry administration departments as well as other customers.

The project achievement indicates the direction for improving effective use of ship energy through a comprehensive understanding of the application and consumption distribution of ship energy and identifying the weak point of energy use and energy saving potential; it offers a reasonable and effective calculation method for ship energy consumption distribution and technical support for classifying energy application level for ships and major equipment; it provides the basis for ship energy saving technology, waste heat recovery and comprehensive utilization of multi-energy resource, and provides support and service for the implementation of national energy saving and emission reduction policy in shipbuilding and shipping industry.



# The Confirmation and Mastery of Redundancy

By Li Mingliang



the thermal insulation of liquid cargo tank(-160°C) fail, cold liquid may leak into vessel body. The hull cold crack may occur, the consequence would be horrific.

## ■ Duplication of Equipment

Two-tiered system doubles the economic cost, but this must be done to prevent catastrophic effects. However, two-tiered system is not widely used on ships and platforms. Duplication of equipment is generally used instead.

Lifesaving plays an important role in ship and platform safety, it is the last line of defense of ensuring safety of lives. Conventions for cargo ship set out that life boats on each side of the ship must accommodate 200% of the people onboard. Two sides add up to 400%. It is reasonable to adopt such high redundancy. In case the water enters the broken ship and makes the ship list to one side, the lifeboats on one side will fail. As to fixed offshore platform, the redundancy of life saving equipment is 100%, since no list will happen to fixed platform.

The theory of equipping of the global distress system introduced in SOLAS is that every function adopts duplication of equipment. For example, there may be several schemes of ship-to-shore distress alert function, and each of them must have two alert facilities. Ships equipped with medium-high frequency communication facilities may send distress alert by digital selective

By studying SOLAS, MARPOL and classification society rules, it is not difficult to find out that redundancy is the most universal measure for ensuring safety. Generally, people understand redundancy as surplus and backup. But the degree of redundancy should be considered and decided in conventions and rules, and both safety aspect and economic aspect should be taken into account. This article analyzes and discusses various redundancies.

## ■ Two-tiered System

The so called two-tiered system means that a complete backup is made for a certain system. For example, two completely independent dry powder extinguishing systems should be equipped on liquefied natural gas vessel and floating natural gas platform. There will be three extinguishing systems, if a set of water extinguishing system is counted. Such a high redundancy has been adopted because if the liquefied natural gas catches fire and gets out of control, there will be serious consequences. On liquefied natural gas vessel and floating natural gas platform, the cofferdam between liquid cargo tanks is equipped with heating system. There are two parallel and independent systems. One system is the main system, the other is put on standby. The function of heating system is to keep the cofferdam temperature above 5°C. If the system and

calling or position indicating radio beacon.

In addition to equipment redundancy, the place where the equipment is located should also be redundant. For example, fire pumps, ballast pumps, bilge pumps of semi-submersible platform should be duplicated, in addition, the main equipment must be located in a different place than the spare equipment, in order to prevent the failure of both the main and spare equipment caused by water ingress in the same location or fire.

### Two-Level Protection

Practice shows that threats to ship and platform safety are often caused by system or equipment failures. If we analyze possible failures and develop redundant plans, the equipment can run reliably. High pressure fracture, light explosion and burning down caused by lacking of water may occur to a boiler. First level protection of pressure transducer is widely used to prevent high pressure fracture. When the pressure approaches preset pressure value, the transducer will work and the boiler will be shut down, so that the pressure will stop raising. The second level protection is safety valve. When the transducer fails, the valve will be opened, the redundant pressure will be released. A lot of flammable gas existing in furnace may cause light explosion. First level protection of flame failure detector is widely used to prevent this serious accident. When the boiler is shut down, the flame failure detector will work and the supply source of the fuel will be shut down and will not inject oil into the furnace. Accumulation of flammable gas is prevented. The second level protection is pre-purge of furnace. Since the inflammable gas that could be accumulated has been blown away, there will be no light explosion.

### Double Control

With the development of science and technology, automatic control is used widely on ship and platform. Double control is

widely adopted for operation safety.

#### Automatic control and manual control

All automatic control equipment are equipped with manual control. For example, fire detector of fire detecting system on platform will trigger the hydraulic spraying system if it detects the fire. On finding fires, the stuff can also launch the hydraulic spraying system when the detector fails.

#### Remote control and local control

All equipment that will be controlled should be able to be switched to local control. This is a safety measure usually adopted by conventions and rules. For safety, local control can be used when the remote control system fails. As to huge ballast system of semi-submersible platform, pumps and valves can be controlled in central control room and can also be controlled locally in lower hull. If the local control is not possible due to restrictions, we should take equivalent measures. For example, if local control of oiler liquid cargo tank fails to operate, a set of manual hydraulic equipment must be installed on the board.

#### Overstep control

The so called overstep control means canceling one process of control. For instance, high water temperature of cylinder liner and low pressure of main engine lubricant may lead to shut-down. In order to prevent collision accident, shut-down or slowdown of main engine is not permitted. We need overstep control so that the main engine can continue to run. Engine damage is preferable than collision to minimize the losses. In actual design, manual control can overstep automatic control, local control can overstep remote control.

Redundancy is used for safety and it is not that the more redundancy, the better. Under the precondition of safety, the lower redundancy, the less cost. We should continuously summarize and deepen redundancy theory, and promote our understanding to a theoretical level, so that we can set the redundancy scientifically in future rules, and the advancement and rationality of rules can be reflected.

# Status Quo and Key Technology of LNG-Powered Ship

By Xu Jianyong & Gan Shaowei

**M**/V “KLATAWA” is a passenger ferry equipped with dual-fuel propeller which is the first of its kind in record, and in 2005, the Atlantic Shipyard in France built the world’s first and biggest LNG dual-fuel ship. There are some representative LNG-powered ships abroad such as the world’s first LNG-powered ferry ship “M/F GLUTRA”, the world’s first LNG-fuel support ship “VIKING ENERGY”, the world’s first LNG-powered container ship “MAERSK DRURY” of 5,000 TEU, the world’s first dual-fuel chemical tanker “ARGONON”, and the world’s first modified LNG-fuel product oil tanker “BIT VIKING”.

In terms of technical standard for LNG-powered ship, IGF Correspondent Group of IMO has completed the sixth draft edition.

Domestically, CCS started to develop standards for LNG-powered ship relatively early, and has successively established related technical documents. Currently, CCS is undergoing the key technology research on LNG-powered ships and the development work on Rules for Construction of Natural Gas Fuelled Ships and Rules for Construction of Natural Gas Fuel Filler Pontoon.

“Lun Du 302” of Wuhan Ferry Co. Ltd., was the first project applying to CCS for LNG dual-fuel modification. Later, CCS took part in the modification work for “Chang Sun San Hao” container ship of CSC. The 3,100DWT LNG-powered bulk carrier is the first ship classed with CCS and has now completed trial voyage.

## Risk Factors

Fuel system for LNG-powered ship generally includes fuel filling, storage, supply and usage.

Due to the features of LNG fuel, the danger of LNG-powered ships is mainly reflected in “three spaces, one system and four parts” i.e. gas tank space, machinery space and filling space, and piping system (including fittings and valves), and engine, gas tank, heat exchange equipment and central control unit.

## Key Technology

The main target of the rules or technical standards for LNG-powered ships is to reduce the risk relating to gas fuel to an acceptable level, making the safety, reliability and availability of LNG-powered ship at least equaling to conventional oil fuel ships. According to the above risk analysis, the rules focus on providing safety and technical requirements in such respects as gas fuel filling, storage, supply and usage.

### 1. Gas fuel filling

LNG filling can be divided into two types, i.e. integral fuel cell (POTABLE TANK) replacement or direct filling on board. The major risk of integral fuel cell replacement lies in: (1) frequent replacement of the integral fuel cell, so that leakage occurs to its connection with the gas supply system due to potential airtight damage; (2) the risk of lifting fuel cell dropping off; (3) inaccurate fixture of fuel cell causing pipe leakage and danger.

### 2. Storage of gas fuel

Tank: the rules allow LNG-powered ship to use membrane tank,

half-membrane tank or independent tank.

At present, C type tank is commonly used as LNG tank and designed according to the pressure vessel standards. Its heat preservation modes include: (1) pure vacuum; (2) FRP wrapping and vacuum; (3) perlite and vacuum.

### 3. Supply of gas fuel

The gas supply pipes within machinery space: all gas supply pipes are all required to be double-walled within the intrinsically safe engine room, and for this reason, there are two types: one is the concentric pipe, filling the inert gas (positive pressure nitrogen) between the internal and external tubes with pressure higher than that within internal pipe, and once the detected inert gas pressure is reduced, it would be immediately alarmed; the other is to enclose the gas supply pipe in the ventilation duct, which is equipped with suction fan with its ventilation capability no less than 30 times per hour.

### 4. Use of gas fuel

Engine: natural gas inlet modes for gas fuel engine include: entering into cylinder through the inlet manifold before the supercharger mixing with air; entering into cylinder through the inlet manifold after the supercharger mixing with air; entering into the

cylinder from the inlet branch pipe or air inlet after mixing with air; directly injecting into cylinder.

At present, the engines produced by MAN B&W MEGI use direct injection mode, which is high pressure air intake, and the DF engines by Wartsila use branch pipe inlet.

Another potential danger in modifying existing diesel engines is that detonation phenomenon would appear if the mixed fuel gas ratio exceeds 20% : 80%, which will impact the safety of diesel engine.

ECU (electronic control unit): the main function of the electronic control unit is embodied in three aspects: control of diesel engine work status, control of oil and gas supply, fault identification and treatment.

The control of diesel engine and gas supply system can be integrated into an ECU, or divided into main and subsidiary ECU controls. The safety of ECU mainly embodies three facets, i.e. software reliability, hardware reliability and life, and firmness of connection.

This paper briefly summarized the LNG-powered ships and related technical standards abroad, LNG-powered ship's modification in China, and CCS' technical standards and key technologies for LNG-powered ship.





# CCS Pushes Technology to Upper Level

By Wang Sijia

In 2012, China Classification Society (CCS) explicitly put forward the guiding ideology for the science and technical work which is “independent innovation and leading development”, increased the investment in the scientific and technical work, achieved notable results of capacity building related to rules and research and technology and led the informationization construction onto a fast traffic lane.

Firstly, CCS continuously increased the investment in research and development and improved the capability of independent innovation. CCS finished 47 projects of rules, guidelines and scientific research throughout the year of 2012. It studied and developed the first Rules for Green Ships around the world, actively promoted the approval of green ship type and certification service of ship energy efficiency and developed technical standards for LNG-fuel powered carriers. CCS played the leading technical role in promoting green shipping and the transformation and development of ancillary products.

CCS actively participated in the research and development of harmonized common structure rules (HCSR) of IACS, took the lead in releasing the matching calculation software which supports China's shipbuilding industry for grasping, testing and verifying the requirements of new rules and the development of new ship types. It also organized the preparation work for the audit of the rules for “goal based standard”, cooperated with the domestic scientific research institutions to achieve breakthrough in the core technology and made periodical results. With regard to ship structure

database project, more than ten items of independent innovation technology were researched and developed and they were accepted by Ministry of Industry and Information Technology (MIIT) and Ministry of Finance, which lays foundation for data analysis in order to continuously enhance the overall strength the ship industry.

Secondly, CCS actively participated in national science and technology projects. CCS strengthened the cooperation with the scientific research units, colleges and universities and related enterprises. It undertook the project of MIIT “research on key technology of common structural rules based on goal based standard”, verified eleven ship types by cooperating with the industry and laid the foundation for meeting the development of new ship type and market competition under the HCSR. CCS took part in fifteen science and technology projects of Ministry of Transport and MIIT including ship cabin acoustic design evaluation, basic design of polar self icebreaking





scientific research ship, top design of standard system of offshore engineering equipment, which showed science and technology standard and capability of CCS. It developed analysis and calculation software for wave load together with Harbin Engineering University. CCS, by working with related colleges and universities, set up the collaborative innovation center of ships and offshore engineering, collaborative innovation platform of green and safety technology of Yangtze River gold waterway and collaborative innovation center of green and safety technology of sea transportation.

Thirdly, CCS strengthened the study on offshore engineering technology and made significant progress. CCS determined the development framework of offshore engineering rules system; established the rules and guidelines for basic mobile unit and floating production unit and had the service ability of independent classification and survey and certification of shallow-water mobile unit and fixed unit. Based on the summary of “Offshore Oil 981” project, CCS carried out the key technology research on deep-water semi-submersible drilling unit in terms of overall performance and fatigue life analysis and had the analysis and plan approval ability of deep-water semi-submersible unit. CCS accumulated the survey and certification ability of deep-water production unit by means of “Liwan” project.

Fourthly, CCS promoted international exchanges and technical cooperation, digested and absorbed the advanced foreign technology.

CCS, by cooperating with foreign classification societies and universities at home and abroad, carried out technical exchanges of wave load, structure and hydro-elasticity of ships, mastered the international cutting-edge development trend and determined the technical route of research and development; it completed the accreditation for LNG membrane tank patent of French GTT company and carried out the technical cooperation; by carrying out technical exchange and cooperation with Lloyd’s Register of Shipping, CCS provided the technical support for ship type design of the new polar expedition ship of State Oceanic Administration.

Fifthly, CCS continued to improve technical level for plan approval and service capability. CCS strengthened the key technology research on plan approval, actively promoted the service before signing contract, carried out upgrade approval of HCSR of 17 types including 320,000DWT VLCC, ship type approval of 4 types ships including bulk carrier of 76,000DWT and design approval of 10 type ships including LNG carriers of 30,000 m<sup>3</sup>.

Sixthly, CCS played an important technical support role in national key research projects, naval ships and public ship projects. It provided standards, plan approval and on-site survey and classification service in the project of “Jiaolong” manned deep sea submergence vehicle (DSV) of 7,000 meters; It organized special research on law enforcement vessels including customs anti-smuggling vessel, marine supervision vessel and coast guard vessel and etc., perfected related rules and guidelines and continually promoted the classification service of coast guard vessel and naval ship.

Seventhly, CCS vigorously strengthened the construction of informationization. CCS completed fifteen information construction and development projects, eight newly approved projects, and finished informationization top design planning, built guidance and system for the informationization construction and management; organized and completed energy efficiency management, port state inspection information and management evaluation, development of intelligent instructions to surveyors, electronic plan approval of ship and of products and other management systems which strongly supported the development of related businesses.

# CCS and GTT Developed Cooperation on the Issue of Ship Type Developing

By Yue Mengqiang

China classification society (CCS) and GTT who owns the patented technology of French membrane liquid cargo tank on LNG vessel achieved cooperative purpose on the issue of developing small membrane LNG vessel and ship type recognition. The signing ceremony of the collaboration agreement was held in Shanghai on 23 Nov 2012.

As only owner of the membrane tank technology widely accepted by insiders, GTT owns industry-leading patented technologies of fundamental research, design instrumentality, calculating and analyzing instrumentality and experimental conformation instrumentality. It keeps a high customer confidence level and market share in the market of large-scale LNG vessels. In addition, GTT have participated widely and deeply in setting international standard of LNG logistics chain and have rich experience.

As the only government authorized ship survey organization, China classification society (CCS) involved in setting domestic law and various of survey requirements and technical management regulations masters all of the requirements and regulations expertly. CCS has an in-depth

and extensive knowledge about characteristics of domestic LNG logistics chain, such as sources, ship routes and docks. It also keeps a long-term and good cooperative relationships with domestic ship owners and shipyards.

National energy policy encourages and promotes green energy, the need for LNG import traffic, distribution and transshipment among internal clients, marine LNG fuel popularization and construction of supply chain is becoming more and more urgent.

With the development of the project, the two sides conjoined together will make breakthroughs and bear fruits in the respects as follows:

- Through sufficient communications about input informations of client needs, channels, regulation requirements during the R&D processes of the ship types that is suited to water area in China, the ship type can better meet the requirements of industry.

- China classification society (CCS) accepted new ship types developed by GTT and related patented technology of cargo hold, mastered core technology of improving examination and service abilities. CCS can



provide technical service of LNG vessel independently, improve the development of shipbuilding industry and meet the demand of ever-increasing LNG transportation equipments.

- As the only government authorized ship survey organization, China classification society (CCS) plays an important and irreplaceable role in helping competent authorities set the standards about LNG feeder service and fuel supply. Through the cooperation, CCS can set reasonable and feasible safety standard of domestic LNG transportation industry.

China classification society (CCS) will develop the pattern of technology cooperations with home and abroad core technology owners, grasp the development trends, gear technical service ability to the development of industry. The cooperation with GTT will be a beneficial attempt for this pattern.

# Open the Door of HCSR

By Xu Wei

According to industry needs, the international association of classification societies(IACS) developed short-term and long-term project managements respectively to maintain and coordinate CSR norm after common structure rules(CSR) of oil tank and bulk carrier was issued. IACS established CSR maintenance team and four project teams(PT), in accordance with short-term project management. PT1 and PT2 undertake explanation and maintenance of bulk carrier and oil tanker respectively. PT3 and PT4 provide CSR limited computational data and data of norm calibration standard. They should also guarantee all classification societies consistent understanding of the norm and guarantee external users norm computational data for reference. CCS entered CSR norm maintenance team in the beginning of the project and CCS become the project manager of the finite element team. Coordinating two CSR norms is the

long-term project management of IACS. General structural problems should unify the standard, such as calculation methods of load, finite element, buckling and fatigue, except bulk carrier and oil tanker which own their inherent particularities. During the HCSR norm and software development phase, all the norm developments, numerical verification calculations and software developments should proceed inside the society. On 1 July 2012, IACS punished the first published HCSR norm draft and asked for external advices. IACS held a Chinese zone tech-in On 5 Sep. in Shanghai and helped Chinese industry to master the influences which the draft

of HCSR norm have exerted on current CSR vessels as soon as possible. Chinese industrial circle gave some advices at the tech-in and put forth efforts to develop the norm towards direction that is benefit to current shipbuilding situation in China. At the same time, CCS held a series of activities, cooperated with shipyards and design institutes closely, conducted joint research about HCSR draft and the consequent impacts.



## Tech-in of HCSR Software

In view of IACS internal regulations, classification societies(including CCS) should not publish any norm draft or numerical calculation result before official publication was released by IACS. In the meantime, for timely understand of HCSR development and for better first-phase preparations before the IACS draft was released, CCS held a HCSR software



tech-in in Shanghai on 5 June 2012. Technicians who took part in developing HCSR norm and software introduced newly developed software of CCS, and they reported development schedule of the software and verification results from comparison with software developed by other classification societies. At the same time, the need for HCSR software and actual ship verification calculation of each shipyard and design institute was collected one by one. At the meeting, all shipyards and design institutes have reached a preliminary consensus on the issues of subsequent norm and software training and actual ship verification calculation.

### Norm and Software Training

IACS officially released first published HCSR norm draft on 1 July, CCS started the first phase of HCSR norm and software training on 18 July. Among IACS members, CCS developed the software and training earliest of all. Training participants are first-line technical staff of shipyards and design institutes. They took part in actual ship verification carried out by MIIT after they finishing the training. They calculated the existing CSR ship types by HCSR software of CCS, verified the influence that the draft of HCSR norm have exerted on current CSR vessels structural strength. In order to maximize the reach of training, CCS developed second phase HCSR norm and software training, so that more technical staff of shipyards and design institutes can know about HCSR. These two trainings were all arranged before the time of tech-in, provided shipyards and design institutes technical support for doing research of HCSR norm before tech-in. These two trainings covers 20 institutes and altogether 80 technical stuff. In addition to external training, CCS trained altogether 12 technical stuff who come from drawing review centers of headquarter(Shanghai) and some other area. They will be awarded HCSR calculation qualification after they passing the examinations. On the basis of drawing review centers, shipyards and design institutes can find the qualified drawing review engineer and get technical support in time when confronted with problem about HCSR norm comprehending or software.

### Actual Ship Verification Calculation

On the basis of HCSR software of CCS, shipyards and design institutes can calculate and verify existing CCS ship types, determine whether the place that the structure size should be increased and reduced exists. Through the research of changes in structural requirements, rationality of HCSR norm draft can be analyzed further. In order to minimize the impact on shipbuilding industry brought by HCSR after it took effect in China, a team of MIIT actual ship verification group consisted of 11 shipyards and design institutes led by MIIT developed a three-weeks actual calculation. This calculation covers 7 bulk carriers and 5 oil tankers. Through the comparisons of HCSR and CSR norm requirements, the group summarized more than 20 suggestions. On the meeting of IACS tech-in, these suggestions were all adopted by IACS and drew high attentions.

### Pre-contract Service Related to HCSR

Although the effective time of HCSR is not determined, we should take precautions, seize market opportunities. It seems important to provide suitable HCSR ship types when HCSR takes effect, especially at the time of shipbuilding industry depression. CCS utilized the experiences accumulated in developing HCSR norm and examining CSR drawings and provided shipyards and design institutes all kinds of pre-contract services, such as ship types developing(including optimization and upgrading) , ship type recognition, design recognition and drawing preliminary examination etc.

- ◆ Ship types developing(including optimization and upgrading). CCS takes part in scheming ship types and designing structure in the early stage of project planning, contributes to orders. More than 10 projects of MIIT HCSR actual ship upgrading are carrying out.

- ◆ Ship type recognition. According to promissory working range and technical standards of ship recognition protocol signed by client, CCS verifies the conformity of the design drawing related to main ship structure, on the basis of calculation and analysis. The ongoing pre-contract service of ship type recognition includes ship upgrading recognitions of 76,000DWT bulk carrier, 82,000DWT bulk carrier, 95,000DWT bulk carrier and 205,000DWT bulk carrier.

- ◆ Design recognition. As to design scheme provided by design institute, CCS verifies the conformity of main design drawing, according to promissory working range and technical standards signed by client.

- ◆ Service of drawing preliminary examination. Client provided design drawings, but the contract was not signed for various reasons. According to promissory working range and technical standards specified in protocol of drawing preliminary examination signed by client, CCS verifies the drawing in advance and discusses about the project, submits preliminary examination suggestions, guides design improvement so that the design can meet related technical standards. On the basis of HCSR norm draft, cargo hold structural strength calculation of 320,000 tons VLCC is making.

Due to CSS prophase intervention, designers guarantee the design meeting the requirements of ship owners on the one hand. On the other hand, CCS acts as bodyguards, makes sure the first punished drawings can meet requirements of related norms. With the cooperation between CCS, design institutes and shipyards, quality of prophase design is improved, lots of suggestions and modifications produced by anaphase examination are avoided.

HCSR norm is asking for external suggestions at present. CSS has put great technical force to taking part in norm modification and HCSR software upgrading. CSS will synchronize with HCSR, optimize the services, enriches communication and cooperation with design institutes and shipyards, sequentially provide support and guarantee for shipbuilding industry in China.

# Support to Implementation of MLC 2006

By Yang Liming

**M**aritime Labour Convention 2006 (hereinafter referred to as MLC 2006 as below) was approved at the ILO 94<sup>th</sup> meeting and the tenth maritime conference in February 2006. By August 20, 2012, 30 countries had ratified the convention with their gross tonnage taking up 33% of the world's commercial fleet. So, the convention will enter into effect for all member countries on August 20, 2013 according to related rules.

Founded in June 1919, ILO was originally an independent agency associated with the League of Nations, and became a specialized agency of the United Nations in 1946. ILO insists on tripartite rules. Various meeting of the organization will be composed by representatives of governments, employers and workers to jointly shape policies and programmes promoting Decent Work for all.

As a comprehensive maritime labour convention, MLC 2006 was accomplished by ILO on the base of compositing and amending 68 conventions and proposals, and its establishment united the international maritime labour standards. The main content of the convention covers five titles including conditions of employment, accommodation, recreational facilities, food and catering, and health protection.

CCS has been engaging in plan approval, inspection, and certification work for ship compartments since the 1980s. After the approval of MLC 2006, CCS began to establish implementation work plan. In terms of technical preparation, CCS has established the procedure for MLC 2006 inspection and certification work. In 2010,



CCS, in order to find out quantitative criterion, launched research analysis of maritime labour regulations of flag state.

In order to provide high quality and expedited service for flag states, shipowners and seafarers, CCS devotes a great deal of effort to reserve human resources.

Meanwhile, CCS actively carries out cross-industry cooperation, training, and technical exchange with relevant administrations and authoritative institutions.

Since 2010, some port states and international organizations have enhanced maritime labour condition inspection to ships arriving at their ports, and shipowners are facing huge pressure. Since February 2010, CCS, considering the urgent need of related parties in implementing practice and developing cooperation, has successively established working teams for implementing MLC 2006 demonstration ship with shipping enterprises in Dalian, Tianjin, Qingdao, Shanghai, Guangzhou, and etc. to help shipowners accomplish implementation work.

By the end of 2012, CCS had been authorized by 30 major international flag states to perform various statutory surveys. Currently, CCS has received the MLC authorization from Panama, Singapore, Liberia, Saint Vincent and the Grenadines, Marshall Islands, Cyprus, the Bahamas and Tuvalu. Hong Kong Marine Department has also promised its authorization to CCS.

Over the years, CCS has been actively taking part in related implementation work and providing technical support services, and received great recognition from the leaders of MOT and MHRSS, who hope that CCS will play a more important role in the future.

# The Classification Survey of “Jiaolong” Submersible

By CCS Shanghai Branch

On 6 November 2012, the classification survey of “Jiaolong” manned deep-sea submersible vessel (DSV) under construction, China’s first DSV boasting independent design and integrated research and development, was successfully completed. It is not only a national key and strategic project for which CCS provided technical support and guarantee for a single class, but also a classification of the first manned DSV with titanium alloy material and a designed maximum descending depth of 7,000meters. Issuing classification certificate for “Jiaolong” demonstrates that CCS is taking the world leadership in classification survey of submersible.

“Jiaolong”, as one of national major projects of high technological research and development program (863 program), has witnessed joint efforts made by nearly a hundred of prestigious scientific research institutions in the country and gone through the design, manufacture, assembly alignment, and tank performance test and sea trial and development stages of 3,000m, 5,000m and 7,000m level. “Jiaolong” with the maximum descending depth of 7,000meters among the same type of manned submersible worldwide means that its submersible working range can

cover 99.8% of the world's ocean area; it has a stable hovering and positioning ability with regard to operating object, which provides a reliable guarantee for the submersible to complete high precision operation task.

On 26 November 2010, 702 Institute of China Shipbuilding Industry Corporation submitted to CCS the application for classification survey of “Jiaolong”. Classification is a new requirement for “Jiaolong”, which was not specified in the previous contracts for research and development. Getting a classification certificate from CCS is very important for the safe use in the future especially for carrying out the international cooperation. However, the classification of submersible is very complicated, and it means challenge and pressure for CCS which is for the first time to undertake the classification of deep manned submersible. First of all, CCS did not have the suitable classification rules for manned submersible of 7,000meters at that time. Secondly, the manned submersible of 7,000meters has basically taken shape before applying for classification, and just finished the sea trial of 3,000 meters with the maximum depth of 3,759 meters. It is necessary for each party to study how to conduct classification survey of this manned submersible of 7,000 m.

For the submersible classification project of “Jiaolong”, the top management of CCS

has attached great importance to it, repeatedly stressing to guarantee the smooth development of classification of “Jiaolong”. According to the instruction of the Executive Meeting of the President, it is decided to set up project teams which are respectively led by the vice President and other leaders and technical backbone numbers for two types of the DSV, consisting of coordinating the management team, rules and standards team, plan approval team and survey team.

Delegated by CSS Headquarters, the Offshore Engineering Newbuildings Department of CCS Shanghai Branch established a field survey project team, which undertook the classification survey of “Jiaolong”. With the help of CCS Headquarters and Shanghai Branch, the field survey project team conducted careful planning and arrangement. Focusing on the working characteristics of “Jiaolong” and giving full play to the advantages of CCS, the classification survey of “Jiaolong” is creatively carried out. Especially in the survey of sea trial of 7,000meters, the field survey project team of the Offshore Engineering Newbuildings Department of CCS Shanghai Branch showed unswerving attitude in the face of various complicated situations and finally guaranteed that the classification of “Jiaolong” was smoothly carried out.

1. Collaborate to determine principles of plan



approval and survey for the classification of DSV

According to the requirements of CSS Headquarters, the field survey project team of Offshore Engineering Newbuildings Department of CCS Shanghai Branch particularly studied and analyzed the technical characteristics of “Jiaolong” and communicated with Shanghai Rules & Research Institute, Plan Approval Center and 702 Institute to carry out the technical exchange, coordinate related technical requirements and disposing suggestions. In June of 2011, on the basis of suggestions widely solicited from the industry, CSS finished the development of “principles of plan approval and survey for the classification of DSV” and took it as guidelines for plan approval and survey of “Jiaolong”. The guideline provided basis and standard for the following classification work and created conditions for the 702 Institute to finish the design of technical drawings.

#### 2. Collaborate to promote the plan approval

At the early construction stage of “Jiaolong”, necessary drawings are not complete due to many reasons. The survey project team convened several on-site meetings to collaborate the work and assisted in ensuring the content and integrity of the relevant submitted drawings collected by 702 Institute. The team actively contacted CCS plan approval center and helped 702 Institute timely getting all the approved drawings.

#### 3. Positively promote the on-site classification survey

To choose and determine the structural materials of “Jiaolong” manned submersible vehicle is of vital importance to the success of the project. In the process of choosing and determining some special materials, CCS survey project team, accompanied by

the experts from 702 Institute, almost fully participated in material selection of 702 Institute. They visited some special material manufacturers to carry out joint study and type selection across the country and gave the technical assistance at the first time.

#### 4. On-site classification survey of sea trial of 7,000meters

Since 31 May 2012, “Jiaolong” followed the mother ship “Xiang Yanghong No. 9” and reached the sea area near the Mariana Trench in the Western Pacific Ocean to conduct dive test of 7,000meters. On 27 June 2012, “Jiaolong” reached a depth of 7026 meters which created a new record of maximum depth for the world similar manned submersible. It means that “Jiaolong” has successfully completed the dive test. Meanwhile, it has verified the reliability of “Jiaolong” submersible.

Before the sea trial of 7,000meters, according to “Rules for Construction and Classification of Diving System and Submersible”(1996) and “Principle for Plan Approval and Survey of Deep-sea Manned Submersible” (2011), the Offshore Engineering Newbuildings Department of CCS Shanghai Branch examined and approved “Testing Programme for Diving and Sailing of “Jiaolong” Submersible of 7,000meters”, put forward opinions and suggestions to it, and used it as the basis for the on-site classification survey of CCS for the sea trial of 7,000 m.

During the sea trial, the surveyor conducted the following main survey works:

(1) Inspection of the performance of pressure and sealing parts and verifying the safety of all parts, confirming the inspection log of various equipment including the hatch

cover and observation tank.

(2) Under the maximum design depth, carrying out operating test of control system and flotation condition control system (buoyancy tank, adjustable ballast tank, diving and surfacing ballast). At the same time, testing the performance of underwater communication system;

(3) At the appropriate depth, testing the performance of the underwater propulsion speed of each direction, carrying out the operation test of the surfacing, diving, rotating, and stop function;

(4) Inspection of propelling, electrical safety operation;

(5) Testing the performance of life support and environmental control system.

#### 5. Discovering and dealing with on-site survey issues

During the pressure testing of pressure equipment of “Jiaolong” submersible conducted in workshop, some minor unforeseen problems occurred, such as efficacy expiration of pressure gauges, rupture of pressure tube causing pressure decline and jamming of cylinder lid after testing etc. Due to high pressure (78MPa), longer testing time (7 hours), the process of testing is prone to unforeseen problems. That’s why before conducting stress testing, the pressure equipment and instruments should be checked carefully to ensure the smooth progress of testing and to prevent any mishaps in the testing process. Some unforeseen problems such as interruption of communication under waters, loosening of thrust hoops, bursting of hydraulic tubes and malfunctioning of 24V earthing etc., occurred when testing was done in the sea trail. These kinds of problems can also be eliminated in time.

# Implementation and Application of Green Ship Rules

By Sun Wu

Against the backdrop of the current downturn of shipping and shipbuilding industries, green ship is an important direction for ship type upgrading in the shipping and shipbuilding industries and an entry point for product structure adjustment. IMO began to consider introducing the subject of air pollution prevention from ships on the diplomatic conference regarding air pollution prevention from ships in 1997, and its MPEC 62 approved in July 2011 the Annex VI amendment to International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, introducing the two ship energy efficiency requirements, i.e. EEDI and SEEMP. The amendment has entered into force since January 1<sup>st</sup> 2013, indicating that the low-carbon era of the international marine industry has come and the maritime industry is going to face rigorous “carbon” test.

On September 28<sup>th</sup> 2011, the Ministry of Transport of China released the program on implementation of energy conservation and emission reduction in the water-borne transport sector during the twelfth five-year period. By 2015, compared with 2005, the overall energy consumption of port production unit throughput will be decrease by more than 8% and CO<sub>2</sub> emission will be declined by more than 10%. Meanwhile, the transportation turnover per unit of ship in service will be reduced by more than 15%, with CO<sub>2</sub> emission declined by more than 16%.

To adapt to international and domestic development trend, CCS began to implement the green ship plan in 2008, and compiled a comprehensive evaluation and verification standard for green ships based on GBS approach: Green Ship Rules. The rules came into effect on Oct. 1<sup>st</sup> 2012 and is the first green ship rules in the world.

## Definition of Green Ship

The industry gives extensive definitions to the green ship from different angles, such as environmental protection, sustainable development and pollution free, etc. Most of these definitions provide requirements for green ships from a facet or a point of ship. When developing the Green Ship Rules, CCS adopts a systematic method—GBS, and advances the basic modes as below by starting with the foundation and the goal of green ship:



Through the modes above, CCS has advanced the definitions as below: the green ships refers to those that can utilize relatively advanced technology (green technology) to economically meet the scheduled function and capability in its lifecycle, and improve energy efficiency, reduce or eliminate environmental pollution, and provide good protection for operation and other relevant personnel.

Based on the definition, the Green Ship Rules advances the goal requirements from four facets involving safety foundation, environmental protection, energy efficiency and working environment.

In terms of safety foundation, the ship under the intact and damage conditions should have proper strength, integrity and stability. Application of green technology should not add extra safety risks to the ship. In terms of environmental protection, green ship should reduce pollution or damage from ships to ocean, land and atmosphere. In terms of energy efficiency, it can reduce CO<sub>2</sub> emission produced by ships in operation, and enhance energy efficiency level. In terms of working environment, it can improve seafarers' working and accommodation condition, and reduce the seafarer's labour intensity.

## Main Contents of Green Ship Rules

The Green Ship Rules covers the latest requirements of current international conventions and the latest research outcome of the industry and provides technical requirements from the perspective of integral ship lifecycle. In terms of safety foundation, the Green Ship Rules requires that the green ships should meet the related requirements of international mandatory conventions, state flag regulations and related major classification requirements. To fully evaluate the green performance of ships, the system identifies the factors and sub-factors of green ships, mainly including environmental protection factor, energy efficiency factor, working environment factor, and etc. Environmental protection factor includes elements involving prevention of oil pollution, sanitary sewage pollution, garbage pollution, air pollution, ballast water control, ship recycling control, and etc. Energy efficiency factor includes the two main elements, i.e. energy efficiency of ship design and ship in operation. Working environment factor includes automation, vibration and noise elements.

The Green Ship Rules advances the notation representing the ship's green characteristics, and the notation is a comprehensive identification in terms of advancement in environmental protection, energy efficiency and working environment. To improve structural optimization and upgrading of the shipping and shipbuilding industries, it divides the green ship notation into three levels: Green Ship I/II/III, and establishes grading requirements and review process.

Apart from identifying the comprehensive green performance of ship, the Green Ship Rules also establishes special notations for green technologies to encourage their application, such as energy-saving propeller, wind power, solar power, fuel cell, etc.

In order to highlight the advantages of ship energy efficiency, the Green Ship Rules provides dedicated notations for ship design energy efficiency: EEDI (I/II/III).

Apart from the Rules itself, related guidelines for the Green Ship Rules includes verification guidance for technical requirements and common green technology guidance.

## Advice on Implementation and Application

The Green Ship Rules provides direction for ship design, construction, survey and operation from technical perspective. In order to realize the targets as described in the Green Ship Rules, I deem that we should make breakthroughs from the following aspects:

### 1. Optimization of current ship type

The mandatory implementation of EEDI promulgated by IMO provides new requirements for ship designers and shipyards, mainly embodied in constantly striving for excellence during the ship design and construction process. At the peak of shipbuilding market,

ship designers and shipyards in China sprang up like mushrooms, but remained repetition at low technology level, and not many outstanding ship types were developed. Currently, shipyards can only take ship orders when the EEDI of new ships satisfies the 2<sup>nd</sup> tier requirements of IMO. They can take measures such as linear optimization and slow steaming to meet the target.

Good ship construction craftsmanship and precision is the best way to control empty ship weight. By comparing existing empty ship weight of 56,000DWT bulk carriers in series, we can find that the change range of empty ship is relatively big, and we can obviously reduce the EEDI of new ship by optimizing arrangement.

### 2. Equipment for the whole industry needs to be improved

By analyzing ship design drawings, we can find that the thickness of steel plate chosen for real ship is always bigger than that required by strength analysis due to the fact that the thickness of steel plate provided in domestic is very limited or constrained by the welding procedure. Only this facet will make empty ship much heavier. In addition, the positive error of steel plate thickness is also an important reason behind the weight of empty ship higher than design value.

According to the feedback from shipowners, if we chose domestic equipment for our ships, it would increase 10% of the whole ship's power station capacity.

From the phenomena above, it is necessary for the whole industry to join efforts to keep up with the high international standards in order to realize the energy efficiency target of green ship. Then, it can move green ship forward.

In terms of environmental protection, relatively rigorous technical standards have been introduced by international conventions, Europe and north American, and all these standards are reflected in the Green Ship Rules. In order to realize these targets, we also need to support ship equipment standards such as NO<sub>x</sub> Tier III, ballast water treatment system, and so on.

### 3. Application of green technology

To meet the requirements of Green ship III, it is, based on current analysis, necessary for us to adopt energy saving green technology. Judging from current technology, LNG fuel is the best way to reduce energy consumption and emission.

By analyzing nearly 50 types of current energy saving and

emission reduction technology applicable to green ships in five facets, involving ship design, propulsion, machinery, operation strategy and scrubber, as well as their energy conservation results, applicable ship types, cost effectiveness and application prospect, it is considered that most of the three main ship types (oil tanker, bulk carrier, container ship) could meet EEDI(I) standard of Green Ship Rules based on the energy efficiency of ships currently under construction in China. If it met EEDI(III) of Green Ship Rules, it would be a more appropriate choice to adopt such technology as gas layer reducing resistance, reducing design speed, zero ballast water, etc.

### 4. Improving vibration and noise reduction technology

In terms of working environment for seafarers, vibration and noise are the two most important indicators. To normal commercial ships, the requirements on vibration and noise indicators are always attributed to non-mandatory scope, so the controlling technology and experience of designers and shipyards in the indicator is not perfect yet. However, the Green Ship Rules provides the minimum requirement for vibration and noise indicators. The requirements of strong noise regulations approved at the IMO MSC 91 meeting are basically the same as the Green Ship Rules. To realize the target, it is necessary for the whole industry to devote more energy to carry out related research.

The Green Ship Rules clearly defines the scope of green ship, and provides green classification standard, which not only is in line with international standards, but considers the development level of current global shipbuilding industry, and points a direction for development of green ship. In order to realize the target of green ship, it is necessary for the industry to increase consciousness towards green ship, actively explore and practice. The organic bond of exploration, practice and national energy saving and emission reduction policy will greatly optimize and upgrade industrial structure of shipbuilding, relating manufacturing and shipping industries, and also promote the development of domestic shipbuilding and shipping industries. It is delightful to see that the Ministry of Industry and Information Technology and the Ministry of Transport are establishing relative incentive policies, and the whole industry is acting now. It is undoubted that in the near future, our country would be bound to develop optimized green ship types.

# Security for Ship Financing

By CCS Ship Business Operation Dept.

In recent years, as a result of suffer from European debt crisis, major global financial agencies and European ship financing bodies have successively reduced their ship financing scale or withdrawn investment to avoid risks, while Chinese financial institutions have seized the opportunity and started to get deeply into this challenging field.

Ship financing is a financial service field characterized by specialization, high-risk and long period. Depending on long-time market experience accumulation and with advantages in relatively perfect maritime technology, information consultation and services, western financial institutions have probed and finally established the ship financing service mode and service products suitable for their development under a relatively perfect framework of legal system. However, it is not an easy task for China to simply copy or adapt to the mature experience of the western financial institutions. The Chinese ship financing institutions or loaners that are needed have a large difference in financing strengths and in levels of management or operation. The causes of high risk for developing ship financing services in China may include lack of related policy support, lack of matching laws and regulations, shortage of financing talents with background of ship technology and the just starting stage of the credit evaluation system to be established

At present, neither the legal system construction nor credit evaluation system nor policy guidance is the most effective way or method to resolve the prominent contradictions between the market demand and the lag-behind ship financial service. Therefore, some domestic large financial institutions begin and try to evaluate and manage risks by getting to understand and control the source of risk. This is the primary drive for CCS and China's large and medium-sized

financial institutions to conduct win-win co-operation. Currently, CCS has already signed various cooperation agreements with bank institutions like China Development Bank, Export-Import Bank of China, Industrial and Commercial Bank of China and ship financing and leasing companies like ICBC Leasing and China Minsheng Bank Leasing. The signing of these agreements marks that both parties on the basis of giving full play to their respective professionalism have begun to expand their business service spectrum aiming at shipping and shipbuilding industries.

According to senior banking experts, financial institutions choosing CCS to establish strategic cooperation have mainly considered three factors. Firstly, CCS is a professional technical institution engaging in ship survey and inspection. Its core of survey technology and most abundant technical experience are risk assessment and ship safety management. This unique specialty is what we financial institutions need to make up for the insufficient knowledge, skill and experience if we want to do cross-industry business. Secondly, CCS is the largest and most powerful organization in China that is engaged in statutory and classification survey of ships flying Chinese flag. Since its establishment, CCS has not only kept close contact with IMO, IACS and other international organizations grasping the latest dynamic and advanced technology of international maritime industry, but has also had profound understanding of China's shipping, shipbuilding, designing and other related industries and enterprises and accumulated the most abundant information and technology resources in ships, enterprises and industries. These unique advantages are not what foreign classification societies can equally have in China. Finally and also most importantly, shipping-related industries and enterprises in China need CCS with her unique position and technology in shipping to provide



necessary help and guidance.

After summing up its long time cooperation experience with banks and ship financing and leasing companies, CCS has fully tapped out its own unique position in information integration and made the best of its technical advantages by offering its customers with new service products which can be used to control ship financing risks. The new services are based on “ship financing and classification clauses” and take the form of “customized information service” and “professional technology assessment” whose functions are aimed at risk assessment and management.

The first area is providing evaluation of technical development for the industry. In order to evaluate the risk of industry and reduce predictable losses caused by outdated technology and ship types which may further lead to fluctuations in ship prices and rents, profitability reduction and other industrial tendency-related risks, financial institutions will inevitably need to make estimation and evaluation about technology development status and trend of related industry.

The second area is providing risk evaluation for shipyards and shipping companies. CCS has carried out audit and certification for shipping companies for many years and had a deep understanding about the management status of most ship management companies. In recent years, CCS has also carried out a series of assessment and investigation for shipyards. These information and resources are what financial industry badly needs to analyze the owner and the shipbuilder’s market position and management ability.

The third area is providing technical condition assessment for ships. The actual technical conditions of ships have great influence on the value of vessel, operation risk and etc. Financial institutions must consider it in the professional technology filed involved in risk assessment. But this kind of assessment involves technology and areas most known to classification societies. Therefore, to gain support of CCS having advantages in technology, manpower and

network resources is undoubtedly the wisest choice.

The fourth area is providing customized information service in the process of financing new buildings. The information gathered about the ship during construction by the on-site surveyors of CCS working at the front line is the most complete and the most objective; especially those information related to engineering progress, major equipment purchasing and installation is greatly helpful to finance institutions in judging the rationality of its loan progress and amount and is undoubtedly necessary for financing risk control. Information covering building quality, accident condition, construction progress and schedule of delivery is of important value to the control of financing risks.

This fifth area is providing after-loan risk management for ship leasing. Classification service offered by CCS is a technical service throughout the ship’s entire life cycle. This service concept and form determines that CCS has experience in all aspects of the ship’s operation and management which no any single industry or enterprise can surpass, and CCS has in hold various information about the ship operation, including the ship’s dynamic information, owner change, flag change, repair information affecting the ship’s quality and value, new technology and regulations to be effective and applied to the ship. To timely grasp, integrate and analyze this information is an important aspect of after-loan risk control for ship financing and leasing, also known as credit assets quality management. Unlike other similar appraisal institutions, CCS has gathered the above experience and information objectively and independently through many years. It is the result of comprehensive participation and observation and is therefore more valuable and reliable.

Additionally, in the establishment of credit assessment system construction, ship risk assessment management and many other areas, CCS and financial institutions have huge opportunities to cooperate with each other. We firmly believe that CCS and China's financing industry will continue to deepen and speed up their synergy through constant communication, exchange and cooperation.

# Super Assistant of Developing HCSR Ships

By CCS Technology R&D Center

**C**OMPASS HCSR is a calculation software developed by CCS with independent intellectual property right. It is the calculation and analysis software for ship structure based on Harmonized Common Structure Rules (HCSR) of the International association of classification societies (IACS). The software consists of two modules of standard declarative process (SDP) and direct strength analysis (DSA).

After 1 July 2012 when the first draft HCSR was published, CCS developed a system software in the first time which realizes all the functional requirements of the first draft IACS HCSR on the basis of large amounts of previous work. The software can be simultaneously updated according to the process of HCSR development. Among IACS members, CCS is among the first to develop the software. The completeness of function coverage and the calculation accuracy have also been tested by the cross-check and consequence analysis by IACS HPT10. Among the results submitted each time to IACS HPT10, CCS performance is among the best.

HCSR software consists of calculation software for prescriptive requirements (HCSR-SDP) and direct strength analysis software (HCSR-DSA). The function of software covers completely the various calculation requirements of HCSR. HCSR-SDP covers the strength of ship's hull girder (yield strength, ultimate strength, and residual strength), size requirement (yield strength, prow pound, hull bottom impact, liquid sloshing), yield strength, fatigue strength, and the special requirements of bulk carriers and oil tankers. HCSR-DSA covers yield strength, zoom analysis, calculation of yield strength and fatigue strength.



## HCSR-SDP

This software is based on the original CSR-SDP platform, and can operate stably on computers that run Windows XP and Windows 7. Calculation covers the whole ship, i.e. cargo hold area, bow and trail, and equipment area. As to strength assessment of hull girder, HCSR-SDP realizes the calculation of minimum section modulus and inertia moment, bending strength assessment (sailing, within the port, water ingress), shear strength assessment, ultimate strength assessment (sailing, within the port, water ingress), residual strength assessment and replacement criteria. As to size requirements calculation of constituent components, the software can meet the requirements of board (including plane and groove profile), stiffener (portrait and landscape), main support component, bow flare impact, hull bottom impact, liquid sloshing as well as special requirements for bulk carriers (side frame, up-down connection, mail support component of bulk carriers of less than 150m, coil, grab, double

bottom water ingress strength) and the special requirements for double hull oil tankers (vertical groove type of bulkhead, main support component). As to the assessment of longitudinal fatigue, the software can assess the fatigue strength of end regional panel points of longitudinal at transversal bulkhead and non-transversal bulkhead. In addition, the software offers convenient calculation tools, such as components characteristics calculation, multi-span beam calculation and shear flow calculation.

The subsequent HCSR-SDP will be improved further. It is planned to develop pressure calculation tools, as well as analysis functions for supporting column buckling, structural arrangement, cargo hold figure-of-merit curve of bulk carriers, superstructure, deckhouse, welding throat, and hatch cover of bulk carriers.

## HCSR-DSA

This software is based on MSC. Patran platform, it can operate stably on computers that run Windows XP and Windows 7 32bit or 64bit.

Analysis scope of the software covers all cargo holds, areas between bow and forepeak, areas between stern and engine room. Main functions are as follows:

Parameter definition of ship type: ship type setting, analysis area setting, evaluation type setting, etc

Property definition: profile library, SDP data input, build thickness and corrosive environment setting, thickness deduction in corroded condition.

Structure search: automatic search, semi-automatic search, ship structure unit definition.

Load computing and imposing: principal parameters, cabin definition, loading mode, working condition definition.

Hull beam adjustment: shear, bending moment, torque adjustment.

Border terms: MPC, ending beams automatic generation.

Assessment of strength: yield strength, fatigue strength, fatigue assessment.

Mesh refinement: refined net automatic generation

Report output: output of intermediate data, assessment outcome.

The software can automatically load working conditions specified in the rules according to design parameters, and it can also load self-defined working conditions according to user preferences, based on this, it can complete yield, buckling and fatigue strength proofread. As to yield strength assessment, coarse mesh model assessment, refined net model assessment, functions of refining and screening have been realized. As to buckling strength assessment, panel auto partition has been realized. The software can realize the assessment of all types of panel specified in the rules, including stiffened panels, non-stiffened panels, ringent plate, groove bulkheads, side shell(SSS BC) and the buckling assessment of transverse prop. As to fatigue strength assessment, assessments of free edge(hatch corner) , toe of weld (4nodes, 8nodes) , cruciform joint(4nodes, 8nodes) have been realized. Functions of fatigue screening and post welding treating have also been realized.

Functions of automatic deduction of thickness in corroded condition, automatic detection of yield structure type, loading on hull girder synchronously, outputting load integral curves, independent buckling calculation will be implemented in subsequent HCSR-DSA.

The HCSR software developed by CCS has been acknowledged and supported widely in the Chinese industry due to its complete function and high accuracy. Through cooperation with the Chinese industry and with this software, CCS has played an important role in rule research, providing suggestions to IACS and HCSR full-scale ship test, and thereby offers strong support for the industry to understand and grasp the new rules and lays a solid foundation for the development of HCSR ships.

# CCS Proposed a Perfect Solution to Meet the Challenge from Hong Kong Convention

By Liu Lin

Problems related to safety, environment and occupational health may be caused in the course of disassembling ships. Hazardous materials which have been used in the course of shipbuilding, such as asbestos product, materials which contain heavy metals of lead, mercury and cadmium elements may leak into waters, soil and air and pollute the environment. All these problems have to be eradicated to build up green shipping, and disassembling, storage and management shall be conducted in an environment-friendly manner. The IMO Assembly that was held in Hong Kong on 5 May 2009 adopted the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (hereinafter referred to as Hong Kong Convention), which indicated that the usage, effective management and supervision of hazardous materials used on ships entered a new level. The development and issue of the Guidance of Formulation of Inventory of Hazardous Materials 2011 with possible amendments and the Instructions for Survey and Certification have detailed related operation steps.

In addition to unified international and regional instructions, flag States requirements have also come out one after another. The EU Directive of Restrictions on Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) 2002/95/EC which came into force on 1 Jan. 2013 puts forward specific stipulations on lead(Pb) , mercury(Hg) , cadmium(Cd) , chromium 6(Cr6+) , polybrominated biphenyls (FBB) and Polybrominated Diphenyl Ethers (PBDE) used in electrical and electronic equipment (EEE).

The Hong Kong Convention requires that the design, construction, operation and maintenance of ships shall comply with related requirements. An inventory of Hazardous Materials

(IHM) developed by the shipyard should be kept onboard a new ship. Existing ships shall also develop IHM not later than 5 years after the Hong Kong Convention came into force, or prior to disassembling, whichever is earlier, and IHM shall be updated during the ships' life cycle. Hazardous materials that listed in Appendix 1 of the supplementary provisions of Hong Kong Convention shall be prohibited and (or) limited in the procurement and application of products. IHM should be kept onboard a new ship which at least indicates the names, location and the rough amount of the hazardous materials that are included in appendix 1 and 2 of Hong Kong Convention supplementary provisions and are used in the hull structure and equipment. A clear statement as to whether the Convention requirements have been met shall also be made. During subsequent operation and maintenance of ships, IHM shall be updated and kept according to changes of hazardous materials brought about by the new equipment stalled onboard or by structural and equipment conversions.

As the main party to implement Hong Kong Convention, CCS carries out the initial survey and renewal survey of ships. At the same time, overall or partial additional survey will be carried out as a result of changes, replacements or major maintenance of the structure, equipment, system, fittings, arrangement and materials. After the survey, the International Compliance Statement of Inventory of Hazardous Materials will be issued. Ships shall be warned, detained, expelled or prohibited to enter the port in case the ship does not carry effective certificates or there is clear reason to believe that the ship or its equipment is not in conformity with the certificate and/or the first part of the IHM (appendix 1 and 2 of Hong Kong Convention supplementary provisions), or the ship has not carried out the maintenance of the first part of the IHM.

The introduction of the Hong Kong convention gives new challenges to the construction of ships. It requires that shipyards should have the ability of risk identification, information management as well as the ability of developing the IHM on the basis of the information provided by suppliers. The formulation of IHM is based on the inventory of orders, material declaration (MD) provided by suppliers and Self Declaration of Conformity (SDoC). These requirements will have a major impact on every process of design, procurement, production and file management of ship yards, and there will be more work and cost. According to the calculation by Nippon Kaiji Kyokai(NK) , the cost of the formulation of each IHM will be 30 to 50 thousand dollars.

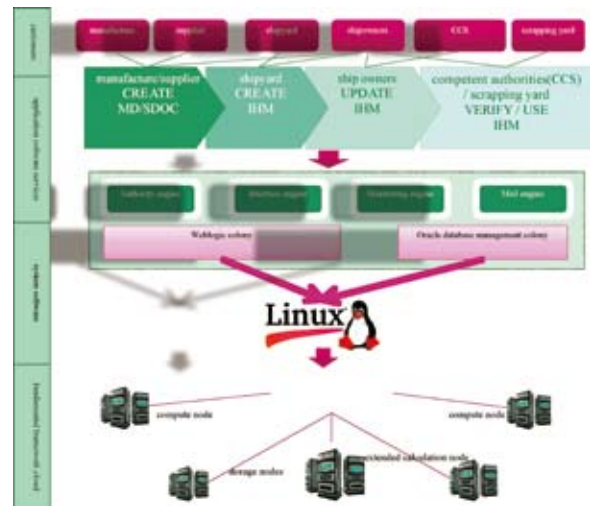
How to comply with the requirements of Hong Kong Convention, and the requirements of the other regional and administrative authorities? And how to better manage the MD and SDoC in paper and electric forms provided by suppliers through all channels and timely provide MD and SDoC of ship equipment and product to ship owners during the inspection and detention of ships? All these problems have come out as a result. In order to meet the requirements of Hong Kong convention, and to provide CCS clients with a competitive and all-around solution, CCS has developed the “formulation and management system of Ship IHM (Picture 1) based on market demands, customer investigation and comprehensive study. By providing a standard formulation form of MD/SDoC and the normalized formulation process, the system enables shipyards, suppliers, ship owners, classification societies and scrapping yards to share data and finish the formulation and management of MD, SDoC and IHM through full cooperation and efficient work on a single platform. An all-round and easy management of a single product, a series of products, a single ship and a series of ships will be realized. The system can also realize the access control of customers and internal users and the management of tasks, as well as the management and supervision of the whole process by multiple levels of suppliers, ship yards and ship owners under authorization, and the electronic transmission of IHM to the classification society. The system can also be tailored according the needs of the clients.

The Formulation and Management System of Ship IHM is



Picture 1 Login interface of Formulation and Management System of Ship IHM

currently consisted of several modules based on management by company, MD/SDoC management by suppliers, management of IHM by shipyards, management of IHM by ship owners, examination and approval of IHM by CCS and management of data dictionary. The system was designed and developed as multilayer structure (Picture 2) with distinguished features of safety, practicality, advancement, maturity, reliability, scalability and flexibility.



Picture 2 General System Framework

This system can assist CCS customers in a much better way to meet the challenges of Hong Kong Convention, and to realize “green” production and management. A beautiful China will also be realized as instructed by the requirements of promoting a conservative culture proposed by the 18th National Congress of CPC.



# Key Technology of Sea Pipe Laying

By Liu Jinshu

The project of “Li Wan 3-1” large deep-water gas field has inaugurated deepwater development in the South China Sea, and CCS has successfully won the bid to carry out third party inspection of the project. By the end of October, 2012, 200km of the 270km subsea pipeline from Zhuhai Gaolan terminal to “Li Wan 3-1” center processing platform has been laid. As the representative of the third party inspection on the site of sea pipe laying, the reporter attended the third party inspection of two pipe laying ships including “offshore oil 202” and “Global1201”. Taking “Li Wan 3-1” sea pipe project as the basis, this article will introduce the key technologies of sea pipe laying operation in four parts. They are “cold pressure welding and seam welding technology of sea pipe laying”, “automatic ultrasonic inspection technology of cold pressure welding and seam welding of sea pipe laying”, “panel point antisepsis and weight of sea pipe laying” and “sea pipe laying operation control”.

## Cold Pressure Welding and Seam Welding Technology of Sea Pipe Laying

With the development of welding technology, the constant upgrade of welding methods and welding equipment, some traditional inspection modes have also changed, therefore, as the third party quality control, we need to explore and develop continuously, make steady improvement and keep up with the pace of the times.

### Welding Process of Sea Pipe Laying

Sea pipe laying relies on pipe-laying ships, we call it “offshore mobile factory”. The whole process of pipe-laying is a production line. With constant extension and welding of pipes, pipe-laying ships move forward. Each workstation along the production line of pipe-laying pipes only needs to finish its own part of work. For welding stations,

distribution of stations will be made according to wall thickness of pipes to achieve the best welding efficiency. “Li Wan 3-1” sea pipe laying has five welding sites and one welding defect repair site. The five welding sites are as follows: the first station is for root welding and heat welding, the second to fourth stand serve as filling welding stations, the fifth stop is capping welding. The distance between each site is fixed, so the size of each single node tube is also fixed as 12.2 meters in general.

### Welding Methods

In the process of pipe laying, hand welding, semi-automatic welding and automatic welding, the welding methods commonly used in early times for the sea pipe butt circumferential welding are also used for “Liwan 3-1” sea pipe laying.

#### (1) Hand Welding

Hand welding is widely used in the early times of pipe-laying, the equipment is simple and cheap, all kinds of electrodes are also relatively easy to obtain. This welding technology is considered to be universal. Along with the continuous improvement of welding equipment and welding electrodes, hand welding has always been able to maintain high welding quality. The specification of sea pipe material adopted in the offshore section of “Li Wan 3-1” is 30 inches in diameter, 30.2 mm in wall thickness, with X70 grade material, the requirement for welding quality is very high. The constructor uses hand welding. However, the biggest defect of hand welding is low efficiency and can only be used in offshore sections with a small quantity of welding.

#### (2) Semi-automatic Welding

There are two ways of semi-automatic welding, one is using gas maintain arc welding (GMAW), the other is FCAW. Both of the two welding methods can be used in sea pipe-laying welding. In “Li Wan 3-1” pipe laying project, only GMAW is adopted, and is used for welding defect repair. The welding efficiency is high, human controllable factor is good, and repair quality of the weld joint is high.

### (3) Automatic Welding

Automatic welding is actually an automation application mode of GMAW. Because of its high welding quality and welding efficiency, it has currently become a popular welding method in sea pipe-laying. The operation is simple: just enter welding technique parameters (voltage, current flow and wire feed speed, wire swing, etc.) in the welding control box through the authenticated software, the welding process is controlled by the program, the welder (accurately speaking the welding operator) only needs to accurately install head guide of the welding machine, adjust wire centering well, and then start welding. During the welding process, welding operators can start and stop welding with the control box in hands, and at the same time have a range of 20% accommodation on the wire swing and welder's walking speed. Because of being less affected by human factors, the requirement of welding operation skills for automatic welding is relative lower than other welding methods, and its welding quality and efficiency is high. It has a great advantage for saving the cost of sea pipe-laying.

### Welding Techniques

Automatic welding technique will be introduced with a real example. Generally, the groove types are J type or improved J type, they do not differ a lot. The picture below shows the groove technique setting, especially 2 mm truncated edge of root and the bottom extinction angle are very important. The groove treatment has bigger influence on the welding quality. We compared groove treatment quality of two pipe-laying ships, the groove bottom extinction angle on domestic ships often does not reach the designated position. Bottom burnt also occurs on foreign ships. Once there is bottom burnt, what can be done is only to cut pipes and make groove again. One reason of groove problems is the problem with groove machine operation, and the other one is the problem with pipe oval-shaped degree.

We compared the similarities and differences of the welding techniques of two ships. The first is preheating temperature. The preheating temperature of domestic ships is 120°C, and 75°C for foreign ships. High preheating temperature is good for the quality of welding, but higher preheating temperature needs longer preheating time, so the efficiency is slow. In addition, oxy-acetylene flame generally has difficulties in preheating, it is usually heated by electricity. Secondly, as regards cooling method after welding, since sea pipe needs nondestructive

testing as soon as possible after the welding, water cooling is generally adopted after welding, however, domestic welding technique stipulates that water cooling should be done under 150°C, whereas overseas welding technique is almost directly cooling after welding (cooling from 250°C). Both welding techniques have passed welding appraisal. From the perspective of influence on welding resilience, the former treatment is better, but the latter has high efficiency without the need to wait for cooling under 150 °C after welding.

### Welding Process Control

As the third party on-site inspection body, it is important to control the welding process. I would share some on-site experience.

(1) Solid basic skill. Be familiar with all kinds of common welding methods, know their advantages and disadvantages, grasp the possible welding defects and the causes;

(2) Be familiar with welding process requirements, especially the requirements affected easily on site by human factors, this is the focus of attention;

(3) A higher level understanding of welding parameters, and their influences on the welding quality. Out-of-range changes need re-evaluation of techniques, and this requires familiarization with related contents of welding qualifications.

#### On-site control of automatic GMAW

(1) With high automation degree and the basic parameters being controlled by the welding procedure, we should not only observe the voltage current of the control box, but should also monitor the voltage transmitted to the welding head, this is the basic element to guarantee the welding quality;

(2) GMAW inspection and monitor, this is something that most likely can be ignored, gas purity, air demand and so on;

(3) The most likely welding defect is poor fusion and porosity. The reasons of not fusing are many such as operation, influence of welding wire on center swing control and the influence of conductive mouth.

(4) Automatic GMAW equipment is rather complicated, which increases the possibility of welding quality problems caused by mechanical failures. The regular normal maintenance of the complete set of equipment is important. On domestic pipe-laying ships, there have been significant problems, the causes were finally confirmed as unstable output voltage and big deviation caused by failure of welding machine. (To be continued)

# The Difference Between Combustible Oil and Flammable Oil, Fuel Oil and Oil Fuel

By Li Mingliang

The international conventions and rules are instituted and published in English that is internationally used, and it is inevitable that there will be ambiguities in translation and understanding as well as in implementation of these conventions and rules. How to minimize or even eradicate the losses caused by the differences in understanding? As the only ship survey body authorized by the Chinese Government, China Classification Society (CCS) takes part in the formulation and is familiar with the international conventions and regulations and it has rich experience in the study of international conventions, national policies and regulations and in the research of management standards. Below is the study and analysis of two norms in the conventions and rules that have controversies in understanding.

## Combustible Oil and Flammable Oil

Taken literally, combustible oil is the oil that can burn, flammable oil is a kind of combustible oil that burns easily. The word of flammable in English has both of the meanings and this should be given particular attention when doing translation. The flammable oil mentioned in the SOLAS Convention and MODU Code of IMO includes fuel oil, diesel, lubricating oil and hydraulic oil, of which, fuel oil, lubricating oil and hydraulic oil are obviously not the oil that burn easily. Therefore it is not right to understand or translate flammable oil in the SOLAS and MODU Code as the oil that burn easily.

The liquid whose flash point is below 60°C is defined as flammable liquid in the International Maritime Dangerous Goods Code(IMDG) of IMO. It is widely known that the lower the flash point is, the stronger the volatility and the easier the liquid can burn. Therefore, it is appropriate to understand and translate the flammable liquid in IMDG as the liquid that burn easily, and it is also appropriate to categorize the flammable liquid as dangerous goods.

Understood in the context, the flammable liquid/oil that appears in the rules of Lloyd's Register and American Bureau of Shipping, as well as in the standard B 31.3 of American Institute of Mechanical Engineers (ASME) seems to mean the liquid/oil that can burn, it is therefore

appropriate to understand and translate as such.

The liquid whose flash point is below 37.8°C is categorized as inflammable liquid, i.e. Level I liquid, according to the standard of National Fire Protection Association (NFPA). Whereas the liquid whose flash point is not below this value is categorized as combustible liquid, which is divided into Level 2 liquid and Level 3 liquid. The purpose of categorizing the liquid is to set different safety requirements according to different levels.

It can be seen from the table above that the word of flammable has different meanings in different standards, and should be translated accordingly.

## Fuel Oil and Oil Fuel

The terminologies of Fuel oil and Oil fuel appear constantly in SOLAS convention and MARPOL. They have different meanings, and it is not right to translate both of them into fuel. Translators are not professionals and they do not understand the accurate meanings of these two terminologies.

Fuel oil means heating oil, which is refined originally for low-speed machines of ships. Actually, it is a kind of residual oil. It is inexpensive but its calorific value is relative high. Fuel oil does not include diesel, heavy diesel fuel or light diesel oil. Kerosene and gas are not included either.

Oil fuel refers generally to fuels that are of oil nature and should be translated as oil bunkers. Oil fuel covers a wide range. It includes all kinds of oil which can be used as fuel, such as furnace oil, heavy diesel fuel, light diesel fuel, kerosene, gas, and even crude. But when the oil whose flash point is below 60°C, such as crude oil, additional anti-explosion safety measures should be taken.

norms	T Flash point of the liquids		
	T < 37.8°C	37.8°C < T < 60°C	T > 60°C
SOLAS, MODU, ASME	Flammable		
B31.3, LR/ABS Rule	Flammable		
IMDG	Flammable		
NFPA	Flammable	Combustible	
	Level I	Level II	Level III