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Make good use of subtraction

In the context of development of maritime technology, we can also see that every technological change is a process of simplification.

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Partnership

The fifth issue in 2014
(The 11th issue in total)

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CCS Signed a Strategic Cooperation Agreement with Transportation Department of Jiangsu Province

On August 29, leaders from China Classification Society and Transportation Department of Jiangsu Province, i.e., Sun Licheng, the President of CCS, Yang Yong, the Party Secretary of CCS, and You Qingzhong, the Director-General of Transportation Department of Jiangsu Province witnessed the signing of a strategic cooperation agreement between both parties in Beijing. Sun Feng, the Vice President of CCS, and Mei Zhengrong, the Deputy Director of Transportation Department of Jiangsu Province signed the agreement on behalf of both parties. It marks that both parties have established a new cooperation platform to promote the transformation development of water transport hand in hand and promote the development of "four traffics".

Before the signing ceremony, leaders of both parties held talks. During the talks, leaders of both parties and the relevant heads of departments introduced the business development situation respectively, and carried out the thorough exchange to promote standardization of ship type, risk control of sub-standard ship, new energy, new technology promotion, the Yangtze river and inland water transportation development, and exchange the views on how to expand areas of cooperation at the next step.

Sun Licheng, the President of CCS, and Yang Yong, the Party Secretary of CCS congratulated the result achieved in modernization construction of Jiangsu comprehensive transportation system, hope to take the signature of the strategic cooperation agreement as an opportunity to further intensify cooperation scope and intensity, make efforts to create a new situation of the win-win cooperation. You Qingzhong expressed thanks to CCS for long-time support and promotion in shipping, shipbuilding and other related supporting industry in Jiangsu Province, and said to further consolidate the good cooperation formed for a long time, give full play to the advantages of Transportation Department of Jiangsu Province in policy, planning and management as the local transportation authority and the advantage of CCS as the ship survey organization in quality control, technical support and new technology application, in order to jointly promote modernization construction of Jiangsu comprehensive transportation system, to make their due contribution to realize the transportation construction of "four traffics" put forward by the leading Party Group, Ministry of Transport.

According to the agreement, CCS and Transportation Department of Jiangsu Province will establish cooperation and coordination mechanism, work together on national and provincial major development strategies such as the implementation of the Yangtze river economic belt construction, shipbuilding industry, to provide convenience and support to each other and jointly promote the new technology research and development and promotion, strengthen the information and technology sharing, as well as the cooperation in green and peace water transportation system construction and talents training and exchange, etc.

At the same time, as the counterpart unit of this agreement, CCS Jiangsu branch and ship inspection bureau of Jiangsu Province also signed cooperation agreement. Fan Qiang, the general manager of CCS Jiangsu branch and Fang Jianhua, the director general of ship inspection bureau of Jiangsu Province signed the cooperation agreement on behalf of both parties.

Vice Minister of MOT Weng Mengyong Required CCS to Play the Leading Role in Rules and Standards

On September 18, 2014, Weng MengYong, the Vice Minister of Ministry of Transportation (MOT) met with CCS' leaders and carry out work investigation and research during his visit to CCS Headquarters. CCS President Sun Licheng introduced CCS' development in terms of structure, income, employees and business, the objectives for future development and some latest situations in the process of development.

After hearing the report, Weng Mengyong gave sufficient approval to the development achievements that CCS has made in recent years. After understanding deeply the structural reform, development positioning, technical service capability and other aspects, Weng Mengyong pointed out that under the background of great reform promotion, CCS should deepen research in system and mechanism, plan and deploy at an early time and lay a good foundation for development in the future. He stressed that the period falling within the thirteenth five-year plan is the key time for China to build up maritime power and develop comprehensive transportation, the innovative development of technology will play important role in transforming and updating industry. CCS should closely follow the maritime power strategy, establish its own development program, and play along with the effective implementation of the overall national strategy. Weng Mengyong expressed his hope that CCS should continue to strengthen research efforts and innovation, become the leader in the development of rules and standards and increase its voices in the international platform. By complying with the requirements of "internationalization, modernization, socialization and providing good service", CCS should speed up the construction of the international first-class society and promote the development of all businesses to a new level.

China Oil Transportation Safety Forum (2014) Held in Beijing

On September 17, China Oil Transportation Safety Forum with the theme of "Safe Oil Transportation Harmonious Development" was grandly opened in Beijing. More than 140 delegates from relevant organizations gathered in this forum, and together planned the safe, harmonized and sustainable development of oil transportation.

This forum is jointly organized by China Classification Society (CCS) and China Shipping (Group) Company, for the purpose of further enhancing communication about oil transportation safety chain between related parties, promoting China's participation in the development of safety standards of international oil transportation industry and the voice,

safeguarding national energy transportation safety and preventing marine environment pollution. The forum has one main venue and one parallel session. Delegates had positive communication and discussion about the latest development of the industry, best practices of oil transportation safety and the latest technical issues of oil transportation, etc.

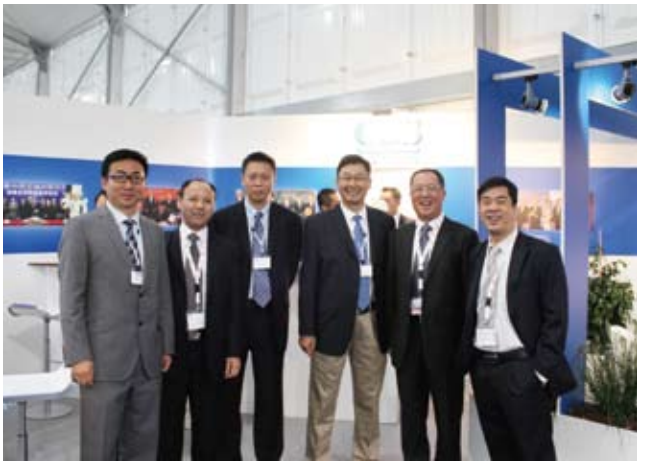
At the opening ceremony, Sun Licheng, the President of CCS made a presentation with the theme of "Cooperate Hand in Hand to Promote New Development of Oil Transportation Safety", advocating parties of the industry to strengthen collaboration, innovate technology, strengthen the safety responsibility and actively maintain the oil transportation safety. At the same time, Wang Jinfu, the director of Safety Department, the Ministry of Transport, Liu Xihan, the deputy general manager of China Shipping (Group) Company also gave keynote speeches respectively.

"China Oil Transportation Safety Forum" was founded in 2010 with the approval of the Ministry of Transport. With the strong support of the Ministry of Transport and the concerted efforts from the relevant parties, it has been successfully held for five sessions. The topics for discussion on the forum are hotspot and focal issues of today's oil transportation industry, which become more thorough and pragmatic year after year. The forum provides a channel for the representatives to understand related policies and regulations of international and domestic oil transportation and the latest development of the industry, also builds a platform for the domestic industry to realize cross-industry, inter-departmental communication. Forum shows practice and innovation of China's oil transportation industry, spread the voice of China's oil transportation industry and plays a positive role in safeguarding the development of China's oil transportation safety.

CCS Participated in the Twenty-sixth Hamburg Maritime Exhibition

The twenty-sixth Hamburg Maritime Exhibition (SMM) was held on September 9, 2014, China Classification Society (CCS) participated in the exhibition for the first time. CCS met with new and old friends from global shipbuilding industry, ship design units, financial sector and other sectors, and introduced main business and the latest development of CCS in detail.

As one of the most renowned international maritime exhibitions, SMM is on the top list in terms of the degree of internationalization and profession. 26 exhibition groups from 26 countries and 2100 enterprises from 67 countries participated in the SMM international maritime exhibition, making this exhibition the largest one in SMM history.



CCS and AVIC International Shipping Development (China) Co., Ltd. Signed Strategic Cooperative Agreement

On September 22, a strategic cooperative agreement was signed between CCS and AVIC International Shipping Development (China) Co., Ltd. in Shanghai. Li Hua, General Manager of CCS Shanghai Branch, Chen Shi, General Manager of CCS R&T Center, Sun Yan, General Manager of AVIC and other leaders and representatives attended the signing ceremony. Li Hua and Sun Yan signed the agreement respectively on behalf of CCS and AVIC.

Both CCS and AVIC believed that the two sides have extensive basis for cooperation in shipbuilding, construction of offshore engineering equipment, survey and certification, international shipping trade and other areas, and have common goal and aspiration in improving quality and technical progress and promoting China's position in the international maritime community. Faced with the new situation and based on the understanding of development of national economy and the intention of national strategy, as well as the common understanding of the development trend of related industry in international and domestic shipbuilding market, the establishment and maintenance of a long-term and stable strategic cooperative relationship between the two sides and the construction of smooth and fairly good cooperative platform for information and business exchanges will play an important role in the business development of both sides.

The two sides will carry out specific cooperation in R & D and approval of ship type, plan approval project service, newbuilding project, international business cooperation, rules and standards and etc.

As a professional operation platform, AVIC relies on its background of aviation industry. With more than 110 overseas institutions located in more than 50 nations and regions and customer resources, AVIC is a comprehensive shipbuilding enterprise well-known at home and abroad.

Application for the First Time of Marine Corrosion Resistant Steel for Refit Project on Real Ship Completed

The application of marine corrosion resistant steel for real ship refit under the project "research of application technology of corrosion resistant steel based on IMO standard" was completed recently, the work completion meeting was held on the refitting field of Shanghai Wusong ship engineering company on September 17. Representatives from the Ministry of Industry and Information Technology of the PRC, China Shipbuilding Industry Association (CSIC), China iron and Steel Industry Association, Chinese Shipowners Association, China Classification Society and other units, and the representatives from shipowners, shipyards, steel yards attended the meeting and visited the refitted ship

The meeting introduced the background of "research on application technology of corrosion resistant steel based on IMO standard", the process of the project, and showed the documentary film on "development and application of domestic corrosion resisting steel". The representatives from shipowners and shipyards fully approved the achievement obtained by the research of application of corrosion resistant steel, and communicated and exchanged ideas on application of corrosion resistant steel.

According to the Ministry's requirement for "research on application technology of corrosion resistant steel based on IMO standard" project, the oil tanker "Daqing 435" of NJTC was chosen as the example ship to be refitted, the refitted ship used domestic corrosion resistant steel plate, steel and corrosion resistant steel welding material to evaluate the practical corrosion resistance performance of domestic corrosion-resistant steel.

Technical Analysis of Low-Speed Dual Fuel Engine

By Wang Min & Zhan Yu & Li Zhenzhong

As the global oil price keeps rising and the emission limit becomes increasingly stringent, ship owners have paid more attention to ship's economy and clean environmental protection. Although fuel cell, hydrogen power, hybrid technology etc. can be seen in the market, at present the most mature and most economical energy undoubtedly is natural gas.

As a fuel used for ships, in the beginning natural gas was mainly used in coastal ferry and other small vessels. On one hand, the fuel tank size has limited the use of the dual fuel engine in ocean-going ships; on the other hand, the electric propulsion efficiency used for ocean-going ships is much lower than low-speed diesel engine, which does not have efficiency. With an increasingly large difference between oil and gas price as well as emission limit, MAN Diesel & Turbo introduced ME - GI series low-speed dual fuel engine and Wartsila company also launched the Flex - DF low-speed engine. These blockbuster products from two large monopoly manufacturers will have obvious competitive advantage in the ocean-going ship market where low-speed diesel engine dominates, change the market pattern of current dual fuel engine and make it possible that the gas powered ships sail to the ocean.

Whether a low-speed dual fuel engine can be promoted for application depends on the results of technical and economic analysis. The feasibility of the technology, environmental benefits and the difficulty of the transformation can also be included in the technical and economic analysis model. We adopt traditional Net Present Value (NPV) to analyze.

$$NPV = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0$$

where, t- the time of the cash flow

n- total operation period of project

r-the discount rate or expected return rate

Ct- the net cash flow i.e. cash inflow– cash outflow, at time t

C_0-initial investment cost

The estimated initial investment cost and operation cost in above analysis is derived from China Classification Society (CCS) investigation of several companies; We consider as much as possible to deal with all kinds of new increased operating costs and benefits, such as the demand changes of fuel costs, maintenance costs, the crew wage increase, cargo capacity reduction, environmental protection equipment and re-liquefaction equipment. We carry out comparative analysis of the economy of various schemes under different scenarios: Comparison of electric propulsion power systems including medium speed engine, medium-speed engine adjustable blade, low-speed dual fuel engine and low-speed diesel engine; Carried out the sensitivity analysis of the initial investment and the price of natural gas; Ship types including container ship and natural gas carrier respectively considered; Analyzed the feasibility of using low-speed dual fuel Engine instead of low sulfur fuel and exhaust gas cleaning (EGC) system.

Through analyzing and comparing the economy of the different schemes, we draw the following conclusions:

For natural gas carrier using dual fuel engine, because there is no need to increase the investment in fuel tank and air supply system, all

kinds of gas power solutions have prominent advantages than fuel oil.

Among a variety of gas power devices, the low-speed dual fuel engine scheme has the advantage.

Due to the limit of fuel tank, it is feasible for container ship, oil tanker and ore carrier on fixed route.

Because of the cost of gas power plant is higher, occasionally using natural gas instead of the low sulfur oil in the emission control area (ECA) is economically infeasible.

The relative price of natural gas and fuel oil in different markets is the most sensitive parameter which decides the application of LNG power plant. The size of LNG tank decides the endurance, and is also the key factor influencing the initial investment.

The natural gas price is low in the United States market, and most ship types are economical.

For ships usually operating in EU ECA and other ECAs, using natural gas instead of low sulfur fuel or EGC is feasible and the economy depends on the navigation time in ECA.

China's natural gas price level decides that domestic natural gas replacing normal fuel oil is infeasible, and using natural gas instead of diesel oil is economical.

CCS and Dalian Maritime University jointly adopted FMEA analysis method to carry out risk analysis for ME - GI engine system. On one hand, the safety of this type of engine is analyzed; on the other hand, analysis is carried out to the applicability of Unified Requirements M59 of International Association of Classification Society. M59 was introduced more than ten years ago, and some provisions are not suitable for the development of the industry today.

CCS and Dalian marine diesel engine company jointly made identification and study of ME - GI key technology. Gas injection valve, gas valve block, double-wall pipe gas pipeline and ventilation and gas detection system, sealing oil system, gas control system are newly added to the engine, and the design of cylinder head and exhaust manifold are modified. In order to prevent the high pressure gas leakage, window valve and gas valve block are added and gas leakage is monitored at any time; Perfect combustion monitoring algorithm is provided for the engine, which can detect combustion failure within a cycle. The control function and safety function of the engine's gas control module are independent from each other.

Conventions and rules have no mandatory requirements for such safety measures, but require evidence that it can achieve the equivalent level of safety of diesel engine by risk analysis. The provision of these devices above is the measure taken for risk reduction. We are increasingly recognizing that for the gas engine, gas supply system, control system and other new products, due to the diversity of design plan, rules are often unable to fully identify the risks so as to develop the corresponding provisions. Subject qualification and evaluation of quality of the risk analysis should be controlled.

Flex - DF new engine has just been introduced and it will be subject to type test next year. We have not carried out comprehensive study of technical details of this engine. The engine continues to use thin combustion technology which is adopted by low-pressure medium-speed dual fuel engine, effectively reducing emissions to Tier III standard. To prevent cylinder knocking, the maximum continuous output power rating of engine was brought down to around 82.5%. To prevent explosion, the engine needs to control the air-fuel ratio, and it is not clear whether exhaust bypass or similar air-fuel ratio control device fitted on medium-speed engine is also provided for this engine.

Usually the dynamic performance of low-pressure medium-speed dual fuel engine is bad, which needs to be propelled by using electric propulsion or adjustable blade. This engine allows direct driving of fixed pitch propeller, and its mechanism of dynamic performance improvement is unclear.

In order to ensure the air inflow and reduce methane escape, the design pressure is increased to 16 bar. Strictly speaking, it can no longer be called low pressure engine, but how much risk the 6 bar pressure difference will bring needs to be evaluated.

The gas control and safety system also adopt the systems which are similar with the four stroke dual fuel engine. The system integrates the control, alarm, safety functions in a control box, and the safety function and control function of the system are independent from each other.

The Latest Trend of Fatigue Assessment Study of Fracture Mechanics

By Wang Siyuan & Tianyu

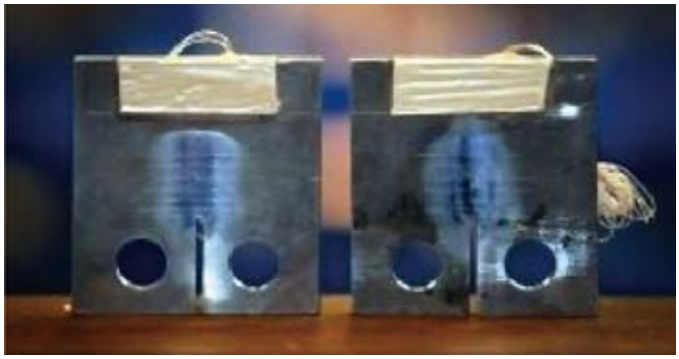
The research of fatigue and fracture engineering has been going on for more than 150 years, and is still developing, and it has attracted the attention of contemporary researchers. Recently, the rapid development of computational mechanics and the enhancement of computing ability has enabled the offshore and shipbuilding industry carry out more advanced and more detailed analysis of fatigue fracture. Therefore, there are many commercial tools that are able to achieve the whole structural integrity analysis of large-scale structure. Figure 1 is an example showing the offshore and ship structure fatigue analysis of different technical development level (accuracy VS complexity). However, although the development of the new commercial software is rapid, which enables the engineers to design safer, lighter and more reliable structure in daily work, it is very important to commit to further improving the existing fatigue design methods and developing new methods.

At present, the fact recognized in the international shipbuilding research field is that due to ignoring the loading sequence effect, structure initial flaw size, and many other key factors which are needed to be considered in the fatigue analysis, the result of the traditional S-N curve fatigue life prediction method based on the theory of cumulative fatigue damage (CFD) is often not satisfactory, and at the same time the forecast test result can't be clearly tested. The S-N curve is appropriate for the limit with the yield strength less than 400MPa, there is no clear statement for restriction relax and it is not applicable for the fatigue evaluation of the defected structure. The fracture mechanics fatigue life prediction method that is based on the theory of fatigue crack propagation (FCP) can overcome the defects that exist in the theory of CFD, and it is the development trend for the research of fatigue strength verification of ocean structures.

Fatigue crack extension evaluation has been a hot issue in the fatigue research field. In recent years, the importance of cracking model of practical design crack has attracted the interest of the researchers. For high quality welding line or processing welding line, welding defects similar to cracks do not exist, therefore, cracking process is the most important part of the whole fatigue life. In addition, in order to be able to better make analysis of crack growth, we need to further study the growth of short crack. To make the whole life prediction of ship structure, it is bound to involve extension of small cracks of a few millimeters, and the life extension of this phase accounts for a larger proportion of the whole life, and the rule of small crack extension and that of the long fatigue crack extension are significantly different. Therefore, based on the application of theory of fracture mechanics fatigue assessment, if you want to ensure the accuracy of the results, small crack extension study can't be avoided.

The current concept of local welding does not contain capturing cracking, because in the rules, S-N curve usually identifies the final failure of the whole fatigue life. Therefore, in the future we need to study the design method that can separate crack initiation from crack extension. In order to achieve this goal, we need to further develop the existing theoretical model of crack initiation, and carry out small crack growth research, only the model of crack initiation that contains the rule of small crack propagation that is based on the experimental observations and mathematical descriptions has the theoretical and application value.

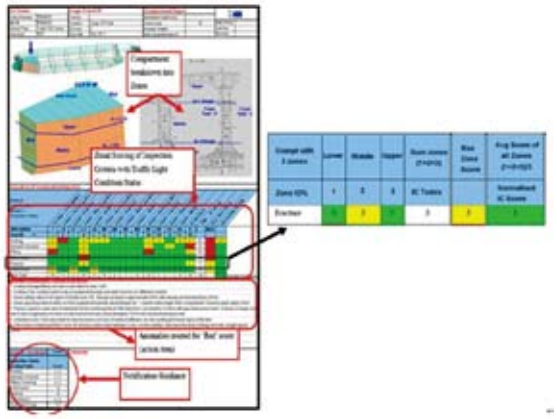
Rule design and related design methods have great effect on the safety and integrity of the structure, so it is the important foundation of the structure design. It is well known that it is difficult to determine the design method or the rule and their uncertainties are high. We suggest that the industry and the academic community continue to cooperate with



each other and committed to developing more effective methods and rules to be applied in designing safer structures. In addition, the designers still need a universal rule and regulation in their work related to fatigue and fracture. In ISSC2009 report, members also point out this problem. We expect that the achievements of this work could be practiced in the industry and produce a general standard as soon as possible.

The Paris formula has been widely used in evaluating the crack propagation life caused by the fatigue of ship and marine structures. The Paris formula believes that fatigue crack propagation rate depends on the stress intensity factor. Under the condition of yielding with small percentage, the stress intensity factor is only determined by stress in the strain areas near the crack tip. The application of Paris formula in practice need to assume the fatigue crack size, because the fatigue driving force of micro cracks is usually lower than Paris tolerance.

When using the Paris formula to evaluate crack propagation life of the component or structure, not only the load range should be depended, usually the maximum or minimum value of load level should also be depended. The latest research focus is committed to the fatigue crack propagation model based on energy criterion, containing the elastic-plastic deformation and mixed loading mode of the crack tip. Different fatigue crack growth rate models are expressed by stress intensity factor cycle range, crack opening displacement range, crack tip opening displacement and energy release rate range. Compared with the experimental results, the expression of crack tip opening displacement and energy release rate range has nothing to do with stress ratio, whilst the expression of stress intensity factor cycle range or the crack opening displacement rate has a lot to do with stress ratio.



The study of the hot research points of the other classification societies found that the evaluation of fatigue crack propagation is the fundamental research for technical services. Currently, foreign classification societies have no complete fatigue life prediction method based on the crack extension. In order to ensure the future transformation of rules, it is recommended that CCS take earlier action in IACS to make real ship verification of ship fatigue crack propagation life prediction method.

The study report SSC - 462 *Review of Current Practices of Fracture Repair Procedures for Ship Structures* which was published in 2012 by ISSC (the project was undertaken by ABS). The report studies crack starting position, assessment of crack, crack danger degree, crack tolerance and other related problems; The future research focus of SSC 2014 includes the study of fatigue crack, “Real-time measurement of stress and fatigue accumulation including onset of crack and tracking crack growth”.

In the technical report of ABS 2007, *Mesh Size Effects in Simulating Ductile Fracture of Metals* studies the unit size problem of fracture analysis using finite element; ABS 2009 technical report *Hull Inspection and Maintenance Systems* makes an introduction to the ship inspection and maintenance management system, this system is used to guide the location, time and testing cycle for hull crack inspection and

maintenance, the report lists six hull structure inspection criteria, one of them is the structure fracture, used to evaluate the influence of local structure crack on the hull structure.

DNV GL has been conducting research on fatigue strength and fracture strength prediction, the ongoing related research projects are respectively named *JIPs on fatigue strength and fracture mechanics, and Fracture mechanics & fatigue assessment*. The former one is mainly based on fracture mechanics prediction and evaluation of ultra high strength steel plate fatigue strength, the latter one is the study of initial flaw size based on the theory of fracture mechanics to forecast the residual fatigue life of welded node and assess whether there is any need to repair cracked welding node. DNV has the ability to perform fracture mechanics fatigue assessment in terms of technical ability, test ability and calculation software (including PROBAN and PROINSP).

NK published the anti-crack design guidelines in 2009, since 2011, NK has carried out the structural model tests of large proportion and scale, NK has also conducted finite element analysis of dynamic crack propagation and the related aspects.

Because of the increasing interest in the arctic oil and gas development, in addition to interest in building ships suitable for harsh environment large ships, fracture and unstable crack propagation have become the hot spots of research recently. Because of the widespread use of large-scale and high strength steel, the traditional S-N curve of fatigue life prediction method based on the theory of cumulative fatigue damage (CFD) is no longer used.

CCS obtained certain research results on fatigue crack growth in K coefficient calculation verification calculation method in IACS PT52 project in 2012, but the results of the study is based on the general theory of fracture mechanics, the relevant theoretical model is relatively simple. For hull structure under complex loading, when the formula cannot be directly applied, it needs to calculate the stress intensity factor directly with the finite element numerical method. In order to verify the established forecasting model, fatigue damage case investigation should be carried out, collecting and mastering the fatigue damage case in actual operation of the ship, comparing the investigation results with the corresponding numerical results and analyzing the degree of coincidence to assess fatigue assessment methods. The research needs to make defects and accident investigation on ships in operation of CCS class. Through actual ship investigation, the key position to crack easily and typical form of node shall be determined, opinions and suggestions can be put forward according to the result of damage investigation on actual ship's subsequent calculation and verification. According to the experience of the previous survey, this work is difficult, if necessary, test report may need to be provided by site surveyors.

With the age of ships in operation increasing and the requirement to extend ship life, how to provide a set of effective method and rules to make analysis of fatigue and fracture damage tolerance of ships in order to provide basis for scientific inspection and maintenance of ships and for making damage maintenance decision is an urgent problem needed to be solved by class management departments.

The fatigue assessment research based on the theory of fracture mechanics is a powerful supplement for CCS fatigue evaluation rule system. Through the establishment of a mature and practical method to assess marine steel crack fatigue life and safety, and the software development on the basis of practical theoretical research, the crack defects can be controlled during the inspection of ships in operation, to provide better value-added services for customers and improve safety and economy of inspection and maintenance of ships in operation.

Issue of Hours of Rest for Seafarers

By Luo Linjun & Qiu Xuefeng

During the period from 2011 to 2014, ships were detained in India, Australia ports and other ports due to deficiencies related to hours of rest for seafarers. Especially from August 2013 to April 2014, for ships detained in Paris MOU, there were 22 detainable deficiencies related to hours of work and hours of rest. From September 1 to November 30 this year, the world's two most influential Memoranda of Understanding (MoU) on Port State Control, i.e. PARIS MOU and TOKYO MOU will launch a joint Concentrated Inspection Campaign on hours of rest for seafarers. However, different parties have different understanding of requirements for hours of rest at present, which needs to be clarified, so that seafarers could record the correct hours of rest and avoid being detained by PSC.

Discussion of "any 24-hour period"

Currently, two conventions, i.e. Manila amendments to International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (hereinafter referred to as STCW Convention) and Maritime Labour Convention, 2006 (hereinafter referred to as MLC Convention), specify requirements for hours of rest as follows: "minimum hours of rest shall not be less than ten hours in any 24-hour period and 77 hours in any seven-day period. Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours".

How to define "any 24-hour period"? There are different understandings. A view can be from that any time of the day as a starting point, such as Hong Kong flag PART I guideline interprets "any 24-hour period means starting at any moment during a day must comprise at least ten hours of rest". According to this understanding, with regard to the hours of rest of 0000-0500 and 0900-1900, if the starting point is chosen at 1400, the hours of rest is divided into three periods including 1400-1900, 0000-0500 and 0900-1400, of which each period lasts 5 hours, therefore not conforming to the convention requirements that hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length; Another argument is to make "any 24-hour period" fixed for a period of time. For example, Panama authority defines "24-hour period in the form of legislation which is the period from 0000 to 2400". For watchkeeping by chief officers, the arrangement usually includes 0400-0800 and 1600-2000. When SMS and ISPS work for another 3 hours in addition to watchkeeping duty is arranged in 0800-1000, the hours of rest will be divided into three periods which includes 0000-0400, 1100-1600 and 2000-2400, of which no period exceeds 6 hours, therefore also not conforming to convention requirements.

The PSC inspection guideline of Paris and Tokyo Mou specify that "in the absence of the flag state guideline or reference to expressly provided requirements, 24-hour period will be understood to be calculated from the beginning or the end of a period of rest." Obviously this explanation is unfavorable for Hong Kong flag and Panama flag. But it is more favorable for the five star flag and the Singapore flag which have not been given any explanation. For the hours of rest of 0000-0500 and 0900-1900, as long as the starting point of the 24-hour period is set as 0000 (the beginning of a period of rest) to calculate, the hours of rest of 24-hour period are 0000-0500 and 0900-1900, i.e., 5 plus 10 is equal to 15 hours, meeting the requirements of the convention. For watchkeeping by chief officers, the arrangement usually includes 0400-0800 and 1600-2000. Work other than watchkeeping is arranged in 0800-1000. As long as starting point of any 24-hour period is set at 0400 (the end of a period of rest) to calculate, the hours of rest of 24-hour period is 1100-1600 and

2000-0400, i.e, 5 plus 8 is equals to 13 hours, which also meet the requirements of the convention.

So from the view of convention that hours of rest for seafarers should be arranged as long as possible and continuous for the purpose of alleviating seafarers' fatigue, any 24-hour period should be defined as "the starting point of each seafarer's any 24-hour period can be determined by the master or the department's officer of specific work, usually from the beginning or the end of a rest period. Different positions can have different starting or end point. Once the starting or end point of the same seafarer is established, it must be maintained consistent in a long time, to ensure the same seafarer form relatively fixed biological clock", which is more reasonable and beneficial for the master to arrange the hours of rest for seafarers.

To avoid the PSC detention, if no clear requirements are given by flag State, e.g. five star flag and Singapore flag, usually the starting point of any 24-hour period of the second and third officer on watchkeeping duty and any other seafarers without watchkeeping duty can be determined to begin from 0000; For chief officer on watchkeeping duty, the first column of the hours of rest record can be determined at 0400, that is, any 24-hour period is defined as 0400-0400, to ensure that the hours of rest of "the night" can be used for sleep without interruption. For chief officer on watchkeeping duty, duty other than watchkeeping may be arranged during 0800-1000 or 1300-1500, in order to ensure that the eight hours during 2000-0400 are not interrupted for a good sleep and rest, and the other period is 1100-1600 or 0800-1300. For Hong Kong flag, although the DMLC PART I guideline explaining that "any 24-hour period can be from any time of day as the starting point" is not reasonable, it has not been written into the official DMLC PART I, so it still can be operated based on the above information. But we suggest that ship owner or management company should report to the marine department of Hong Kong in writing and keep written reports and reply letter (if any) which is more reasonable, and also can remind the authority to have more reasonable provisions or explanation before formally carrying out MLC legislation.

Suggestions for a fuzzy set

MLC convention defines hours of rest as "time outside hours of work; this term does not include short breaks". For "hours of rest may be divided into no more than two periods", there are different understandings. One is that the "hours of rest" here means "minimum hours of rest (that is 10 hours)" cannot be divided into more than two periods. For example, Singapore DMLC PART I: "The minimum hours of rest may be divided into no more than two periods..." ; For the hours of rest of 0100-0200, 0300-0400, 0500-0600, 0700-1100 (4 hours), 1200-1300, 1400-1500, 1600-1700, 1800-1600 (6 hours), the total hours of rest of the seafarer can be recorded for 16 hours a day. If it lasts for 7 days, the hours of rest of total 7 days is 112 hours, which meet the requirements of the convention, but can lead to noncompliance with the requirements in PSC inspection guideline.

The second view is that the hours of rest means the hours of rest in any 24-hour period cannot be divided into more than two periods. Such as the five star flag (Order 2012(No. 10) of Ministry of Transport): the hours of rest in any 24-hour period may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours. For the above situation, if the total hours of rest are recorded for 16 hours a day, so the hours of rest in 24 hours is divided into eight periods, which do not conform to the requirements of the convention; But if the total hours of rest are recorded only for 10 hours a day, and those outside the longest two periods are regarded as short breaks, it shall be deemed to satisfy the requirement that the minimum time in any 24-hour period is no more than two periods, but if it lasts for 7 days, then the total 7 days of hours of rest is only 70 hours. In case there is no exception allowed by the flag State, it is still not in conformity with the convention requirements that "minimum hours of rest shall not be less than 77 hours in any seven-day period".

In Paris and Tokyo MoU PSC inspection guideline, it is interpreted as "since the hours of rest only may be divided into no more than two periods, consequently only the two longest rest periods should be counted, and additional short breaks and meal breaks could not be included in the total periods of rest". This explanation basically conforms to the second view.

In order to avoid PSC detention, the "hours of rest no more than two periods" should be understood as "hours of rest in any 24-hour period no more than two periods, at the same time, in order to

alleviate fatigue and improve work efficiency, more short breaks during work should be encouraged to be given to seafarers, that is, as long as the hours of rest outside those two periods are regarded as short breaks and not included in the total hours of rest, it should not be judged to be not conforming to the requirement for no more than two periods of the convention", which is in conformity with the PSC inspection guideline.

The extension and tips of the requirements of convention

For the requirements that minimum hours of rest shall not be less than 77 hours in any seven-day period, it shall be understood as follows according to the PSC inspection guideline "seven days should be any continuous 7 days; if 7 days is understood as a whole week, e.g. invariably from Sunday to the next Sunday, it is wrong". So in order to correctly keep records and avoid PSC detention, for evaluation of any 7 day, seafarers are to add previous 6 days to the present day, that is, the 1st day of each month should plus the hours of rest of last 6 days of last month, and that is, the daily assessment on the total hours of rest in 7 days not less than 77 hours.

The Master should monitor whether each seafarer truthfully and timely record their hours of rest. In view of fact that the record is an effective measure to assess seafarer's fatigue and compliance with convention requirements, once PSCO suspects the record is not true, the inspection will be expanded, which will even give rise to ISM detainable deficiencies related to reoccurrence or false record. For example, between July to September 2010, three ships were detained in Australia because of deficiencies that SMS cannot ensure correct recording of the hours of rest for seafarers on watchkeeping and the Master can't guarantee the hours of rest of the crew on watchkeeping according to the STCW convention. The Master should also pay close attention to seafarers who are the first on watchkeeping and the follow shift on watchkeeping to get sufficient rest and fit for watchkeeping. Once the situation does not meet the requirements, the Master may make adjustment for watchkeeping seafarers at any time, and adjust the record in the log book or voyage plan.

The Master should bear in mind that he has the right to suspend or stop the seafarers' hours of rest for any safety reasons. For example, work necessary for the immediate safety of the ship, persons on board or cargo, or for the purpose of giving assistance to other ships or persons in distress at sea until normal situation has been restored; or fire-fighting and lifeboat drills, and drills prescribed by national laws and regulations and by international instruments which shall be conducted in a manner that minimizes the disturbance of rest periods and does not induce fatigue; or due to environmental or safety factors or other unforeseen reasons when setting sail, the necessary operation that cannot be delayed or avoided. So it is normal and real that the records of seafarers' hours of rest contain the situation not meeting the requirements of the convention, especially vessels of short route, for which the reference column of recording the hours of rest is to indicate the reasons. As soon as practicable after the normal situation has been restored, the master shall ensure that any seafarers who have performed work in a scheduled rest period are provided with an adequate period of rest and indicate clearly compensatory hours of rest in hours of rest record.

Ship owner, management company, all the crew members, especially the Master and the heads of departments who arrange the actual work, should fully recognize the risk and harm caused by safety accidents of ships and persons on board due to seafarers' fatigue, and should also recognize that the convention requirement for hours of rest is the minimum requirement, meeting the requirements of the convention does not mean that it will not lead to fatigue. And they should strengthen the training of preventing and mitigating fatigue, enable the crew to master some basic measures to prevent or mitigate fatigue, see MSC/Circ. 1014 Guidance on Fatigue Mitigation and Management; Seafarers who feel tired and not fit for watchkeeping should promptly report to the Master, who should timely adjust the arrangement on watchkeeping and record the adjustment in the log book or voyage plan for information. If the Master feels tired duet to frequent arrangement of wathckeeping to conform to the requirements of the convention for hour of rest, he should assess whether watchkeeping seafarers already have fatigue, and suggest the company increase the manning, etc. by means of the SMS system review procedures.

LNG Quantitative Risk Assessment—Preventive Measures

By Fan Hongjun & Wu Shunping

Quantitative risk assessment (QRA) can help customers to better understand the risks they are facing, and help them implement more targeted risk management.

Three Key Aspects of Quantitative Risk Assessment

QRA application in the field of oil and gas is meaningful in six aspects: firstly it is the mandatory requirement of international standards and regulations, such as IMO regulations, relevant rules of classification society, ISO standards, etc.; secondly it is optimization design which is related to offshore platform's pry block optimization arrangement and combustible gas detector position optimization and aimed at achieving the optimal balance between the cost and safety; thirdly it is the investigation of accidents, and most of the accident investigations of oil and gas disasters in the world are based on QRA technology; fourthly it is HSE (health, safety and environment)that is related to ventilation optimization, toxic gas emission evaluation, and evaluation of fire radiation, etc.; fifthly it is development of safety clearance, such as the safe distance of onshore, offshore oil and gas facilities and that of navigation or operation of oil and gas carriers, sixthly it is auxiliary risk management. China Classification Society (CCS) will develop service products for the above six aspects

Since China's floating LNG supply chain was formed gradually, in order to provide better services and solutions to customers, CCS developed LNG quantitative risk assessment service product.

Due to environmental protection requirements, and driven by fuel price and the support of national policy, China's LNG water supply chain is forming, and the whole supply chain from the end user of LNG ships, to bunkering, and then to LNG domestic distribution will be established in the next one to two years.

Technical standards and regulations are the prerequisite to guarantee the healthy development of LNG business, Based on the principle of "standards come before market" and the national projects, and in cooperation with the government, industry and research institutions, CCS established the research and development platform incorporating "production, study, research, application and inspection" as a whole to develop standards and regulations. CCS attended the "LNG fuel power ship application safety research" project approved by China Maritime Safety Administration and National Energy Administration. At present, CCS is participating in three projects of the Ministry of Industry and Information Technology covering LNG ships, bunkering ships and carriers. CCS is now undertaking the project of the research of inland LNG carrier risk assessment and preventive measures of the Ministry of Transport.

Based on these research projects, the laws and regulations for each link of LNG supply chain have been basically completed. For LNG fuelled ships, CCS has several classed ships (such as CNOOC's 6500HP harbor tugboat); for LNG bunkering, CCS has provided plan approval inspection service for 12 LNG bunkering pontoons, and is providing classification service for the world's first new LNG bunkering ship (200 m3) of ENN Energy Holdings Ltd; CCS has experience in classification of both large LNG carrier and small carrier. In addition to LNG application on water, China's land

LNG has developed rapidly, about one hundred LNG liquefaction plants, eleven receiving stations and more than 1000 filling stations have been built. The scale of the development of water and land LNG project requires even more badly the implementation of risk assessment and risk management.

Before the quantitative risk assessment of LNG, we should grasp the danger of LNG. The danger of LNG is mainly reflected in six aspects: one is the cryogenic danger, mainly reflected in the harm of steel structure and personnel; the second is the heavy gas diffusion, the gasification evaporation temperature is about -110 °C, since the water vapor is coagulated, the air tightness of evaporation is greater than the density of air, this will lead to the spread along ship's deck surface or ground; the third is the flash fire, when the combustible heavy gas spreads along the near surface, it will form flash fire when there is a source of fire; the fourth is the pool fire, which is caused when the flash fire backs to the liquid pool which is the leakage source; the fifth is the explosion within a closed space; the sixth is rapid phase transition (RPT) explosion, when large number of LNG contacts with water, the phase change could happen suddenly and cause physical explosion. The experiment has proved that the shock wave of RPT explosion has no devastating effect on the structure and equipment.

Many foreign regulations require that QRA for LNG project should be done mandatorily. But in China, QRA has not been carried out in large-scale yet, there are three main reasons: one is that China has not implemented the standard process of QRA; secondly, China has not established equipment failure database; thirdly, there is no uniform risk acceptance criteria. However, LNG QRA is an inevitable trend, therefore in the face of numerous difficulties, CCS has overcome difficulties and developed QRA service products suitable for LNG.

QRA, firstly it is to identify the dangers; the next step is making judgment and selection for each dangerous failure rate, determine the danger scene; and then make the quantitative calculation of leak consequences to the identified scene; finally, make the quantitative calculation of the value -at -risk, and judge whether the risk can be accepted on the basis of risk acceptance criteria. If the risk value can not be accepted, measures should be taken to control risk.

After the identification of preliminary hazard, hazards of the equipment failure rate should be screened based on the database. Since China has not established the related equipment failure database of LNG, and temporarily makes reference to the foreign database (the famous LNG databases are the FERC database of US Federal Energy Regulatory Commission and the Dutch database). For screening the failure rate, the criterion given by FERC is chosen, namely the risk of failure rate less than 5E-5 can be ignored, the risk of failure rate more than 3E-5 is unacceptable, measures must be taken to reduce the failure rate. Three-dimensional CFD software FLACS is used to make quantitative calculation of leak consequences, this software has been approved by the U.S. PHMSA, which is the only CFD software used in LNG leakage consequence simulation on land. CCS has introduced the software and signed a technical cooperation framework agreement with the software developer, GEXCON, a Norwegian company, the two sides will cooperate in the oil and gas explosion, diffusion, hazard assessment, etc.

One of the most important aspects of risk analysis is to determine the risk acceptance criteria, since China has not yet had unified risk acceptance criteria, the international standard is currently referred to.

Problems needed to be noted

In order to further improve the QRA technology, the following aspects need to be focused on:

- China has not had basic database, we need to create a database as soon as possible; when foreign database is adopted, the gap between domestic and foreign industry and management level should be appropriately considered;
- Compared with traditional graphic software or empirical formula calculation, using CFD software to quantify the impact scope of LNG leakage will get more accurate results (e.g., may consider obstacles, atmospheric conditions, arbitrary wind direction, etc.);
- Need to develop “risk acceptance criteria” which is suitable for China.

CCS will be committed to promoting floating LNG projects implementing QRA technology, and providing quality services for government and industry. Recently, CCS will develop new service products for LNG water supply chain to, such as the safety assessment of combustible gas leakage of natural gas engine cabin, etc. CCS expects that the new service products will provide customers with practical solutions.

The Status and Trend of Mutual Recognition of Certificates of Marine Electrical Explosion-proof Product

By Fang Shijie & Li Yuliang & Tan Zhengping

Over a long time, the world's leading industrial nations have established mandatory national standards and technical requirements in their safe work regulations for electrical explosion-proof products based on respective national conditions, and most of them can not be mutually recognized. The practical difficulties caused by the explosion-proof certificates not being mutually recognized are even more distinct in ship and marine engineering area which are characterized by international labor division and cooperation: electrical explosion-proof products must comply with the requirements of different administrations, such as the requirements of national competent authorities and different classification societies, but the standards implemented by these competent authorities or their authorized inspection agencies are different.

The International Electrotechnical Commission (IEC) is the body recognized to develop international standards for electrical products. The main functions of the three systems of "quality assessment system for electronic components (IECQ)", "electrical product conformity testing and certification organization" (IECEE) and "electrical explosion-proof product certification system (IECEx)" are based on IEC standards. The aim is to reduce the difference between different national requirements for product performance, safety and test, reduce or even eliminate unnecessary duplicated certification and inspection, and promote smooth international trade.

As the main force of national inspection agency to inspect ship, offshore facilities and related industry products in China, China Classification Society (CCS) has established detailed technical rules for the setting, installation and use of marine electrical explosion-proof equipment onboard ships and offshore engineering equipment, to ensure the necessity, correctness and rationalization of the use of electrical explosion-proof products.

Considering the international cooperation in ship and marine engineering field becoming closer and closer, the "explosion-proof test bodies" proved by CCS has gradually become a very restrictive condition: almost all overseas electrical explosion-proof products do not have the "explosion-proof certificates" issued by CCS recognized test bodies. On the other hand, domestic electrical explosion-proof products without ExTL explosion-proof test report and certificate cannot obtain the recognition of foreign classification societies. Double-edged sword effect of technical barriers is more prominent for electrical explosion-proof products.

Uniform standard, common rules and mutual recognition are the trend of international cooperation. Based on the three-step target i.e. "following, mutual recognition and leading", which was established in the 2013 annual meeting of IEC certification system by National Certification and Accreditation Commission (CNCA), and considering the actual situation that China's national standards lagging behind the IEC standards, the writer proposed counter measures in the present stage after reviewing the situation above and full discussion:

Firstly, getting IECEx approval certificate is the general trend at present, especially for the ship and marine engineering industry which has deep and fine-tuned international labor division and cooperation;

Secondly, speed up transformation of domestic standards, to achieve as far as possible the "synchronization" and "mutual recognition" before achieving "leading";

Thirdly, promote explosion-proof products research and manufacturing enterprises in China to use the latest international standards as far as possible, and to obtain the approval certificates recognized internationally;

Fourthly, for domestic explosion-proof products, if their certificates are recognized by CCS, and are issued by the ExTL recognized by IECEx system, CCS needs to only confirm the application scope of the electrical explosion-proof products listed in approval certificates;

Fifthly, for the explosion-proof products produced by overseas manufacturers, theoretically, under the prerequisite of having the certificates recognized by IECEx, they are required to undergo additional test to different parts by the ExTL recognized by CCS and has certificates recognized by IECEx, and apply for the explosion-proof approval certificate recognized by Chinese authority.