ClassNK

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62nd Edition

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Chairman and President ***Noboru Ueda***

Welcome to the 62nd edition of the

Welcome to this year's edition of the ClassNK Magazine. It is a special privilege for me to introduce the 62nd edition of this annual publication, as it also marks both my re-election as chairman and president of ClassNK this past March as well as my assumption of the chairmanship of the International Association of Classification Societies, also known as IACS, on 1 July 2010. Over these many years, ClassNK has come to set the standard for success as it navigates the many currents of global challenge, both in the maritime industry as a whole and in terms of the role of ship classification within this dynamically changing environment. Since our founding more than eleven decades ago, ClassNK has grown to become the largest classification society in the world on a gross tonnage basis with more than 178.6 million gross tons or some 20% of the global commercial fleet on our register. This is a truly remarkable achievement and highlights the high level of trust that the maritime community places in us.

Much has changed over these many years, both in the maritime industry and in our work as a classification society. The world economy has grown to become much more global and interconnected, as demonstrated by the recent global financial crisis and its aftermath. In turn, ClassNK has proactively been expanding our service network to better serve our clients around the world. At the same time, the scope of our activities has also expanded to encompass an ever broadening range of cutting edge R&D projects aimed at realizing ever safer, quality ship construction and reducing environmentally harmful emissions from ships as part of our mission of promoting safer, cleaner seas.

Once again, this year's ClassNK Magazine highlights some of the ways that the Society has been doing this as part of its continuing efforts to respond to the dynamic needs of the maritime industry, while staying true to our core mission of providing the best technical service possible to our clients. This includes two Technical Essays, each with a very different focus. The first introduces the Wind Challenger Concept for Next Generation Eco-Friendly Ships which looks at how new advances in technology and design can be used to reduce environmental loads through the effective and novel use of wind power. The second technical article focuses on ship safety with a review of the latest developments in brittle crack arrest design.

These two articles are followed by an interview with me highlighting some of my views on the latest challenges

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facing ship classification both in my capacity as Chairman & President of ClassNK as well as the Chairman of IACS. While there are indeed many issues requiring particular care and attention especially in the light of recent rapidly changing economic and socio-political circumstances, I am basically optimistic about the future and what it holds for both ship classification and the marine industry as a whole.

"Focus on Japan" introduces the major Japanese cities of Tokyo and Okayama. Both cities are significant for their long history and dynamic roles in the maritime industry in Japan. In addition, two internationally prominent cities that comprise key bases in ClassNK's global network, Shanghai and Rio de Janeiro, are the focus of "ClassNK Around the World". Shanghai serves as the center for ClassNK's operations in China, which were reorganized early in 2010, while Rio de Janeiro forms an integral part of ClassNK's growing presence in South America.

The section "Stories from the Sea" takes a look at some of the current R&D efforts being made by the Society in cooperation with industry to improve ship efficiency and protect the marine environment from pollution. This includes a brief review of the projects being undertaken to reduce greenhouse gas emissions through the application of several advanced technologies that are more closely within reach than one may first suppose.

The ClassNK Magazine concludes with the section "Topics and Events" which highlights some of the recent activities of the Society. This includes an introduction to the offices newly added to the NK global network in 2010 and some of the many maritime exhibitions participated in by the Society on five continents during the year.

Finally, I would like to thank all of our clients around the world for extending their continued support to ClassNK and our activities. It is thanks to your efforts that we have achieved such great success over the past 111 years, and I promise that ClassNK will continue to provide the very best in service possible over the many years to come.

Thank you again. I sincerely hope that you enjoy this year's edition of the ClassNK Magazine.

Wind Challenger Project

Development of a Motor Assisted Wind Driven Ship with the aim of significantly

New challenges in using wind energy for ship propulsion

Nowadays, finding effective ways of reducing CO_2 emissions to help prevent global warming has become a major social issue global in scope.

In the maritime field as well as other industries, various technologies aimed at reducing CO_2 emissions from ships have been and are being developed. These efforts include such approaches as reducing hull resistance, improving propulsion efficiency, and recovering and using waste heat, to name but a few.

Under these circumstances, a joint industries project (JIP) was launched in Japan in September 2009, which aims to develop a motor assisted wind driven ship using ocean wind as the main source of propulsion energy.

This project is organized by the University of Tokyo and seven parties, namely: NYK Line, Mitsui O.S.K. Lines, Kawasaki Kisen Kaisha ("K" Line), Oshima Shipbuilding, TEIJIN, TADANO, and ClassNK, amongst others, who are actively participating in the project at present.

This project, known as the “Wind Challenger Project”, aims to develop a motor assisted wind driven ship.

The motor assisted wind driven ship normally obtains propulsion power from ocean winds using hard sails, and while in harbor or in weak-wind weather conditions the ship uses a diesel engine as a complementary form of propulsion. As a result, the ship can achieve significant reductions in CO_2 emissions through the use of renewable wind energy while

reducing CO_2 Emissions from Ships

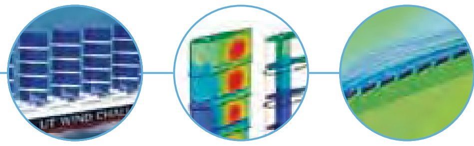


Fig. 2: Wind driven bulk carrier in port . (Courtesy University of Tokyo.)

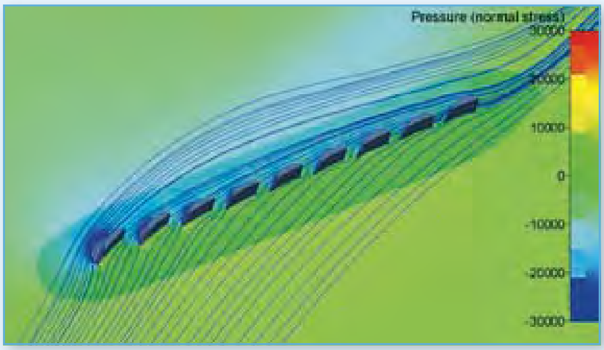


Fig. 3: CFD analysis of wind flow around nine hard sails. (Courtesy University of Tokyo.)

Fig. 1: Wind driven bulk carrier at sea. (Courtesy University of Tokyo.)

maintaining on-schedule navigation, which is one of the most important functions of all merchant ships.

The Wind Challenger Project aims to reduce CO_2 emissions from the ship to as much as one third that compared with ships of the same size operated with conventional diesel engine driven propulsion.

The concept of a motor assisted wind driven ship is being developed using a 180,000 DWT Capesize bulk carrier as a concrete example. This project is currently scheduled to be completed in 2012 together with business models for the operation of motor assisted wind driven ships of various types.

Motor Assisted Wind Driven Ship

The subject ship to be designed for the project (motor assisted wind driven Cape-size bulk carrier) is to be equipped with nine hard-sails made with CFRP (Carbon Fiber Reinforced Plastic) on the upper deck, as shown in Fig. 1. Each sail consists of five separate parts in the vertical direction, which are connected and supported by a spar (mast) having a specially designed telescopic expansion mechanism so that the sail can be expanded and contracted, as needed. When loading and unloading cargoes or when operating in heavy seas or rough weather conditions, the sails can be contracted. (Refer to Figs. 2 and 4.) At such times, the ship can be maneuvered using the supplemental diesel engine mentioned above.

The shape of the sails and their arrangement will be developed for optimum performance through 3-D CFD (Computational Fluid Dynamics) analysis and wind tunnel tests.

Sailing Support System

Proper sail control and navigation course selection are very important for any wind driven ship to realize maximum wind energy efficiency.

Consequently, a sailing support system that combines the traditional sailing technology developed in the sailing yacht race field such as the America's Cup together with state-of-the-art technology such as CFD analysis, ocean wind forecast studies, and the like will also be developed as part of the Wind Challenger Project.

This system will consist of two components, namely the sail control system and the supporting system for navigation course selection.

The sail control system will control the position of each sail so as to optimize the angle of the sails according to the present wind angle and wind velocity, the ship's present course direction, the ship's speed, and similar factors. Wind-flow analysis around multiple sails using 3D CFD is expected to be very effective in the development of this system.

It is also important for the wind driven ship to select the optimum navigation course taking into account the weather conditions in the ship's path in order to obtain maximum wind propulsion. The project is developing a supporting system for navigation course selection based on recent studies of ocean wind forecasts (Fig. 5). It is expected that this system will greatly assist the ship's master in determining the best course for the ship given the actual conditions the ship is operating in at any given time.

Sailing motor assisted wind driven ships

The realization of the motor assisted wind driven ship developed under this project is expected to bring about a great reduction in CO_2 emissions in the maritime field.

Success in this project would mean that in the near future, we may see modern wind driven merchant ships controlled by state-of-the-art computer technology sailing the seas as a normal everyday occurrence.

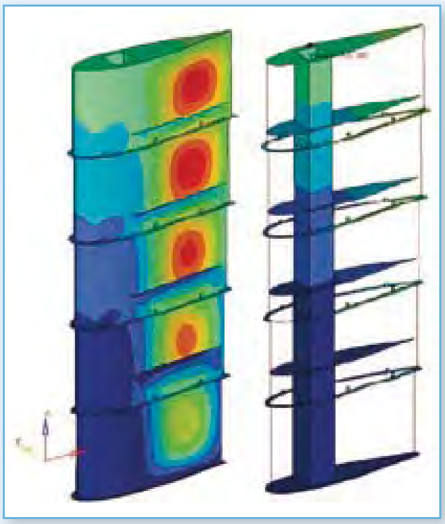


Fig. 4: Sail mast (spar) with telescopic mechanism (Uzawa, Kimura, et al., Conference Proceedings of JASNAOE, Vol.10, May 2010).

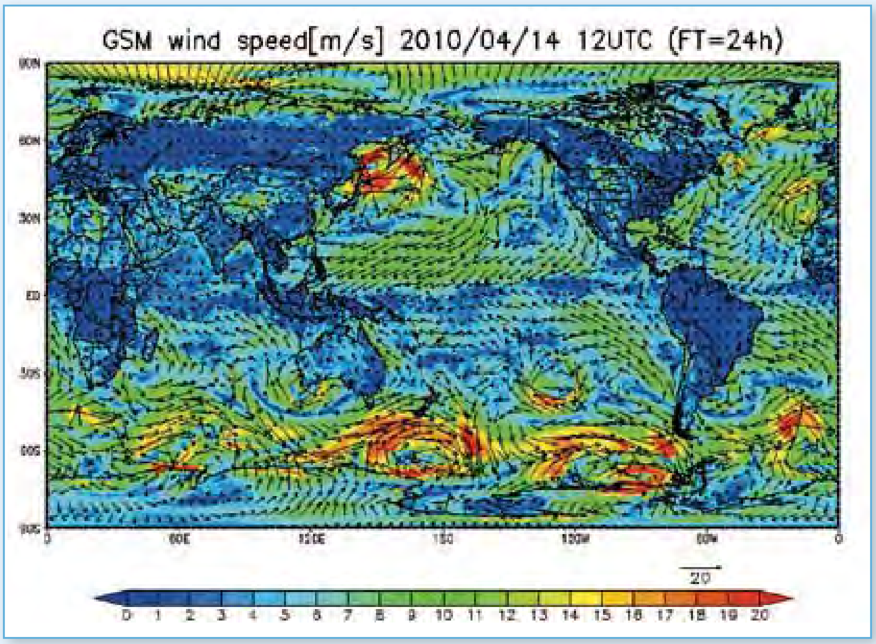
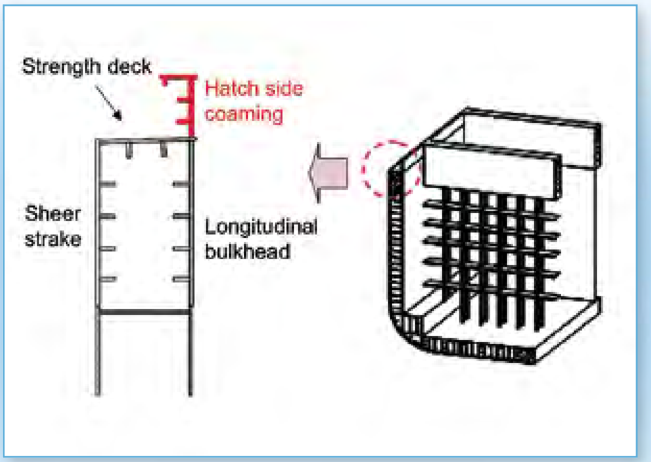


Fig. 5: Example of ocean wind forecast (Waseda, Nishida, Conference Proceedings of JASNAOE, Vol.10, May 2010).

Development of Guidelines on Brittle Crack Arrest Design

Brittle crack arrest design for ultra large container ships

The review of brittle crack arrest design – the art of stopping brittle cracks in steel plates from wreaking havoc with a ship's structure – has raced up the agenda of classification societies as the size of container ships marches ever upwards. The economics driving the growth in ship size are unlikely to change. Accordingly, ClassNK has issued some timely guidelines updating brittle crack arrest design for the modern era. Simply stated, as the fracture toughness of steel plate decreases as plate thickness increases, the most important issue in the use of extremely thick steel plates is the prevention of brittle fractures that could lead to large-scale failure.



Typical midship section of a containership. Hull girder strength needs to be assured using only a limited number of structural members.

Classification societies have specific requirements to prevent the occurrence of potentially fatal brittle cracking and also to arrest brittle crack development (e.g., IACS Unified Requirement S6). However, recent tests coordinated by ClassNK have suggested that these requirements may not be effective for the extremely thick steel plate commonly used in the construction of the largest container ships. In fact, the present rules do not always guarantee the arrest of brittle crack propagation in extremely thick steel plates. The safety implications of such a discovery are alarming as, if left untreated, brittle cracks could, in some cases, cause a ship's hull to break up.

Such a situation requires careful study, and, after looking at the problem in depth, the Society has published *Guidelines on Brittle Crack Arrest Design,* which examine the issue for larger container ships. The new guidelines are expected to prove invaluable in making brittle crack arrest design a workable concept.

Fracture toughness

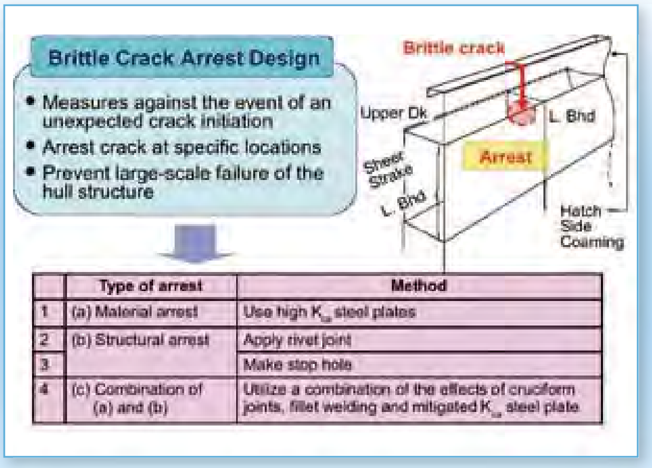
Under present classification rules, it has been assumed that the appearance of cracks could be contained despite the arrival of large steel plates required in super-sized container ships of 10,000 teu and above. Even though the fracture toughness of steel plate decreases as plate thickness increases, it was commonly understood that it would be possible to arrest the propagation of an unexpected brittle crack at the appropriate location. Now, these assumptions about the way a brittle crack might behave are being questioned.

In 2007, ClassNK joined with shipbuilders, manufacturers, universities, and research institutes to look into the problem. It established a research committee to investigate the current situation and suggest a way forward. The results of this committee's deliberations form the basis of the guidelines.

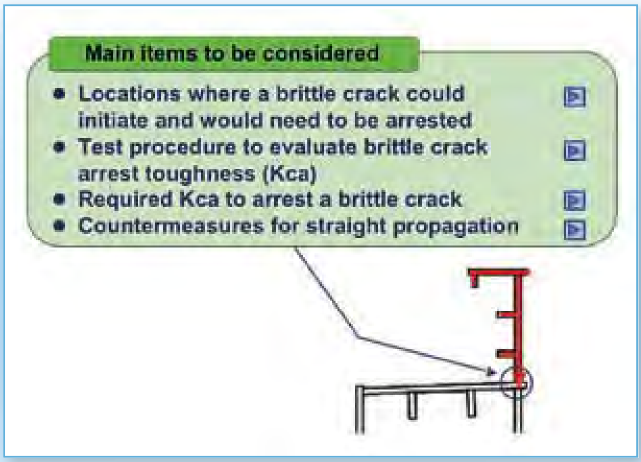
Previous research based its estimations of brittle crack arrest toughness on around 35 mm thick steel plates. The task that ClassNK and other interested parties faced was to define the brittle crack arrest toughness for steel plates of more than 50 mm in thickness.

One area of research has shown that if a brittle crack occurs in the weld joint of a thick plate, the crack would run in a straight line along the weld line without deviation. It was a worrying finding. Even if the hull structure is using extremely thick steel plates which satisfy present classification society rules, an unexpected brittle crack could move rapidly and along a great distance with the clear implication that it could be instrumental in causing large-scale failure. The research also found that when a brittle crack enters into the base metal, it is difficult to stop its progression even if the base metal consists of high toughness steel and brittle crack arrestabilty has been considered during construction.

Development of Guidelines on Brittle Crack Arrest Design



Basic concept of brittle crack arrest design.



Key points to consider in the development of an effective brittle crack arrest design.

Arrested development

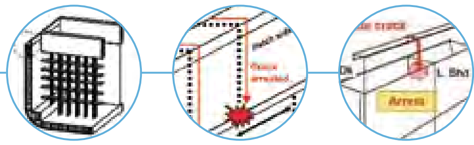
The main idea behind stopping the propagation of brittle cracks is to do so at an appropriate location where the resisting force is stronger than the propagating force. By doing so, it should be possible to prevent large-scale failure in the hull structure in the event that a brittle crack does appear. For this purpose, the desired outcome can be achieved in one of three ways: by material arrest, structural arrest, or by a combination of these two methods.

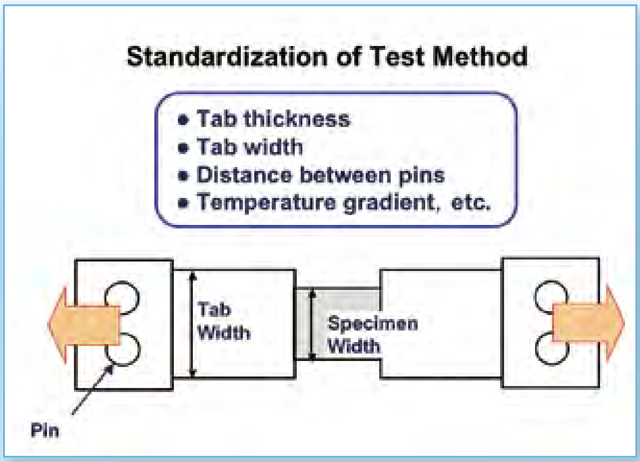
Material arrest involves arranging materials to maximize resistance to brittle crack propagation, while structural arrest is about eliminating the continuity of the crack propagation route. In other words, the first method involves positioning material with superior properties capable of resisting brittle crack progression, while the second seeks to disrupt the predicted path that a brittle crack would follow. The guidelines set out what sort of design is needed to arrest brittle cracks in large container ships using extremely thick steel plates. Fundamental to this approach is the focus on brittle crack arrest design based on the characteristics of the material.

As a starting point, the researchers looked at what kinds of tests for evaluating toughness with regards to brittle crack arrestability were already available in the field. The first wide plate crack arrest test was developed by T. S. Robertson at the Naval Construction Research Establishment in the UK. These findings were taken up by the oil company, Esso, following the failure of two of the company's storage tanks. This test method is commonly used in Japan to evaluate arrest toughness.

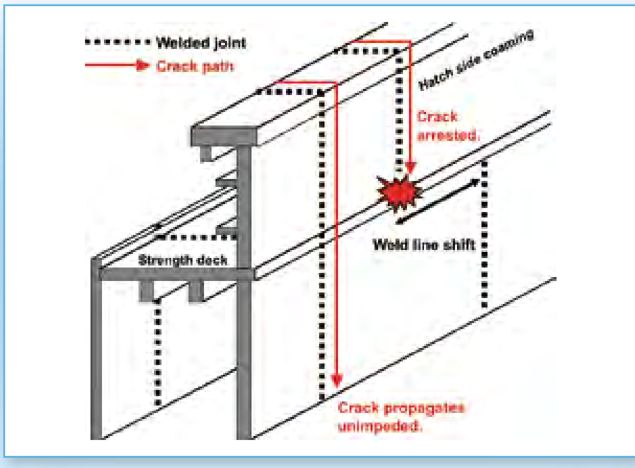
The committee examined the effect of several factors – thickness of tab plate, width of tab plate, distance between pins and temperature gradient and crack length – on the evaluated Kca values. In doing so, it was able to establish the brittle crack toughness (Kca) test method that is now included in the guidelines. However, the potential path that a brittle crack might take is very long, and in order to develop the required toughness to stop crack propagation in actual construction, it was necessary to use tests which reflected this reality.

Three kinds of tests were ultimately used to establish a standard for the concept of brittle crack toughness (Kca). These were: the ultra-wide duplex Esso test, large-scale structural component model test, and the full-scale structural component test. The test specimens for the large-scale





Basic concept of brittle crack arrest toughness Kca test.



The most reliable and practical measure in present shipbuilding to prevent straight line propagation is to shift the weld line.

model test and the full scale test were prepared in such a way that the ends of the hatch side coaming under the butt welded part penetrated the strength deck, thus creating similar conditions to those found on actual ships.

Having established a toughness value, the committee examined the behavior of brittle cracks in the structure of large container ships, and set the minimum requirement for typical brittle crack arrest design at 6,000 $N/mm^{3/2}$. It was found that, in the case of extremely thick steel plate, a brittle crack that starts in the weld joints does not deviate into the steel plates. To stop a crack's propagation, the most reliable and practicable method is the weld line shift. By putting some distance between the two welded joints, the path of the brittle crack runs to the base plate. The butt welded joint of the structural member in which the crack has propagated and the butt welded joint of the structural member which the crack is to penetrate should be separated by more than a set distance, so that the propagated brittle crack penetrates the base place. The distance to be used in this method is around 300 mm.

The guidelines developed by ClassNK from the work of the research committee are a world first in setting out clear, functional requirements for brittle crack arrest design. In addition, the brittle crack arrest toughness (Kca) test method was developed as a standardized method to enable common test results across different test laboratories. However, although the guidelines have undoubtedly increased understanding in this area, the work of the committee will continue and the guidelines will be updated, accordingly.

Numerous large-scale model tests and numerical calculations have been conducted by the committee since 2007 from several aspects on brittle crack arrestability. These have included examining test methods to evaluate brittle crack arrest toughness Kca for thicker steel plates, determining optimal crack arrest locations to maintain survivability of a ship, and studying the effect of structural discontinuities, brittle crack arrest fracture toughness, and block joint shift to arrest a crack within a crack arresting structure, amongst others.

These outcomes have been summarized in the *Guidelines on Brittle Crack Arrest Design* released by ClassNK for large container ships. Specific minimum requirements for arresting brittle cracks in plating up to 75 mm in thickness are covered in the guidelines.

View from the Top

Interview with IACS Chairman and ClassNK Chairman and President Noboru Ueda

ClassNK has achieved a consistent record of growth for more than two decades, setting new records for ships entering class in each of the past ten years. In fact, ClassNK has been the largest classification society in the world on a gross ton basis for each of the past ten years. From July 2010 through June 2011, the Society also serves as the Chair of the International Association of Classification Societies (IACS). As such, ClassNK Chairman and President Noboru Ueda currently wears two hats, one as Chairman and President of ClassNK and the other as the chairman of the prestigious IACS Council. ClassNK Magazine sought Mr. Ueda's views on a number of timely topics, including what makes ClassNK so successful and his expectations for the coming year as IACS Chairman.

1. What are the factors that make ClassNK one of the leading Classification Societies in the world today?

One of our greatest strengths is the fact that we truly specialize in maritime services. In fact, I think this is one of the reasons for our continued success. Almost all of our work is maritime related, and every one of our 116 exclusive survey offices is completely dedicated to the maritime industry. This does not mean that we are ignoring areas like alternative energy and industrial markets, in fact we are conducting a number of wide ranging research projects in those fields, but maritime is the core of our business and I expect it to remain that way in the future.

We are also dedicated to providing quality service and committed to working closely with our clients to meet their various classification, audit, and certification needs. Moreover, ClassNK also carries out, both independently and in cooperation with industry, extensive research and development projects on a broad range of topics aimed at finding effective solutions for realizing a safer and greener maritime industry.

2. What are your goals as IACS Chairman?

While IACS and the maritime industry are asked to deal with a variety of important and pressing issues, I am focusing my efforts as IACS Council Chairman on three major areas.

Firstly, IACS will continue to contribute actively to the challenging technical issues of the maritime industry. As is well known, the international rules that govern safety of life and property at sea and the protection of the marine environment are constantly changing. Now, more than ever, IACS, as IMO's technical consultative organization since 1969, must be at the forefront of these changes, and work alongside the maritime industry to implement and apply every new rule and revisions to existing rules smoothly and effectively in line with its basic philosophy of contributing to the enhancement of maritime safety and protection of the marine environment based on superlative technical capabilities and high levels of quality.

As chairman, I am working to ensure that IACS actively addresses industry's concerns about the development of the Harmonized Common Structural Rules in conformity with the Goal Based Standards (GBS), reduction of greenhouse gas (GHG) emissions, and implementation of new international conventions such as the Ballast Water Management Convention, the Ship Recycling Convention, and the Maritime Labour Convention. I am dedicated to ensuring that IACS works with every sector of the industry, and provides the know-how and expertise to implement these new regulations as smoothly and easily as possible.

Secondly, as Chairman I am dedicated to ensuring that IACS reflects the global scope and diversity of the maritime industry. I will work to ensure that every aspect of IACS, from our decision making process to our rule implementation, reflects the needs and opinions of the entire maritime industry, and not just some regions. We have a duty at IACS to ensure that the work we do and the contribution we make at the coalface of the IMO accurately reflects the needs, opinions and aspirations of the global maritime industry as a whole. I would like to form a bridge between IACS and the wider maritime industry and in particular ensure global input into the regulatory process, including introducing currently silent voices from Asian countries.

Thirdly, I am working to ensure that IACS faithfully complies with its commitments to the European Commission. Any membership application from non-IACS classification societies will be handled truly based on the commitments with full transparency without any bias. Although the new IACS membership criteria provide non-IACS classification societies with a clearer path to IACS membership, there are concerns that these criteria could lower IACS' quality standards. I wish to allay any such concerns and I believe that these new criteria will only improve the high standard of quality that IACS has become known for. I should also point out that already, the Indian Register of Shipping has been accepted as a full member of IACS earlier this year.

In short, I intend to make this transition to a new more open and transparent IACS a successful one.

3. What role can ClassNK play in developing environmental technology?

We are right at the beginning of revolution in green technology. I expect that over the next few years we will see an incredible number of new developments in the way of improved technology and improved ship designs. I think that classification as an industry needs to take a leading role in addressing the challenges posed by GHG emissions and protecting the environment. In fact, I think this is an issue that class is uniquely suited to addressing. Class serves as a bridge between all the sectors of the industry – we work with not only shipyards and shipowners, but also flag states and the IMO. We are also powerful research organizations who are able to take a comprehensive approach to these issues.

For our part, we have never been more committed to the environment than we are now. Since February 2010 we committed some 2.2 billion yen (roughly US$25 million), a quarter of the total budget, to a GHG reduction program sponsored by the Japanese government. The nineteen individual projects we are supporting as part of this program include technologies like micro-bubble (air lubrication) technology for ship hulls, hybrid turbocharger/generators, more efficient propellers, and improved hull coatings, among a variety of other projects. The most important aspect of these efforts is that many of the technologies (like the micro bubble system) are already being tested on ships in actual service, and all of these technologies are expected to be commercially available over the next few years. (See Stories from the Sea for a summary of the 19 projects.)

What makes this program special is that it involves the entire Japanese maritime cluster, and it is focused on developing technology that can be implemented practically in the near term. It is this kind of practical innovation that will have the greatest effect on the maritime industry, and I am confident that it will lead to a greener future for the maritime industry.

4. What is ClassNK doing to make shipping more environmentally friendly?

Ship classification as an industry has always had an important role to play in environmental regulation. Not only does ClassNK actively develop its own environmental standards, but we also play a major role through IACS and the IMO in addressing the technical and practical challenges involved in applying environmental regulation. This is true for all class societies.

For ClassNK however, since the creation of our Practical R&D Promotion Department in 2009, we have decided to go beyond such standards, and take a much more proactive approach. The essential shift we are making is that we are no longer just involved in the development of rules and guidelines as well as affixing notations for the application of new technologies on ships as a classification society, we are now taking a proactive part in the development of the technology itself.

One significant example of this is our active participation in a Japanese national program to reduce GHG emissions. As noted above, this includes contributing some 25% of the total budget for this program and specifically providing funding and research support for 19 of the 22 projects comprising the program. What's really impressive about these projects is that many of the technologies that are being supported by the program are either already being tested onboard ships or will be within the next year or so. I think we are going to witness a revolution in green ship technology over the next few years.

Another ongoing project is our collaboration with the Cooperative Association of Japan Shipbuilders (CAJS: an association comprised of small and mid-sized Japanese shipyards) to find effective ways of reducing GHG emissions during shipbuilding. We are currently conducting a thorough analysis of every stage of the shipbuilding process and seeing where emissions can possibly be reduced (e.g., welding, power usage, etc.). With GHG, in particular, we really need to be taking a holistic approach to emission reduction, and this project is part of that effort.

ClassNK is also currently developing a new software tool called PrimeShip-GREEN/EEOI, due to be released in the spring of 2011 as a GHG index appraisal service. This tool is an EEOI calculation and analysis system designed to support the implementation of energy efficiency improvements made through the introduction of various operational measures onboard ship to reduce CO_2 emissions.

5. What pressures were placed on NK during the economic downturn, and how has the work of the class society changed over the past two years?

Obviously the economic downturn has affected everyone in our industry, but due to the quality of our customers, the

strength of our services, and our somewhat more considered approach to expanding our business activities over the years, we have emerged from the economic downturn in an excellent position going forward. While I cannot speak for other class societies, I think we probably suffered the least from cancellations during the crisis. It is our goal to expand our market share further in the years to come.

One of the big changes for NK, as a whole, is that we are working with a growing number of owners and shipyards around the world, and we are really committed to providing the right services and support to each sector of this industry. This means working with Greek and Turkish owners at Korean yards, for example, but also developing new rules for Offshore Support Vessels (OSV) and workboats for yards in Malaysia and Indonesia, new barge rules for yards in South America, and so on. Although we are the world's largest class society on a gross tonnage basis, we still have very much room to grow.

6. Looking at the next five years or so, what will be the key areas of focus for NK?

As we become a more international classification society, obviously an ever larger portion of the ships in our fleet are being built at Korean and Chinese shipyards for owners from around the world. Future growth in Korea and China are a top priority for us, and just this year alone we will deploy another 85 new surveyors in Asia, with the majority of them going to Korea and China. At the same time, competition between class societies is increasing, and now more than ever owners and shipyards expect the best service possible, and over the next few years we will be further improving our service network and support systems to better achieve that.

Taking a longer view, we believe that cutting edge research will dramatically change our industry over the next 5 to 10 years, and we are determined to take a positive role in that change. Right now our Practical R&D Promotion Division has nearly 50 different Joint Development Projects in the works, with not only the world's leading shipyards, but also major shipowners and manufacturers from around the world. As I mentioned, I think we are right at the start of a green revolution in the maritime industry. These are extremely exciting times on the technology side of things, and I am glad that we can play such an active role in them.

Tokyo

Economic and Political Crown of Japan

Aerial view of the Port of Tokyo with Mt. Fuji in the distance.

Traditional temples, shrines and small parks interspersed among a vast array of buildings ranging from older wooden structures to ultra-modern high-rises and offices buildings... A unique mixture of East and West, Tokyo is a city of seemingly inscrutable contrasts. While compact and often crowded with an urban press of buildings and people, the city is also sprawled out over a wide area and reflects a surprising mix of architectural and interior styles. Land costs are easily among the highest in the world and are measured by the square meter. Even though concrete jungle-like features are often plastered with neon signs in commercial areas, entering many buildings can be like stepping into a whole new world. Whether it be a basement restaurant with high beam ceilings and artfully designed walls inspired by anything from European to Polynesian themes or ultra-modern and highly efficient office buildings, the use of space often gives a sense of being in an area much vaster than one would first imagine possible. Extensive systems of highways, trains and subways also thread their way through the mass of buildings to form one of the most efficient transport systems in the world moving millions of people about their tasks every day.

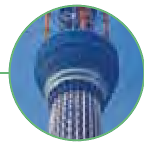
Tokyo today is a metropolitan prefecture located near the center of the Japanese archipelago and sits on the edge of a very large natural and well protected harbor. It is the most populous of all 47 prefectures in Japan at about 13 million (as of the beginning of 2010) or about 10% of nation's total population, yet covers an area of about 2,188 square kilometers, or just 0.6% of the total land area of Japan. It also encompasses a number of island groups in the Pacific Ocean, including the southernmost and easternmost islands of Japan. As such, Tokyo comprises an exclusive economic zone that is about 400,000 square kilometers in size.

From its humble beginnings centuries ago, Tokyo has grown to become one of the largest and most important cities in the world. Not only is it now a major global business and financial center, it is also the capital of the world's second largest economy, Japan. It is also the home of the Head Offices of Nippon Kaiji Kyokai, also well known as ClassNK (the Society).

In the Beginning

While archaeological discoveries date back more than 30,000 years, the earliest history of what is now Tokyo can be traced to the Jomon Period which lasted up to about 300 B.C. The local people were hunters, fishermen and gatherers. In the centuries that followed, they adopted a settled agrarian lifestyle, cultivated rice for the first time, and learned how to use iron. The earliest recorded history of the region can be traced back to the 6th century B.C. when Buddhism, art, architecture, and calligraphy were first introduced into Japan from China.

However, it wasn't until centuries later that the city, originally named Edo after the local clan, began to take shape and work began on the construction of Edo Castle in 1457. As



early as 1392, many ships were moving in and out of the large natural harbor of the city, and the medieval Shinagawa Port, forerunner to the modern Port of Tokyo, bustled with commercial activity that contributed to the development of marine transportation in both the Edo region and Japan. The city started to flourish after Tokugawa Ieyasu established the Tokugawa Shogunate in Edo as Japan's first shogun, or supreme military leader, in 1603. As the center of politics and culture in Japan, Edo grew into a huge city with a population of more than a million people by the mid-eighteenth century.

The Edo Period lasted for nearly 260 years until the Meiji Restoration in 1868, when the Tokugawa Shogunate ended and imperial rule was restored. The Emperor Meiji moved from the former capital of Kyoto in western Japan to Edo at this time. Edo Castle became the Imperial Palace and Edo was renamed Tokyo, meaning "Eastern Capital". Thus, Tokyo became the capital of Japan.

Transition to the Modern Era

The subsequent Meiji era (1868–1912) was a period of rapid change in Japan and the new capital of Tokyo. It was a period of active assimilation of Western civilization, including everything from architecture, fashion and technology to new legal and political systems. It was also a period of great learning and development. Japan's first telecommunications line was opened between Tokyo and Yokohama in 1869, and the first steam locomotive started running from central Tokyo to Yokohama just three years later. It was also during this time that the Japanese shipbuilding industry began to take shape and that the Society was founded in Tokyo in 1899. In fact, the Society played a key role in supporting the development of the shipbuilding and related industries in Japan at the time. This included facilitating the transfer of technological know-how from the West to help the fledging industries realize significant improvements over the years that would position them to become truly independent and global leaders in their respective fields in the next century.

Nishiki-e of early Tokyo.
(Courtesy of Special Collections Room, Tokyo Metropolitan Central Library.)

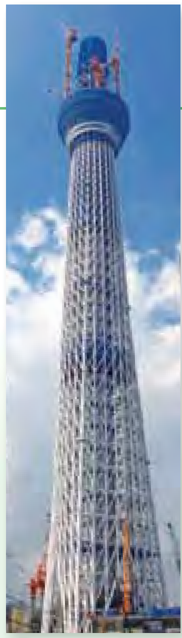
Nishiki-e of bustling waterfront.
(Courtesy of Special Collections Room, Tokyo Metropolitan Central Library.)

Although Tokyo continued to grow rapidly in the following decades, the city was devastated by the Great Kanto Earthquake in September 1923. More than 140,000 people were reported dead or missing, and 300,000 homes were destroyed. Still, it also provided the city a unique opportunity to grow even more afterwards. This included the opening of Japan's first subway line in Tokyo in 1927, the completion of the Tokyo Airport at Haneda in 1931, and the opening of the Port of Tokyo to international shipping in 1941. By 1935 the population of Tokyo had grown to some 6.36 million people, comparable to the populations of New York and London at the time.

However, the Pacific War, which broke out in 1941, had a devastating impact on Tokyo. The city was bombed 102 times resulting in major loss of life and property, including destruction of the vast majority of the commercial fleet, a large portion of which was classed with the Society at the time. By the time the war came to an end, much of Tokyo had been completely destroyed, and the population had fallen to less than 3.5 million, half its level in 1940.

The decades following the war were a period of spectacular growth for both the nation and its capital, Tokyo, as they recovered from the ravages of war and took active advantage of new global opportunities. Technological innovations and the introduction of new industries led to the mass production of synthetic fibers as well as household electric appliances such as radios, televisions, refrigerators, and washing machines. As a result, the daily lives of the people of Tokyo also underwent a considerable transformation as living standards improved. In 1962 the population of Tokyo surpassed 10 million. Two years later in 1964, the Olympic Games were

Tokyo



Tokyo Sky Tree, the tallest building in Japan.

held in Tokyo, highlighting how far the city had come in the eyes of the international community within just two short decades after the war. The Shinkansen (or "Bullet Train") also began operations shortly thereafter, and the metropolitan expressway was opened, forming part of the infrastructural foundation for Tokyo's current prosperity.

Although increasing pollution, the oil crises of 1973 and 1978, the ups and downs of various business cycles, and the more recent changing dynamics in the global economy have created new economic and social challenges for Tokyo and the nation as a whole, the industriousness of its people to find innovative solutions has allowed Tokyo to make significant strides in economic growth and improved quality of life over the years thanks to its increasingly global economic activity and the emergence of the information society. Tokyo has become one of the world's most active major cities, integrating both old and new to boast cutting-edge technology, information, culture, and fashion, as well as a high level of public safety.

Growth of the Port of Tokyo

After more than 200 years of isolation, Japan agreed under the Ansei Treaties (Five-Nation Treaties) of 1858 to open the five ports of Nagasaki, Kobe, Yokohama, Niigata, and Hakodate to foreign shipping and to open its two largest cities, Osaka and Tokyo, to foreign trade, but not foreign shipping. Even after the Ansei Treaties expired forty years later in 1899, the central government maintained its limitations on open ports, and the Port of Tokyo remained a domestic trading port serving only a supplementary role to the Port of Yokohama. The port continued to expand, however, with a series of dredging, land reclamation and development projects taking place over the years as the economic and industrial growth of Tokyo continued dramatically upwards.

Even with the restrictions on the port to handle only domestic shipping, by 1938 the Port of Tokyo had become one of Japan's most thriving ports with an annual cargo handling volume of some 12 million tons, thanks in large part to the spectacular growth of trade and industry in the metropolis. The Port of Tokyo finally opened to foreign shipping 1941.

The redevelopment of the Port of Tokyo as an international trade port after the war was vitally important to the post-war reconstruction of Japan and to the re-establishment of domestic industry. After recovering from the devastation of the war, the Port of Tokyo instituted a number of development plans aimed at bolstering the facilities of the port and easing congested urban traffic. These efforts were also a key aspect in the redevelopment plans of Tokyo itself. This included further successive land reclamation projects (see ClassNK Magazine No. 58, 2006) as well as the active construction of numerous new wharves and berths to handle vigorously rebounding cargo volumes.

The ClassNK Tokyo Branch Office

The Society maintains a Tokyo Branch office that is completely separate from the Head Office. The Tokyo Branch Office is in fact one of the older branch offices of the Society having been established more than sixty years ago in January 1949. It currently has the greatest jurisdictional responsibility of any branch office in Japan, covering most of eastern and northern Honshu, the main island of Japan. This includes a total of 27 ports ranging from Tokyo, Funabashi, and Chiba on Tokyo Bay to Niigata facing the Sea of Japan on the northwestern coast up as far north as Miyako and Akita in northern Honshu. It also spans 14 prefectures, including Tokyo itself, as well as several islands in the Pacific Ocean.

The Tokyo Branch office provides a broad array of services ranging from surveys of new and existing ships, inspection of materials and equipment to audits and registrations of ISM Code and ISPS Code related systems, as well as the assessment and registration of quality and environmental management systems. Requests for surveys and audits for individual ships or companies in the Tokyo area should be directed to the Tokyo Branch office, rather than the Head Office.

ClassNK Tokyo Branch Office.

Okayama

Land of Sunshine


Okayama Castle.

Okayama Prefecture lies on the coast of the Inland Sea of Japan. The prefecture is known as the "Land of Sunshine", because it has more sunny days and fewer rainy days than most other prefectures in Japan. This makes it a very comfortable area in which to live and work. The prefecture is well known for its fruits, especially peaches and grapes. In fact, more than half of the peaches sold in Japan come from Okayama. It is also famous for its textile industry, with over half of the school uniforms in Japan being produced here. The region has also been known for its salt production, fisheries, as well as traditional swords and pottery, which have been among the best ever produced in Japan. Okayama is also blessed with a long coastline and numerous natural harbors. Notable ports include the ports of Tamano and Mizushima, amongst others, which provide marine transport support to large industrial complexes facing the Seto Inland Sea.

The region is home to two world-famous shipyards, Mitsui Engineering & Shipbuilding Co., Ltd. (MES) and Sanoyas Hishino Meisho Corporation, as well as to such preeminent manufacturers as JFE Steel Corporation, MES Tamano Works (which produces Man B&W engines), and Nakashima Propeller Co., Ltd., amongst others. This year's ClassNK Magazine spotlights MES Tamano Works and Nakashima Propeller, top manufacturers in their respective areas of expertise.

The ClassNK Okayama Branch Office

In September 1934, the TAMA office was officially established at Tamano City in Okayama Prefecture to carry out surveys on new vessels built by the Shipbuilding Division of Mitsui & Co., Ltd., the forerunner of MES. In April 1945, the office was upgraded and the name was changed from the TAMA office to the TAMANO Branch office. In April 1990, the office was relocated to the center of Okayama City and the name was changed again, this time to the Okayama Branch office.

The office provides a range of services to clients including surveys for both newbuildings and ships in service, ISM Code and ISPS Code related audits, machinery and equipment inspections and certifications, as well as a host of other related services. More than 90% of the newbuilding surveys carried out by the office are for bulk carriers. Okayama Office is located in the center of Okayama City and handles a wide range of survey services in Okayama Prefecture and prefectures to the north of Okayama Prefecture including Tottori and Shimane lying on the Sea of Japan. The office also carries out much work at the Mizushima Coastal Industrial Zone, which houses major steel works, a petrochemical complex, automobile manufacturers, and shipyards.


ClassNK Okayama Branch Office.

Okayama

MES Tamano Works – A world leader in marine products

Top: NORD ANGEL; Botton: HAIMA.

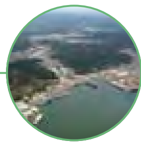
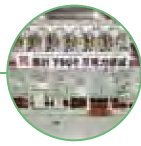
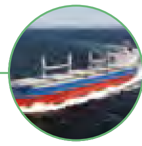
MES Tamano Works.

The Tamano Works of Mitsui Engineering & Shipbuilding Co., Ltd. is the largest manufacturer of slow speed marine diesel engines in Japan and a leading shipbuilder. Located on the coast of Okayama Prefecture in western Japan half way between Osaka and Hiroshima, the Tamano Works is a large complex that faces the Seto Inland Sea south of Okayama City. It was originally established in 1917 as the shipbuilding department of what is now known as Mitsui & Co., Ltd. After a number of reorganizations over the years, the company changed its English name to Mitsui Engineering & Shipbuilding Co., Ltd. (MES) in 1976.

The Tamano Works is one of the main manufacturing centers of MES, which together with the MES Group of companies, is a leading global provider of maritime products ranging from ships, engines, and systems to infrastructure and environmental solutions of all sorts. It currently consists of several groups, including the Ship - Ocean - Underwater Equipment Group, the Machinery Group, the Technoservice Group, and the Research & Development Group, among others. The company provides an extensive range of products and services such as the repair and construction of commercial ships, naval ships and craft, patrol vessels, research, training and other types of specialized vessels, as well as the manufacture of slow-speed and medium-speed diesel engines, turbochargers, turbines, power generators, and various types of marine and other systems. Total consolidated sales for the whole MES group exceeded US $9 billion in 2009.

The company has achieved many firsts over the years, including completing the first diesel cargo ship to be built in Japan in 1924 (the *Akagisan Maru*), building the world's first low-temperature LPG carrier in 1961 (the *Gohshu Maru* - classed with NK), the world's first automated cargo ship (the *Kinkasan Maru* - also classed with NK) that same year, as well as the world's first offshore oil drilling rig for exclusive use in frozen seas in 1983, and an unmanned, remote controlled deep sea research vehicle in 1995 (the *Kaiko*) that succeeded in diving to a depth of 10,911 meters - a world record as of 1995.

Other ships built by the Tamano Works include specialized vessels like the *Chikyu*, a deep-sea scientific riser drilling vessel that was launched for the Japan Marine Science and

Technology Center in 2002 (see the 54th Edition (2002) and 60th Edition (2008) of ClassNK Magazine for details), as well as the MV Haima, a 110,046 dwt oil tanker built to NK class and delivered in 2009 (see the 2009 ClassNK Annual Report, p.17), as well as the MV Nord Angel, a 56,000 dwt type bulk carrier, delivered in April 2010, also built to NK class. This ship is the 102nd of the "Mitsui 56" series delivered by the Tamano Works since the series was first introduced to the market in 2001 and the first ship delivered in 2003. The ship is a 56,000 dwt handy-max type bulk carrier with a very large cargo hold capacity exceeding 70,000 m³. In addition to flexible cargo handling capabilities, each ship is also equipped with a MITSUI-MAN B&W diesel engine as its main engine, which is a light, compact and high output engine with excellent reliability and high operational flexibility. A total of some 160 vessels of this series are expected to have been delivered to clients around the world, with the bulk of these ships being built to NK class.

The Tamano Works is especially known for its production of marine diesel and other types of engines and related systems. Since concluding a licensing agreement with Burmeister & Wain of Denmark in 1926, the Tamano Works has grown steadily over the years to become an all-round builder of diesel engines and supplier of components for both marine and land units. The Tamano Works currently manufactures nearly half of all slow-speed marine diesel engines produced in Japan, making it a preeminent leader in marine engine technology and production. This has been aided by the expansion of the Tamano Machinery Factory at the Tamano Works in 2007, which established a framework

70 million BHP record breaking engine.

for the production of 5 million BHP of diesel engines annually. The plant is also the only engine production facility in Japan with its own shipping berth, greatly facilitating the delivery of engines up to 640 tons in weight without the need for disassembly.

In fact, the Tamano Works reached a major milestone on 2 June 2010 with the production of a 7S80MC-C / 27,160 KW x 76 RPM type main diesel engine which marked the plant's aggregate production of 70 million BHP since the plant completed its first engine in 1928, a world record for a single brand engine being built by a single builder. This engine was both certified by ClassNK and installed onboard a NK classed ship. To date, the plant shipped a total of nearly 5,000 diesel engines to clients around the world. A total of 230 engines (4.2 million BHP) are planned to be shipped during the April 2010 to March 2011 fiscal year, the bulk of which are scheduled to be installed onboard NK classed ships. The Tamano Works celebrated the accumulated production of 50 million BHP in 2005, reached 60 million BHP in 2008, and surpassed the 70 million milestone just a short two years later.

The R&D Division of the Tamano Works Research & Development Group is noted for its mission of leading and assisting in the development of technologies and products primarily in the field of advanced machinery systems. These include measurement and inspection technologies, process technologies, control technologies for machinery systems and plants, as well as advance computer simulation technologies such structural analysis and computational fluid dynamics analysis. A major goal of all these efforts is the development and production of reliable and eco-friendly systems and solutions that meet the needs of clients throughout the maritime world.

The various activities of the MES Tamano Works are prime examples of the firm's corporate philosophy of being a "manufacturing" company trusted by society and its people that is committed to the realization of a sustainable society, through the development and production of earth-friendly products with higher efficiency and lower energy consumption particularly in its main products: shipbuilding, diesel engines, and various marine systems and support services.

Okayama

Nakashima Propeller Tamashima Works

Established in 1926, Nakashima Propeller is one of the world's leading manufacturers of marine propellers and specialized propulsion equipment. Its broad product range includes fixed pitch propellers for all manner of vessels from racing boats to super-sized ships, controllable pitch propellers, as well as side thrusters.

The company operates plants not only in Japan but also in Vietnam and the Philippines. Making the most of its strengths and long experience in design and 3D processing capabilities acquired through the manufacture of sophisticated, world class propellers, Nakashima has also ventured into various new business fields in addition to marine propulsion. These include Nakashima Medical, which specializes in the manufacture and sale of artificial joints, and Systems Nakashima, which specializes in software development.

The Tamashima Works was established in 2005 as a specialized facility for the production of large-sized fixed pitch propellers. It is located on the reclaimed Tamashima Harbor Island in the Mizushima Industrial Zone in Kurashiki City, Okayama Prefecture. The plant was established as part of the company's commitment to satisfying client demand for larger propellers for vessels of ever greater size, delivered to ever tighter delivery deadlines. Meeting these needs has been made possible by relocating the plant near a major sea area, and by achieving higher production efficiencies through the use of the most advanced production facilities and capabilities possible. The full port facilities offered by Tamashima Harbor Island also makes it possible to ship completed products to clients both in Japan and around the world quickly and easily.

Tamashima Works places particular emphasis on the following four points in its operations:

1. **optimization of the production line,**
2. **enhancement of the work environment,**
3. **reduction of environmental loads, and**
4. **recycling of resources.**

CNC Blade Milling Machine.

Highly Skewed Propeller.



Nakashima Propeller Tamashima Works.

Tamashima Works has successfully actualized these goals as the world's most advanced, state-of-the-art propeller factory. In addition, it has successfully developed special processing machinery, the only ones of their kind in the world. These include a CNC blade milling machine capable of 5 axes of simultaneous control, as well as a propeller overturning device that can turn over large propellers safely and efficiently. With these specialized capabilities, Nakashima has established production technology that enables it to realize the propeller design most suitable for each vessel.

Supporting high quality is not just about the best design and the latest facilities. After CNC blade milling, propellers are hand finished to the highest level of precision possible by experienced craftsmen. The blade edge, the most crucial part of a propeller profile, requires finishing by highly skilled craftsmen. The combination of such factors is the true basis of Nakashima's high quality finish, renowned among clients across the globe.

Additionally, Nakashima's Tamashima Works is not only mechanized but also makes full use of advanced information

Tamashima Harbor Island.

technologies. One example is the original production control system developed by the company to efficiently manage each propeller's actual location and each stage of production in real time. Nakashima continuously strives to achieve ever greater levels of optimization and practice, while it keeps challenging new fields with the aim of continuous development. This is the motivating foundation for the company's slogan, "We Go Beyond".

Reducing Greenhouse Gas Emissi

ClassNK and the Japan National Project to Reduce GHG Emissions

Global warming and related environmental issues have become matters of ever increasing concern in recent years. Topics related to energy conservation and the reduction of CO_2 emissions are everywhere. Ever more strident demands for measures against global warming are being made in the international shipping arena, as well. Not only are discussions being held at the IMO and elsewhere around the world related to reducing greenhouse gas emissions, but numerous efforts are being made in both the public and private sectors to develop practical solutions to these challenges.

Joint R&D projects with industry aimed at development of technologies to reduce GHG

ClassNK has been very active in implementing many R&D projects both independently and in cooperation with industry on many levels over the years. As part of these efforts, the Society has also been participating in many projects such as those related to the "Support for Technology Development for Curtailing CO_2 from Marine Vessels", a four-year program that began in 2009, meant for assisting the Ministry of Land, Infrastructure, Transport and Tourism in Japan. The technical areas covered by this program are summarized in Table 1 and extend over a wide range of fields. The Society is now participating in 19 of the 22 projects, already providing some 2.2 billion yen (roughly US$ 25 million) or a quarter of the total budget. An overview of these 19 projects follows by field. The projects are listed by the technical field shown in Table 1, followed by the project title and major implementers of the project in parentheses. A brief description is then given of each respective project.

Table 1 Support for Technology Development for Curtailing CO_2 from Marine Vessels and Number of Projects with ClassNK Participation

Technical Field	No. of Projects	No. of Projects with ClassNK participation
❶ Development of hull form with minimum resistance and high propulsion efficiency	4	2
❷ Development of technology to reduce frictional resistance of hull	3	3
❸ Improving propeller efficiency	3	3
❹ Improving efficiency of diesel engines, exhaust heat recovery	4	4
❺ More efficient operation and maneuvering of ships	5	5
❻ Development of hybrid propulsion systems	3	2
Total	22	19

The most important aspect of these efforts is that many of the technologies (such as the micro bubble system described below) are already being tested on ships in actual service, and all of these technologies are expected to be commercially available over the next few years.

❶-1 Research and development of hull forms suitable for CRP for reducing GHG *(IHI MU, IHI)*

Contra-rotating propeller (CRP) has significant energy saving effects. This project aims to develop duct and hull forms for enhancing the effects of CRP. [1)]

❶-2 Research and development of mega container carrier capable of saving energy and reducing GHG *(IHI MU, IHI Diesel United)*

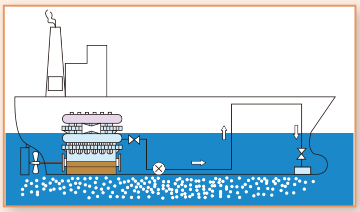
In recent years, mega container carriers having very high engine output are anticipated to conserve energy and reduce fuel consumption, thereby reducing their output of GHG. The aim of this project[2)] is to develop an energy-saving container carrier capable of conserving energy more significantly than in the past through prototype testing and performance checks of twin-skeg hull forms, basic studies on high efficiency main engines, and studies on exhaust heat recovery technology.

❷-1 Research and development of energy-saving technology for ocean-going ships using an air lubrication method

(Oshima Shipbuilding, IHI MU, Imabari Shipbuilding, MTI, Kawasaki Shipbuilding, Sumitomo Heavy Engineering, Tsuneishi Holdings, Mitsui Engineering and Shipbuilding (MES), Mitsubishi Heavy Industries (MHI), Universal Shipbuilding)

This project aims to validate the application of an air lubrication method to ocean-going vessels as effective energy-saving technology, and to establish a design methodology for ships using the air lubrication method.

Together with the development of the air lubrication method, a design support system (design tool) for ships is to be developed using this same technology. An air supply system (gas scavenging system) using a turbocharger as the main engine is also to



Conceptual image of bubble system. (Source: Kaiji Press, 12 Nov. 2009.)

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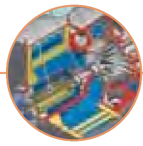
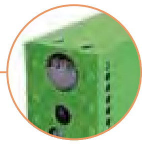




be developed. Individual technical topics are to be selected for realizing the air lubrication method and solutions for this method are to be studied. [3]

❷-2 Tests to demonstrate the technology to reduce frictional resistance of large shallow draft twin-screw vessels *(MHI, NYK, MTI)*

In this project, tests are to be conducted to demonstrate the air lubrication system by blowing air onto the ship's bottom using blowers. For the first time, this system will be permanently installed on a ship, and CO_2 emissions are expected to be reduced by approximately 10%.

The tests are to be conducted on a module carrier. The main features of the module carrier are wide beam and shallow draft among large ships. Thus, the water pressure is comparatively small, and the amount of power required by a blower to send air to the ship's bottom is small. Since the ship's bottom is flat and its width is large, air is likely to reside at the bottom part of the ship. The effect of reductions in CO_2 emissions can be validated easily through demonstration tests. [4]

Image from the bottom of a module carrier equipped with an air lubrication system. (Source: MHI News Release, 24 Feb. 2010.)

❷-3 Research and development of anti-fouling paint for bottom leading to very low fuel consumption *(Nippon Paint, Nippon Paint Marine, Mitsui OSK Lines)*

The evolving type low-fuel consumption bottom anti-fouling paint "LF-SEA" developed by Nippon Paint and Nippon Paint Marine will be further developed and promoted in this project. The CO_2 emitted from a ship comes from the fuel consumed during the voyage. A substantial part of the fuel is consumed overcoming the frictional resistance generated as the hull moves through the sea water. Frictional resistance with sea water accounts for 50-80% of the total resistance of a ship when underway. Reducing sea water friction will directly contribute to reducing fuel consumption.

The aim is to reduce CO_2 emissions by more than 10% compared to that of conventional anti-fouling paints through the development of very low-fuel consumption type bottom anti-fouling paint in which the low friction properties (equating to low fuel consumption) of "LF-Sea" are to be further improved and developed. The effects on ships in service will also be analyzed at the same time. [5]

❸-1 Research and development of limited small blade-area non-hub vortex (NHV) propellers *(Nakashima Propeller)*

According to recent research, if the blade shape near the blade tips is designed properly, the blade surface area can be reduced further than in existing designs. In addition, cavitation erosion and increases in stern vibration can be avoided. Such conclusions have been obtained from the results of model tests. Moreover, the non-hub vortex (NHV) propeller has been developed already, which leads to a reduction and elimination of hub vortex cavitation because of improved propeller efficiency.

A "small blade area NHV propeller" will be designed after theoretical calculations and model tests for demonstrating the energy-saving effects of both small blade surface area and NHV when fitted to four ships for the purpose of verification in this project. After the manufacture and conversion of actual propellers, comparative tests will be conducted on propellers fitted on actual ships to demonstrate that the new propeller has about 3% energy-saving effect compared to existing high performance propellers.

❸-2 Research and development of energy-saving appendages using effects of interference between blades *(Shin Kurushima Dockyard)*

Existing energy-saving appendages have been developed for the purpose of conserving energy by recovering propeller rotational energy. However, in this project, development is being carried out with the aim of enhancing propeller efficiency through mutual hydrodynamic interference effects between the propeller blades and appendages. This kind of technology is being actively pursued as a means of improving lift using the effects of interference between blades in the aeronautical field, such as by using blades with flaps.

The number of blades in an energy-saving appendage is the same as the number of propeller blades. The diameter is assumed to be about 50% that of the propeller, and it is secured to the propeller boss by bolts. Propeller efficiency is increased by fitting an appendage and by reducing the propeller torque, thereby increasing propeller thrust. The target is an energy savings of about 3%. [6]

References
1) Nippon Foundation website>List of projects>Research and development of hull forms suitable for contra-rotating propeller for GHG reduction 1-2 (in Japanese).
2) Nippon Zaidan website> List of projects > Research and development of mega container ships conserving energy by GHG reduction 1-3 (in Japanese).
3) Kaiji Press, 12 November 2009.
4) Mitsubishi Heavy Industries, Ltd., News Release, 24 February 2010 (in Japanese).
5) Nippon Paint, 2010 News, 25 January 2010.

③-3 Development of load fluctuation stabilizer for periodic disturbance from weather and sea conditions *(NYK, MTI, Terasaki Electric, Kawasaki Heavy Industries)*

The fuel consumption of a ship varies with the way the main engine is affected by weather and sea conditions. This project aims to reduce fuel consumption of the main engine by equalizing load fluctuations, and developing a new control system for variable pitch propellers and shaft motor generators. [7]

④-1 Research and development of CO_2 reduction technology for large low-speed marine diesel engines *(Mitsui Engineering and Shipbuilding)*

CO_2 emissions are generally reduced using an exhaust heat recovery system, as well as a high and low temperature exhaust separation system for large low-speed diesel engines (electronically-controlled engines). More specifically, 4-cylinder test engines (cylinder inner diameter: 500 mm) will be manufactured and various tests carried out in this project. The new engine is likely to be similar to the actual engine, and have similar specifications as engines expected to be manufactured 15 years in the future. [6]

④-2 Research and development of exhaust heat recovery system in marine diesel engines *(Yanmar)*

Exhaust heat recovery systems in large diesel engines are already in use on land and on ships. Steam is generated from the exhaust heat of the engine, and power is recovered by a steam turbine. However, in small engines, the efficiency of the steam turbine drops considerably, and cost also increases; so such a system has not been practically used in small engines.

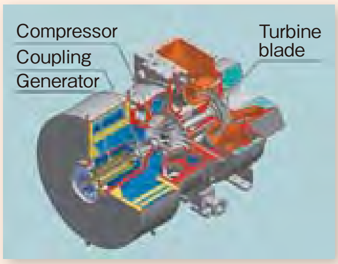
Research and development of a highly efficient and economical steam expander and exhaust heat recovery system will be carried out in this project for use with small diesel engines used as auxiliary engines for power generation and as main engines in coastal vessels. The aim is to reduce the amount of CO_2 generated in the engine (amount of energy consumed) by approximately 6%. [6]

④-3 Research and development of next generation dual fuel engines for ship propulsion *(Niigata Power Systems)*

European manufacturers have already developed marine dual fuel (DF) diesel engines. Such engines have been used for power generation in large LNG ships, but have not yet been used in general cargo ships. The engine to be developed as part of this project is mainly for coastal vessels in which fuel tanks (gas) are ensured. The aim is to manufacture medium speed engines with outputs of up to 10,000 HP. The goal is to reduce CO_2 emissions by approximately 15% compared to conventional engines. [6]

④-4 Development of hybrid turbocharger technology applicable to marine vessels *(NYK, MTI, Universal Shipbuilding, MHI)*

This project involves equipping a Capesize bulk carrier (to be completed in 2011) with a hybrid turbocharger power generating system and demonstrating its effectiveness. This power generating system consists of a small high-speed generator and a power frequency converter within the turbocharger, which is installed on a low speed diesel main engine. The system can supply all the power needed on the ship during a normal voyage. The diesel power generator need not be operated during a normal voyage; therefore, notable reductions in CO_2 emissions are anticipated. [7]

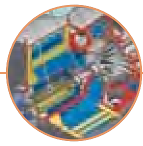
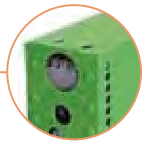


Cut away view of system. (Source: MHI Report Vol. 44, No. 1 (2007).)

⑤-1 Research and development of voyage support system with the aim of reducing CO_2 emissions by optimized operation *(Universal Shipbuilding)*

The voyage support system "Sea-Navi", which searches for the optimum route of a ship, has functions to search for the optimum route for a voyage with the shortest distance and smallest fuel consumption, based on sea and weather data, and based on the features of the hull and the main engine. An energy-saving effect of some 5 to 8% through CO_2 reduction may be anticipated. In addition to the above, the system also contains a monitoring function that collects data on the voyage conditions of the ship, a function to analyze the fatigue strength of the hull from voyage data, as well as maintenance and management functions to estimate the structural life of the ship.

The development of this software is almost complete, but demonstration tests will be carried out as part of this project by installing the system on many more vessels. [8]


6) Kaiji Press, 30 November 2009.
7) NYK Line, News Release, 21 December 2009.
8) Kaiji Press, 11 December 2009.
9) NYK Line, News Release, 15 June 2009.
10) Nippon Zaidan website > List of projects > Research and development of navigation support system 1-4 (in Japanese).
11) Mitsui OSK, Press Release, 14 January 2010.

❺ -2 Development of international navigation control system *(NYK, MTI)*

Efficient navigation is a prerequisite for reducing CO_2 emissions. In this project, development has started on a worldwide time-reservation system for berth windows and canal passage. The introduction of an international port control system will enable vessels to further reduce their time in port and to navigate at lower speeds. This project will also make use of international services when the system is implemented, and propose future roles for international navigation controls. [9]

❺ -3 Research and development related to operational performance of vessels as they increase in size *(NYK, MTI, Japan Marine Science)*

Currently, most pure car carriers in Japan have an overall length of less than 200 m. However, by making these vessels larger, the CO_2 emissions per car (CO_2 emitted for transporting a single car) can be reduced. In this project, the ability of pure car carriers of length above 200 m to navigate by keeping out of the way of other vessels (ability to avoid collisions) will be validated using simulation technology. Based on this research, the project will propose requisite technologies for large vessels so as to achieve the same level of operational performance as that of conventional vessels. [9]

❺ -4 Research and development of "navigation support system" *(Oshima Shipbuilding, Kyushu University, Fluid Techno, Oshima Engineering)*

This project aims to asssist the navigator select the optimum route based on weather and sea data. At the same time, a navigation support system is to be developed to support optimum navigation in rough seas and in restricted areas. [10]

❺ -5 Development of a system for monitoring ship performance *(NYK, MTI, NYK Trading, Kawasaki Technology)*

A navigation monitoring system that will become the basic system for effective navigation featuring comprehensive integration between vessels and land operations is to be developed in this project. This system will be used to accurately monitor the current condition of the ship from land, and suggest an appropriate speed for the vessel based on a specified standard. The project also aims to measure waves and ship motions more accurately, and to estimate their effects on the propulsion performance of the ship. [7]

❻ -1 Research and development of application technology for secondary batteries on ocean-going vessels using large-capacity nickel hydrogen batteries

(Kawasaki Shipbuilding, Kawasaki Heavy Industries, NYK, MTI)

This project aims to develop a hybrid power supply system by combining an existing diesel power generator and a new type of large capacity nickel hydrogen battery (Gigacell ® by Kawasaki Heavy Industries). Verification test devices will be installed on car carriers and tests will be carried out in the actual area of navigation. [7]

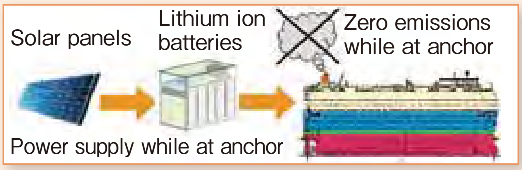
Image of proposed hybrid power supply system. (Source: KHI Website: Gigacell ®.)

❻ -2 Research and development of CO_2 emissions reduction technology by hybridization of power systems in car carriers

(Mitsui OSK Lines, MHI, Sanyo Electric)

This project aims to develop a hybrid power supply system formed by combining a solar power generating system and lithium ion batteries. The aim is to use natural energy more effectively, accumulate the electricity generated in the solar power generating system during voyages in the lithium ion batteries, and use these batteries while the ship is at anchor, so that the diesel engine can be stopped resulting in zero emissions while at anchor.

A "hybrid car carrier" equipped with this system will be constructed (scheduled to be completed in 2012), and the effects of CO_2 emissions reduction will be validated and assessed through actual operation, with the aim of establishing effective CO_2 reduction technologies in the future. [11]



(Source: MOL Press Release, 14 Jan. 2010.)

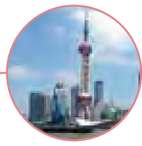
ClassNK is also participating in several joint R&D projects with industry in addition to the above support of projects of the Ministry of Land, Infrastructure, Transport and Tourism. A prime example is the Wind Challenger Project, aimed at researching and developing a motor assisted wind driven vessel with large vertical sails. This project is introduced as a separate article in this year's ClassNK Magazine.

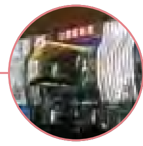
Shanghai, China

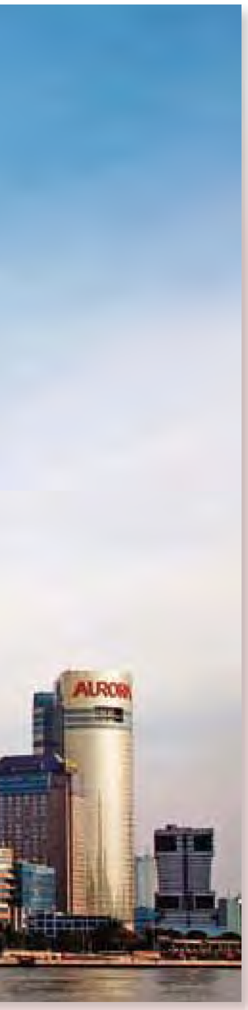
Six hundred years ago marked the high tide in China's shipbuilding history, when Zheng He, a navigator from the Ming Dynasty, explored the seas far away from China with an enormous fleet of ships. That glory is now once again likely to be repeated as the nation strives to become the world's largest shipbuilder.

Statistics from Clarkson's Research showed that China has contracted new orders of 23.78 million deadweight tons in the first half of 2010, a 46.2 percent share of global new shipbuilding orders. In addition, it has delivered 29.63 million deadweight tons, comprising 41.1 percent of global new ship deliveries during the same period.

It is undeniable that the Chinese shipbuilding industry has grown faster than ever expected and has made every effort







View of Shanghai.

to overtake South Korea and Japan as the world's top shipbuilding nation, especially in the past decade.

The shipbuilding industry is China's earliest national industry. Back in 1865, located at Shanghai, Jiangnan Machinery Manufacture Arsenal, the predecessor of Jiangnan Shipyard (Group) Co., Ltd., started up what has since become a more than 140 year history of modern Chinese national industry. As the cradle of the Chinese shipbuilding industry, Shanghai has come to hold a vital position in the strategic development of the industry from its early modern beginnings through to the future.

History and Development

Located on the shores of the East China Sea and the mouth of the Yangtze River, Shanghai is the largest city in China and the window showing the best examples of the China Reform and Opening-up Policy to the outside world, as well.

In ancient times, Shanghai began as just a small fishing village. Back in the 1800s, Shanghai was opened as a treaty port. It was known as an "Adventurer's Paradise" and numerous businessman set up their enterprises here in such industries as shipping, banking, printing, and architecture, amongst others. The above-mentioned Jiangnan Machinery Manufacture Arsenal was a prime example of promoting Chinese national industry and commerce at the time.

In the late 1920s and early 1930s, modern industry developed rapidly in Shanghai. A large number of enterprises, advanced techniques, and systematic factory management ensured Shanghai's position as an important base for modern industry in China as well as the shipping, financial and trade center of the Far East. Although the city suffered greatly from World War II losing much of its former splendor for a very long time, Shanghai once again started to revive after the establishment of the People's Republic of China in 1949.

After the new Reform and Opening-up policy introduced by the government in 1978, Shanghai greatly benefited from the favorable national policies and its own strategic advantages. The open-minded introduction of foreign capital, advanced foreign technologies and management techniques did much to speed up the development of the city and its many industries.

Nowadays, the international metropolis of Shanghai is not only the largest commercial and financial center in China, but also an important international harbor in the Western Pacific region.

China State Shipbuilding Corporation Pavilion at World Expo 2010 Shanghai.

This year the World Expo 2010 Shanghai attracted about 200 nations and international organizations to take part in the exhibitions, with the theme "Better City, Better Life" offering a wonderful opportunity for showcasing the prosperity and development of China over the past decades to the whole world.

Port and Maritime Industry

As a deep-sea port located in the vicinity of Shanghai, the Shanghai Port is one of China's premier ports, a critical transport hub for the Yangtze River Delta. It is also China's most important gateway for foreign trade.

Shanghai, China

China has been working to transform the Port of Shanghai into a global shipping center since 1996. These years of unremitting efforts have resulted in Shanghai not only becoming the world's busiest port by cargo tonnage in 2005, but recent statistics from the Shanghai International Port Group show that the Port of Shanghai has overtaken Singapore as the number one port in the world in terms of container shipping.

In addition, the State Council of China recently has officially approved turning Shanghai into an international financial and shipping hub by 2020, which can be expected to bring another golden opportunity to the local maritime industry as part of its recovery out of the global economic recession.

NK at China Mainland

When NK first entered the Chinese market, surveys were carried out with the cooperation of the China Classification Society. It was not until the official establishment of the first NK office at Shanghai in 1992 that NK surveyors eventually carried out surveys directly in China. After that, the Shanghai Office took full charge of NK-related business throughout the Chinese Mainland and started to open up the Chinese market with a staff of one general manager and several supporting surveyors from Japan.

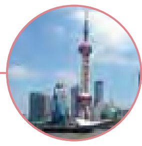
With the rapid expansion of business, soon NK established offices at Beijing and Dalian in 1994 and 1996, respectively, to cover business in Hebei Province and northeastern China. Then from 1997 to 1998, NK opened offices in Guangzhou and Qingdao to be respectively in charge of business in southern China and Shandong Province. In 2008, in view of the increasingly overloaded survey work needing to be carried out in the NK Shanghai region, the Zhoushan Office was established to share the responsibilities in Zhejiang Province. At the same time, NK closed its office at Beijing and opened the Tianjin Office in order to provide better services for shipowners and shipyards in Hebei Province.

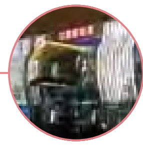
On 5 January 2009, the Headquarters of NK China were officially established at Shanghai in accordance with a request by the Ministry of Communications of China for local corporatization of operations. Subsequently, each local NK branch office at Guangzhou, Tianjin, Zhoushan, Qingdao, and Dalian was transformed from representative offices to local companies one after another along with the new establishment of the Nantong Branch in April 2009 to take over business activities in the Nantong area only. The whole process was finally completed on 8 February 2010 when the Shanghai Branch was officially incorporated under the new Nippon Kaiji Kyokai (China) Co., Ltd. organization.

Growing from initially just one office with several supporting surveyors nearly two decades ago to now encompassing seven branches under one headquarters with hundreds of surveyors and office staff, NK operations on the Chinese Mainland have increased in size several times in less than ten years boosting both its share and range of services offered to the local market.

China Technical Committee.

China Committee.





Presentation of ClassNK Award.

NK China Headquarters and Shanghai Branch

Located at Shanghai, the NK China Headquarters is the Regional Office for ClassNK's activities on the China Mainland, including the Hong Kong Office. As such, it is fully in charge of marketing, training, plan approval, and administrative management related matters for the region within its jurisdiction.

In order to promote intercommunication and cooperation with the local shipbuilding industry and to seize the latest industry technical trends in a timely fashion, NK holds meetings of its China Committee and China Technical Committee at least once a year. By this year's 15th meeting, the China Technical Committee has grown to include 36 members, while the 17th meeting of the China Committee was held in Hainan, China this past December with approximately 20 members.

In addition, the NK China Headquarters presents ClassNK Awards to distinguished students of several well-known maritime universities in China, such as Shanghai Jiao Tong University, Harbin Engineering University, Dalian Maritime University, and Wuhan University of Technology, among others, in order to promote the development of a reserve of local talent with clearly demonstrated interest in the maritime industry. Moreover, NK also actively participates in various maritime exhibitions such as Marintec China, technical seminars and institutes to lift up NK's international presence as part of efforts to attract more interest and awareness of the Society's activities and resources in the local market.

The establishment of a plan approval center at Shanghai in 2003 exactly meets the needs of the ever-growing number of new shipbuilding projects being classed with the Society and industry demands for quality technical services. The plan approval center also facilitates smoother communication channels among owners, shipyards, designers and the Society and effectively shortens plan approval times, especially for local customers, with the help of the newly developed online NK-Pass electronic system.

Regular survey activities are mainly handled by the NK Shanghai Branch. The region under NK Shanghai's jurisdiction at present covers from Shanghai, Jiangsu Province (except the Nantong Area), and Anhui Province to the central and western regions of China. Jiangsu Province generally serves as the shipbuilding hub for NK Shanghai. A large range of ship types are covered, such as bulk carriers, oil carriers and LPG tankers.

Also, NK Shanghai is busy handling a huge number of surveys and audits for existing ships each year. It usually undertakes dozens of surveys at the same time in a cluster of repair shipyards of Shanghai and Jiangyin such as Huarun Dadong Dockyard, Jiangyin Chengxi Shipyard, China Shipping Lixin Shipyard, Minnan Shipyard, as well as COSCO (Shanghai) Shipyard, amongst others. which can include for major conversion jobs, such as from an oil tanker to a bulk carrier.

Along with the ever-increasing number of new shipbuildings, the volume of material and equipment inspection work being conducted at NK Shanghai has been rapidly increasing, as well. Not only has the office received numerous applications for various NK approvals from a multitude of manufacturers and service suppliers each year, the office has also been actively maintaining long-term friendly relations with many renowned companies in the region.

In view of the promising prospects in the local maritime industry here, NK is committed to further developing all local branches in the region in order to provide customers with the best services ever and to ensure the mutual benefit and common development with the local maritime community.

Rio De Janeiro, Brazil

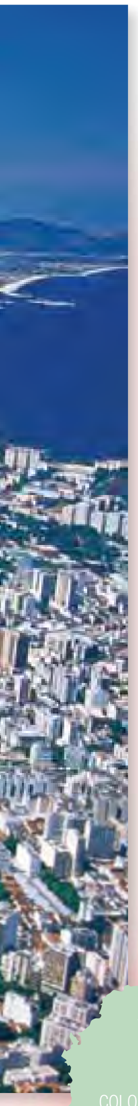
Christ the Redeemer.

Rio de Janeiro, or simply Rio, was the capital of Brazil for nearly two centuries, first from 1763 to 1815 during the Portuguese colonial era, then from 1815 to 1821 as the capital of the United Kingdom of Portugal, Brazil and Algarves, and then from 1822 to 1960 as the capital of an independent nation.

A Portuguese expedition discovered Guanabara Bay on 1 January 1502 which they supposed to be a river mouth (hence Rio de Janeiro, literally "River of January"). The city itself was founded on 1 March 1565. In the 17th century, gold and diamonds were found in the neighboring Minas Gerais, and Rio became the best port for exporting gold, precious stones, as well as sugar. In 1763 the colonial administration in Portuguese America was moved from Salvador to Rio de Janeiro.

The city remained primarily a colonial capital until 1808, when the Portuguese royal family and nobles, fleeing from Napoleon's invasion of Lisbon, moved to Rio. The kingdom's capital was transferred to the city, which became the only European capital outside of Europe. When Prince Pedro I proclaimed the independencee of Brazil in 1822, he decided to keep Rio de Janeiro as the capital of his new empire. Rio also continued as the capital of Brazil after 1889, when the monarchy was replaced by a republic. In 1960 the capital of Brazil was transferred to the newly built city of Brasilia.





The early 1920s to the late 1950s were Rio's golden age. Rio became a romantic, exotic destination for Hollywood celebrities and international high society who came to play and gamble at the casinos and dance or perform in the nightclubs that helped the city to gain the nickname "A Cidade Maravilhosa" (The Marvelous City), which we believe to be true even today.

The most popular sport in Brazil is football, also known as soccer. The city hosted the 1950 FIFA World Cup when the Maracanã Stadium was built. Presently the stadium is under complete refurbishing to host, for the second time, the final game of 2014 FIFA World Cup. Afterwards, the stadium will play an important role in the 2016 Olympic Games. Rio will thus become the first South American city ever to host the event.

The population of the city, occupying an area of about 1,200 square kilometers, is about 6 million. The population of the greater metropolitan Rio area is estimated to be around 14 million. Those born in Rio are known as Carioca. Rio has a tropical climate and the average annual temperature is 23°C.

Sugar Loaf Mountain.

Tourism and entertainment are key aspects of the city's economic life, and the city is no doubt the nation's top tourist destination, with its natural settings, carnival celebrations, samba, Bossa Nova, and beaches. Some of the most famous landmarks include the giant statue of Christ atop Corcovado Mountain, completed in 1931 and named one of the New Seven Wonders of the World, as well as the Sugar Loaf cable cars completed in 1912.

The tradition of Rio Carnival parades originally mimicked the European form of the festival, later absorbing native American and African cultures. Rio is famous for its samba school (Escolas de Samba) parades in the Samba arena and exhibition avenue. In addition, every December 31, nearly 2.5 million people gather at Copacabana Beach to celebrate the New Year. The crowd, mostly dressed in white, celebrates all night at the hundreds of different shows and events held along the beach.

Benefiting from its long held position as federal capital of Brazil, the city has become a dynamic administrative, financial, commercial, and cultural center. Rio de Janeiro is the headquarters of many private, national, multinational, and state corporations, such as the two biggest Brazilian companies – PETROBRAS and VALE, besides the largest conglomerate of media and communication companies in Latin America, the GLOBO Organizations, and the headquarters of BNDES (Brazilian Development Bank).

For many years Rio was the industrial hub of Brazil, with oil refineries, shipbuilding industries, steel, metallurgy, petrochemical, gas, chemical, textile, printing, publishing, pharmaceutical, beverages, cement, and furniture. However, a sharp transformation in its economic profile has been noted in recent decades, acquiring more and more shades of a major national hub of services and businesses. Rio continues to attract more and more companies, especially after the discovery of oil offshore, from where most of the country's oil is produced. This has resulted in many international oil and gas companies being based in Rio de Janeiro.

Brazilian Shipbuilding Industry

Although the Brazilian shipbuilding industry began in Rio during the second half of the 19th century, from the end of the 1950s, the industry has developed significantly after the introduction of modern standards, particularly by IHI of Japan and VEROLME of Holland, reaching its apogee at the end of the 1970s, when Brazil was ranked as the second biggest shipbuilding nation in the world. However, it experienced a progressive decline that culminated in a near deactivation of the sector in middle of the 1990s.

In 1998, a movement to resume production was initiated, favored by the demands of PETROBRAS to increase their offshore oil production. The first vessels produced in this new phase were support vessels for rigs and oil production platforms. Later, in 2001, PETROBRAS launched its Program for the Modernization of the Supply Vessels Fleet, named PROMEF, including standards for international competition – a requirement for Brazilian flag ships, which stimulated local construction of these ships and was the first move toward reactivation of the sector. This Program is a case of success and has now moved on to its second phase.

Today, Brazil is storming back with an amazing revival of its shipbuilding industry driven by the sudden influx of orders

Copacabana beach.

Samba carnival.

from PETROBRAS. The shipbuilding market has in excess of 100 firm orders for ships in a variety of shapes and sizes, in addition to a large number of drill rigs and production unit orders. In addition, companies from around the globe are flocking to Brazil to set up shop and engage in the industry's renaissance. The national shipyard workforce has hit 50,000, impressive considering its rise from a low of around 2,000 just a decade ago and 25,000 just three years ago.

Rio de Janeiro continues to lead the market in terms of shipyards, as it concentrates 50% of the country's steel processing capacity and 40% of the shipyard acreage in terms of square meters. However, the Northeast region of Brazil is growing in shipyard construction and catching up, accounting for 30% of the country's steel processing capacity and 40% of the shipyard acreage in terms of square meters.

Positive signs are coming from a number of leading shipbuilders who are setting up shop in Brazil, forming partnerships with Brazilian shipbuilders or investors, in order to fulfill national content policies to be eligible to compete for shipbuilding contracts. These shipbuilders are lining up to invest billions in local infrastructure and allow technology transfer, made all the more interesting by the status of global shipbuilding today due to the recent economic meltdown. The growth of the Brazilian shipbuilding market is a reality and Brazil is presently considered the sixth biggest shipbuilding nation in the world and growing.

ClassNK Rio de Janeiro Office

The ClassNK Rio de Janeiro Office, located in the historic downtown business district, was officially opened on 1 October 1980, with a single surveyor to cover all Brazilian ports. In November 1981, ClassNK was accredited by the Brazilian Maritime Authority as a Recognized Organization to act on its behalf with respect to the statutory survey and certification of Brazilian flagged ocean-going vessels. 1986 was a remarkable year for the office, as a contract for classification services for five supply vessels was concluded with DELBA MARITIMA NAVEGAÇÃO LTDA. These vessels are still in service today with PETROBRAS.

In 2005, a LAR office was opened in Santos under the jurisdiction of the Rio de Janeiro Office. Moreover, the Rio de Janeiro Office was relocated in April 2008 from downtown to the booming Barra da Tijuca District.

The Society celebrated its 30th anniversary of activities in Brazil in 2010. During these past years ClassNK focused its core activity mainly on the attendance of ships in service. However, in order to face forthcoming challenges to increase its share in the promising Brazilian market, the RULES FOR SURVEY AND CONSTRUCTION OF STEEL BARGES FOR INLAND WATERWAYS was published by the Society in Portuguese at the end of 2009, which has resulted in obtaining from the Brazilian Maritime Authority full recognization to act on its behalf (including inland navigation, passenger ships and MODU), since 31 May 2010. Other business activities are in progress aimed at increasing ClassNK's presence in the Brazilian market.

We are confident that these efforts will lead ClassNK and the Rio de Janeiro Office to succeed in achieving this goal.

ClassNK Rio de Janeiro Office staff.

Newly Established Offices

Ever since opening its first international exclusive surveyor office in 1962, ClassNK has grown to have a truly global presence. The Society has been especially active in expanding its global network over the past few years, opening numerous new exclusive surveyor offices across the globe. This has included opening seven new offices in 2010 in Europe, the Middle East, India, Southeast Asia, and South America, and follows on the establishment of seven new exclusive surveyor offices in 2009.

Callao, Peru A

A new Local Area Representative office was established in Callao, Peru on 1 July 2010. Centrally located, Callao is the largest and most important port in Peru. Just 12 kilometers to the west of the capital city of Lima, Callao serves as the major gateway to the sea with both a naval base and extensive commercial and fishing complexes. About 70% of the country's seaborne trade and 90% of its containerized cargo is handled by the port. The Central Railroad of Peru runs through the city, which is also the site of Lima's international airport.

The ClassNK Callao LAR Office is the first exclusive office to be opened by the Society in Peru.

Tartous, Syria B

A new exclusive surveyor sub-office was established in Tartous, Syria on 1 July 2010. Tartous is a port city on the western coast of the Syrian Arab Republic facing the Mediterranean Sea. The city is located some 220 km to the north-northwest of the capital Damascus and 90 km south of Syria's largest port city of Latakia, about an hour by car along the Mediterranean coast.

The Tartous Sub-Office is the first exclusive office to be opened by the Society in Syria.

Sibu, Malaysia C

A new Local Area Representative office was established in Sibu, Malaysia on 1 July 2010. Sibu is a city in the eastern Malaysian state of Sarawak, and is situated on the confluence of the Rajang and Igan Rivers. Located in the northwestern part of Borneo, the city is about 80 km from the coast, and has a population of some 250,000 people, including a sizeable community of overseas Chinese originating largely from the city of Fuzhou in Fujian Province, China.

Sibu boasts a robust shipbuilding industry consisting of a number local yards engaged in the construction of smaller vessels largely for export. As a river port, the city also serves both small ocean going vessels and local shipping as well as serves as a gateway for the export of many local natural resources including timber, rubber and pepper.

Although the Society already has four exclusive surveyor offices in Malaysia, the new Sibu LAR Office has been established in order to support the ClassNK survey network in Borneo given the recent growth of the shipbuilding industry on the island.

Cardiff, UK D

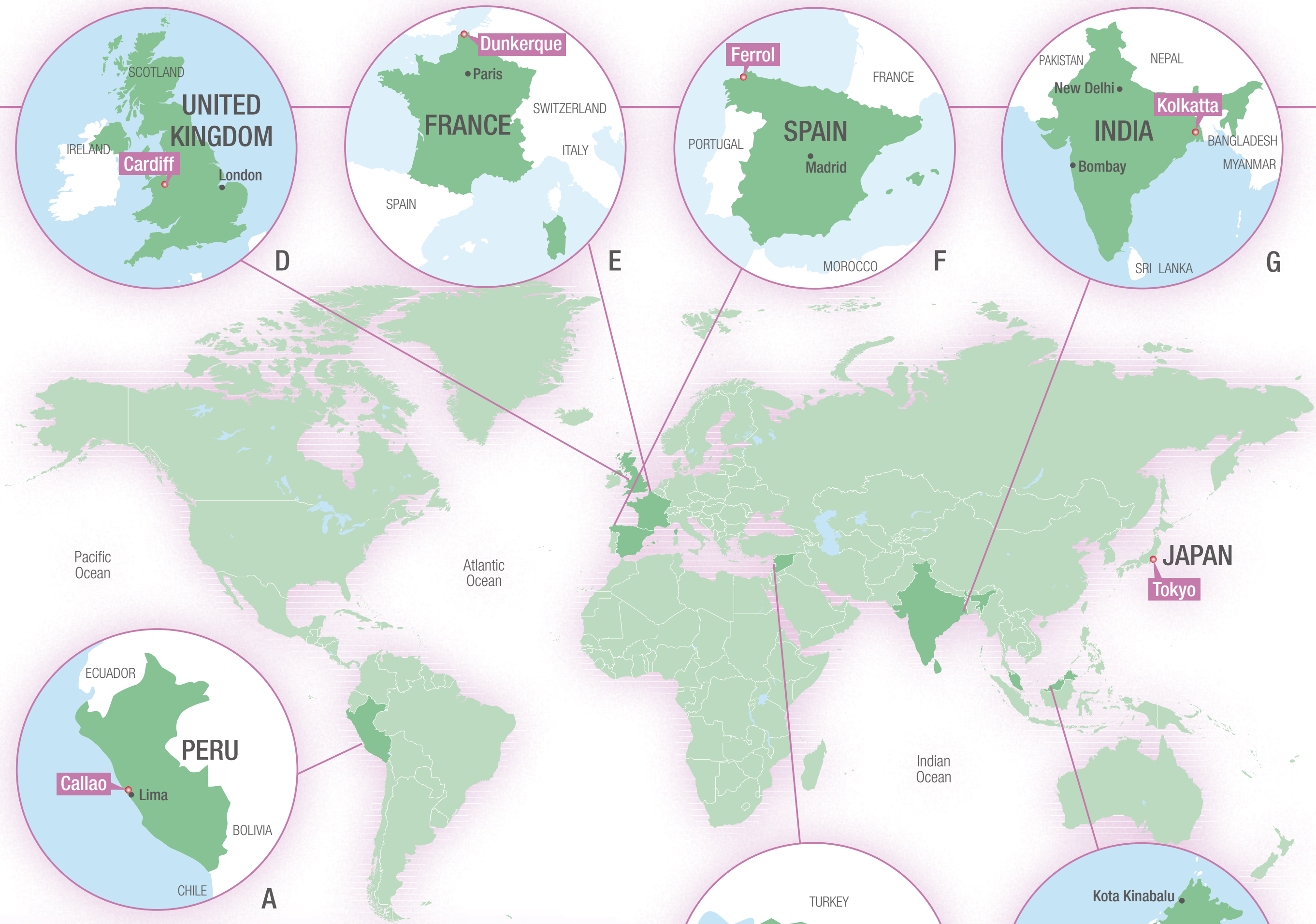
A new ClassNK Local Area Representative office was established in Cardiff, in the United Kingdom on 15 July 2010. The capital of Wales, Cardiff has a population well exceeding 320,000 people making it the largest city in Wales. The Port of Cardiff has grown rapidly since coal was shipped from the port after the start of the industrial revolution.

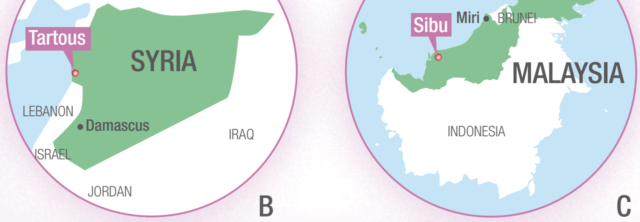
ClassNK already has other three exclusive offices in the United Kingdom, including in London. The establishment of the new Cardiff LAR Office further strengthens the Society's network in the country to better serve clients in the U.K. and around the world.

Dunkerque, France E

A new exclusive surveyor office was established in Dunkerque, France on 1 October 2010. Dunkerque, also known as Dunkirk, is the third largest port city in France following Le Havre and Marseille. It is located in the northernmost corner of the French mainland. The city is also known for its steel production, food processing, oil manufacturing, and shipbuilding, among other activities.

The new office becomes the fifth new office to be opened by the Society during the year, following the establishment of four new offices in July. The new Dunkerque Office is also the second office to be opened in France by NK, joining the existing NK office in Marseille.





Ferrol, Spain F

A new ClassNK Local Area Representative office was established in Ferrol, Spain on 1 November 2010. Ferrol is a thriving mining and shipbuilding city on the northern coast. The numbers of docking and afloat surveys are growing at major ports in the city including La Coruna, Vigo, and Marin. In fact, a local shipyard, Navantia Ferrol, has concluded agreements to repair ships with a number of Japanese ship owners, such as NYK, MOL, and K-Line, amongst others. For this reason, ClassNK expects more survey business in the future. The Society previously had to accommodate local client needs by dispatching surveyors from its NK Bilbao Office, which often took over a day, or had to request an acting surveyor (ACS) to conduct surveys instead of an exclusive surveyor of the Society. The establishment of the Ferrol LAR Office is expected to permit the Society to provide clients in the region with more timely, higher quality service. The new Ferrol LAR Office is ClassNK's fifth exclusive surveyor office to be opened in Spain, joining existing offices in Bilbao, Algeciras, Barcelona, and Las Palmas.

Kolkata, India G

A new ClassNK exclusive surveyor office was established in Kolkata, India on 15 December 2010. The new office is the seventh new office to be opened by the Society in 2010, and becomes ClassNK's sixth exclusive surveyor office in India, joining existing offices in Chennai, Dahej, Kochi, Mumbai, and Visakhapatnam.

The new office will serve the Port of Kolkata and other nearby ports in the northeastern part of the country, which is among India's fastest growing regions. The opening of the new office in Kolkata is only one part of ClassNK's expansion efforts in greater India, where the NK service network is expected to expand further in the years to come to better support the growth of the local maritime industry and to provide ever better service to clients in the region.

The rapid expansion of ClassNK's service network parallels the rapid growth of the Society's register, which has grown by more than 9 million gross tons since the beginning of the 2010 to reach a total of more than 178 million gross tons. With the opening of its Kolkata Office, ClassNK now maintains a global network of 116 exclusive surveyor offices around the globe.

Exhibitions

Marintec China 2009

The Marintec China 2009 exhibition was held from 1 to 4 December 2009 at the Shanghai New International Expo Centre. The event is held every other year, and this year marked the fifteenth time the exhibition has been held. ClassNK Executive Vice President Dr. H. Kitada, Managing Director S. Kakubari and BND General Manager J. Iida attended from the Head Office, in addition to Regional Manager of China J. Katsumata and other staff who attended from the Society.

More than 1,200 companies from 30 countries established booths at the event, including China's leading shipbuilding and marine equipment manufacturers, and the exhibition drew roughly 50,000 visitors. Over the four days the event was held, more than 800 visitors exchanged business cards at the Society's booth, the largest amount of all the exhibitions the Society attended in 2009.

In addition to the Society, almost every IACS member society exhibited at the event, as did a total of 30 Japanese companies, such as Japanese Marine Equipment Association, clearly showing the importance of the Chinese market to the world maritime industry.

VietShip 2010

The VietShip 2010 exhibition was held from 17 to 19 March 2010 in Hanoi, Vietnam. ClassNK Managing Director S. Kakubari and Haiphong Office General Manager Y. Ogahara, along with other staff attended the event from the Society, VietShip is held every other year at the National Convention Center, and this year was the fifth time that the exhibition has been held. Vietnamese shipbuilders and marine equipment manufacturers, as well as more than 300 organizations exhibited at the event, which drew more than 15,000 visitors. Several other classification societies also exhibited at the event in addition to ClassNK.

The exhibition was a great success for the Society, with the ClassNK stand drawing many visitors from throughout the maritime industry. Over the three days the event was held, all pamphlets that had been prepared were completely distributed.

Asia Pacific Maritime 2010

The Asia Pacific Maritime 2010 exhibition was held at the Singapore Expo in Singapore from 24 to 26 March 2010. This was the eleventh time that the Asia Pacific Maritime event has been held. Some 8,000 visitors came to the event. Representatives also came from a number of other classification societies, as well. The NK stand was well positioned in the center of the exhibition hall, and a banner hung from the ceiling which drew the eyes of visitors resulting in many people coming to the NK stand.

The 2010 Marine Propulsion & Auxiliary Machinery Asia Conference was also held at the same time as the exhibition. On the last day of the event, MCD technical staff member K. Naito gave a presentation on "Safety precautions for slow steaming" that was well received.

LNG 16

LNG 16 conference and exhibiton was held in Oran, Algeria from 18 to 21 April 2010. NK Marseille Office General Manager F. Van den Brande amongst others attended the event from the Society.

Held once every three years at different locations



around the world, this was the sixteenth time that the event has been held. Many of the participants scheduled to attend from Europe and elsewhere could not make it to the event due to the eruption of a volcano in Iceland. Although this resulted in the event being held for a shorter time than originally scheduled, more than 200 companies were represented and as many as 5,000 visitors came to the exhibition, many from the local area. Five classification societies besides ClassNK also attended the exhibition. In addition, some ten firms came from Japan including MHI, IHI, Kawasaki Shipbuilding Corporation, INPEX, Chiyoda Corporation, and JCG Corporation, amongst others. This served to highlight the great level of interest in the LNG industry.

SEA JAPAN 2010

The SEA JAPAN 2010 maritime exhibition was held at the Tokyo Big Sight Exhibition Center in Tokyo from 21 to 23 April 2010.

This event is a maritime exhibition held in Japan every other year. This year was the ninth time that the event has been held. A total of 389 companies and organizations participated in the exhibition, with the greatest number being Japanese marine equipment manufacturers. Some 17,390 visitors came to the event, with more than 600 visiting the NK stand.

Chairman and President N. Ueda, and other members of the board also came by and inspected the NK stand during the event.

A number of presentations were also given by various exhibitors at the event. ClassNK gave a total of three presentations, two on its own and one jointly with Napa Japan (head office based in Finland). The exhibitor presentation given by Managing Director Y. Nakamura on 21 April was particularly well attended and a great success.

The particulars of each of the presentations is given below:

— New R&D Promotion Scheme of ClassNK: Managing Director Y. Nakamura, General Manager, Practical R&D Promotion Division

— Introduction to ClassNK PrimeShip-NAPA Manager: T. Takamoto, Manager, HLD

— Activities on Ship Recycling Convention in Japan and ClassNK's Role: H. Takano, General Manager of EQD

POSIDONIA 2010

Posidonia, one of the world's largest maritime exhibition was held at the Hellenikon Exhibition Centre in Athens from 7 to 11 June 2010. A total of 1,855 companies from 87 countries participated in the exhibition. This is five times more than the number of participants who attended Sea Japan earlier this year. The Society had an independent stand this time, rather than joining a group pavilion as in previous events. All told, more than 700 visitors came to the NK stand.

In addition to Chairman and President N. Ueda and Honorary Chairman K. Ogawa, visiting and inspecting the NK stand during the event, numerous other top members of the Society from many countries including Regional Manager of Europe and Africa T. Kinoshita, Piraeus General Manager A. C. Dalakas, Istanbul General Manager K. O. Karakoc, Taipei General Manager G. Imamoto, and Seattle General Manager J. Kim, among others, joined with other NK staff to welcome customers and visitors to the stand.

Various parties were also held during the course of the event which provided an excellent chance for the Society to interact with many people and promote itself.

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