Nippon Kaiji Kyokai, also known as ClassNK or just "NK", is a ship classification society. The principal work of the Society’s expert technical staff is to undertake surveys to ensure that the rules which it has developed are applied to newbuildings and existing ships, in order to ensure the safety of these vessels and the prevention of marine pollution. The rules cover not only hull structures, but also safety equipment, cargo handling gear, engines, machinery, and electrical and electronic systems, among others. At the end of December 2006, the Society had 6,636 ships totaling 144,438,721 gross tons on its Register. This figure represents approximately 21% of the world merchant fleet currently under class. Although based in Japan, where it has 21 offices, ClassNK has worldwide representation through a network of 77 exclusive surveyor sites in 42 countries and territories. ClassNK surveyors work in shipbuilding and repair yards and at ports across the globe, wherever they may be called upon to examine the condition of a ship, so that all of the Society’s services are available worldwide. Nippon Kaiji Kyokai celebrated the 107th anniversary of its founding on 15 November 2006.
The NK Mission

ClassNK is dedicated to ensuring the safety of life and property at sea, and to preventing pollution of the marine environment.

To achieve this mission ClassNK will:

Focus on delivering the highest quality classification services, by the highest quality personnel while maintaining its totally independent third party, non-profit status.

Focus on the development of relevant rules, procedures and guidances, and maintain and develop its commitment to scientific and technological research, development, and education.

Maintain and develop its global operations in line with the needs of those using its services.
Chairman’s Message

Welcome to the 2006 Nippon Kaiji Kyokai Annual report. Although 2006 was a year of contrasts in Japan and around the world, it was also a banner year for both the global maritime industry and ClassNK.

The economies of various countries in East Asia continued to maintain high levels of economic growth overall for the year exceeding 7%, with China leading the way at more than 10%, followed by India with a high growth rate of nearly 9%. The U.S. and Europe also continued to do well economically, while the recent economic expansion in Japan steadily continued to gain steam.

Buoyed by these economic conditions in Japan and overseas, the global maritime industry enjoyed another year of unprecedented prosperity. Newbuilding activity reached some 18.1 million GT in Japan, 18.9 million GT in Korea, and about 7.7 million GT in China, with the global total reaching some 52.1 million GT for the year. This total significantly surpasses the past maximum record of 47 million GT attained the previous year, 2005, by more than 10%. These prosperous conditions enjoyed by the worldwide maritime industry also had a very favorable effect on the operations and business conditions of the Society, as well.

Some 14.3 million GT of newbuildings were registered to NK class last year, exceeding the previous maximum record of 12.4 million GT attained in 2005 by more than 15%. This represents more than 95% of the gross tonnage added to the NK register in 2006. Nearly 34% of the 543 vessels newly built to NK class during the year were built at yards outside Japan. All told, the Society had about 144.4 million GT of ships under class comprising some 21% of the total global commercial fleet as of the end of 2006.

Notable of the 580 ships entering NK class last year are the luxury passenger ship Asuka II, and the container carrier Humber Bridge, which is the first 8,000 TEU class container carrier ever to be built at a Japanese shipyard. In addition, the 313,992 dwt VLCC ASIAN PROGRESS IV, the largest ship to enter NK class in 2006, and the 173,541 dwt C H S MAGNIFICENCE, a double hull Cape size bulk carrier built to NK class, are representative of the tankers and bulk carriers added to the register during the year. These
ship types combined comprise some 70% of the ships under NK class in terms of gross tonnage.

Internationally, the Common Structural Rules (CSR) for oil tankers and bulk carriers developed by IACS came into effect in April 2006. The Society played a leading role in the development of these rules and has developed software based on these requirements that is used by numerous ship designers and builders in Japan and around the world in a host of bulker and tanker newbuilding projects. Further, performance standards for ballast tank coatings came into force on 8 December in line with a resolution by the IMO. The Society has been active in supporting these and similar initiatives and believes that they will help contribute significantly to raising the standard for safer ships and cleaner seas both now and in the future.

In addition to these favorable business conditions and results, the Society was most fortunate in that no ship under NK class was involved in any major class related casualty last year. Still, the mishaps that unfortunately do occur serve to highlight the essential need for every link in the chain of safety to maintain the highest levels of vigilance if the maritime industry is to attain the levels of operational safety and quality that are expected of it across the globe. This means that ClassNK, as one such stakeholder, must be ever vigilant in fulfilling its mission of ensuring the safety of life and property at sea and preventing pollution of the marine environment, and must also continually strive to find ever better ways of accomplishing these goals in partnership with other stakeholders in the maritime community around the world.

These times of prosperity offer both challenge and opportunity to the Society. On the one hand, it means a greatly increased survey and audit workload for both the 14 plus million GT of newbuildings that are also expected to enter class in 2007 as well as class maintenance surveys and various audits and inspections for the more than 144 million GT of existing ships already on the register. The challenge is not only to maintain the high standards of service we have been able to achieve with the support of strong research and development programs, top-of-the-line IT systems and services, further enhanced survey network, and improved operational administration, but I also believe that the Society as a whole must continually make every effort to carry out all its activities even more effectively and efficiently as possible. Internally, this means enhancing the technical and human potential of NK, while externally, it means providing ever better quality service to our clients, so as to raise the integrity and good reputation of the Society to even higher levels as it strives to meet the needs of an ever-changing industry.

I invite you to read through the detailed reports presented herein that highlight the efforts of the more than 1,100 ClassNK personnel from various offices around the world as they dedicated themselves during the past year to ensuring the safety of life and property at sea and the protection of the marine environment. On behalf of all the management and staff of NK, I thank you most sincerely for helping to make 2006 the best year ever for the Society, and I look forward to working together with you more closely this coming year to achieve even more in 2007.

Kenji Ogawa
Chairman and President
NK at a Glance

New Board
The Society announced changes to its Board of Directors in March 2006. Executive Vice President M. Murakami and Managing Director T. Akahori retired, resulting in two new appointments. Mr. F. Imakita and Dr. H. Kitada were newly elected to the Board. The current members of the Board are shown in the above photo.

New Service Sites Established Overseas
As part of the Society’s ongoing efforts to enhance its survey network in order to better meet the needs of our clients around the globe, two new sub-offices were established in the Americas last year. The Guayaquil Sub-Office was established in Guayaquil, Ecuador, on 1 April 2006 further expanding the NK survey network in South America, and the Miami Sub-Office was established in Miami, Florida in the U.S., on 1 May 2006 further expanding the NK survey network in North America. In addition, an Exclusive Surveyor was stationed at Newcastle, Northern Ireland (U.K.) on 1 January 2006 as a Local Area Representative under the jurisdiction of the ClassNK London Office, and a Local Area Representative was also newly established at the city of Visakhapatnam under the jurisdiction of the Mumbai Office in India on 1 July 2006.

International Exhibitions
The Society participated in five major international maritime exhibitions in 2006:

- VIETSHIP 2006 in Hanoi, Vietnam from 21 to 24 February
- CMA Shipping 2006 in Stamford, Connecticut in the U.S. from 20 to 22 March
- SEA JAPAN 2006 in Tokyo, Japan from 5 to 7 April
- POSIDONIA 2006 in Athens, Greece from 5 to 9 June
- GASTECH 2006 in Abu Dhabi, United Arab Emirates from 4 to 7 December

Record Newbuildings
The number of newly built ships classed with the Society reached a total of 543 ships in 2006, surpassing the previous year’s total by 28.1%, which saw 424 newbuildings added to the Register. The 14,295,666 gt of newbuildings classed in 2006 represents a 15.2% increase of over the 12,408,135 gt added in the previous year, and once again set a new record for the Society.
Breakdown of NK Fleet by Ship type: GT
(As of the end of 2006: Total 144.4 million gt)

- Bulk Carrier 33%
- Oil Tanker 12%
- General Cargo 9%
- Chemical Tanker 8%
- Container Carrier 7%
- Vehicle Carrier 5%
- LPG Carrier 5%
- LNG Carrier 1%
- Others 21%

Total exceeds 100% due to rounding.

Breakdown of NK Fleet by Ship type: No. of Ships
(Total 6,636 ships)

- Bulk Carrier 33%
- Oil Tanker 12%
- General Cargo 9%
- Chemical Tanker 8%
- Container Carrier 7%
- Vehicle Carrier 5%
- LPG Carrier 5%
- LNG Carrier 1%
- Others 21%

Breakdown of NK Fleet by Flag
(As of the end of 2006: Total 144.4 million gt)

- Panama 58%
- Japan 7%
- Hong Kong 6%
- Liberia 6%
- Singapore 6%
- Malta 2%
- Others 15%

GT and No. of Ships Newly Classed

Newbuildings: 14.30 million gt. and 543 Ships
Total: 15.01 million gt. and 580 Ships

Total exceeds 100% due to rounding.
ClassNK continued to expand and solidify its operations in 2006, classing more vessels than ever and expanding its international presence.

The Classed Fleet

The number of NK registered ships as of the end of December 2006 totaled 6,636, or 240 more than the total for 2005. The total gross tonnage of NK registered ships as of the end of December 2006 was 144,438,721 gt, up 9,945,728 gt over the total for the previous year. The average age of the NK fleet was 10.8 years.

Additions to the Register during the year numbered 580 ships with a cumulative gross tonnage of 15,009,709 gt, 125 ships and 1,967,723 gt more than were added during the previous year, both figures yet again setting new records for the Society. A total of 340 ships of 5,104,940 gt were withdrawn from the Register, 9 fewer than in 2005, representing 350,419 less gross tonnage than was “lost” in 2005. Of these, 78 vessels
Domestic Newbuilding Highlights

With 2006 a record year for newbuilding activity for the Society, it would be impossible to fairly and fully describe the activities of all 21 domestic offices in this report. However, below are some selected highlights from a number of NK’s busiest offices.

Tokyo
The Tokyo Branch Office is one of the largest offices in NK’s network in Japan. Although it mostly handles a vast number of in-service surveys, it also had its fair share of newbuilding surveys in 2006. This included the **SHIN-SHO**, a 177,489 dwt bulk carrier built by Mitsui Engineering & Shipbuilding Co., Ltd., Chiba Shipyard for Sandigan Ship Services, Inc., and the **SEA PULL** - a 177,533 dwt bulk carrier also built at the same shipyard for Hisamoto Kisen K.K.

Newbuildings
At 543, the number of newly constructed vessels classed by the Society in 2006 increased 28% over the 424 of the previous year. The 14,295,666 gt of newbuildings classed represented an increase of 1,887,531 gt, or 15.2%, over the 12,408,135 gt added in the previous year, once again a record for the Society. In terms of the number of ships, these newbuildings represent 93.6% of the ships added to the Register and 95.2% of the additional gross tonnage. Of the 543 vessels newly built to NK class during 2006, 183 ships or 33.7% were built at yards outside Japan, up 47.6% from 2005.

Nagoya
Nagoya is known for being one of the liveliest cities in Japan, especially in terms of economy. Representative of the currently booming activity in this region, Suzuki Shipyard Co., Ltd. began construction on the 1,888 dwt double hull tanker, **SANWA MARU**, for coastal service for Marukyo Kaiun K.K. and the Construction,
Transport and Technology Agency of Japan. Universal Shipbuilding Co., Tsu Shipyard built the 176,303 dwt bulk carrier, GREAT NAVIGATOR, for Cido Shipping (H.K.) Co., Limited, which is the largest vessel built at this yard. The Toyohashi Shipbuilding Co., Ltd. built the 39,782 dwt container carrier, KOTA KAMIL, under contract to Shin Kurushima Dockyard Co., Ltd for Pacific International Lines (Private) Limited. The ship boasts an operational speed of 22 knots and a top speed during trials of more than 25 knots, making it the fastest ship built to date in this location.

**Kobe**  
Kobe is famous for its beautiful night view. Many ships are built in this region. Notable of these last year was the JANESIA ASPHALT IV, a 4,317 dwt asphalt carrier built by the Awaji Works of Kurinoura Dockyard Co., Ltd. for Nissho Odyssey Ship Management Pte Ltd.

**Okayama**  
Initial production of the Mitsui MAN B&W 12K98ME electronic controlled fuel injection and exhaust valve type engine was launched on 24 July 2006 at the Tamano Works of Mitsui Engineering and Shipbuilding Co., Ltd. This engine was built for IHI Marine United’s HUMBER BRIDGE, noted under Hiroshima below.

**Onomichi**  
Shipyards in the Onomichi had a busy year in 2006, as well. The Innoshima Shipyards of Naikai Zosen Corporation built the HELENE S, a 32,878 dwt, 2,529 TEU container carrier for H. Schepers Bereederungs GmbH & Co. KG. 
It was the first container carrier to be built by the yard in about twenty years. Kambara Shipyards built its first vessel to NK class, the 428 dwt tug, HUB GAZELLE, for Steel Hub Co., Ltd., while Suzuki Shipyards of Koike Shipbuilding built the BANDAI II, a 2,645 dwt chemical tanker for Saehan Marine Service Co., Ltd. This was the first chemical tanker to be built by the shipbuilder.

**Hiroshima**  
IHI Marine United Inc. Kure Shipyard built the 99,214 dwt container carrier, HUMBER BRIDGE, for "K" Line Ship Management Co., Ltd. The ship is the largest container carrier ever constructed at a Japanese shipyard and is capable of transporting 8,000 TEU. The ship is the first of eight vessels of the same series scheduled to be constructed at same shipyard. Another notable newly built addition to NK class in 2006 from Hiroshima is the KIHO, a 300,866 dwt VLCC built by
IHI Marine United Inc. Kure Shipyard for Nippon Oil Tanker Corporation. The vessel is world’s first VLCC mounted with an electronically controlled type diesel engine, DU-Wartsila 7RT-flex84T-D.

**Sakaide**
The Sakaide Branch had a particularly busy year registering some 57 newly delivered ships to NK class during 2006, the most in the past five years. Of particular note was the delivery of the NK classed 80,889 dwt, 145,000m³ capacity LNG carrier *LNG DREAM*, built at the Sakaide Shipyard of Kawasaki Shipbuilding Corporation. A notable feature of this tanker is the gigantic 40 meter by 20 meter beautifully artistic murals painted on the covers of the ship’s four independent nearly 45 meter diameter spherical tanks. Another notable ship newly built to NK class during the year was the *STAR FIRST*, a totally newly designed 13,202 dwt reefer cargo carrier built by Shikoku Dockyard Co., Ltd. for Nissen Kaiun Co., Ltd. The 30,401 dwt ro-ro cargo/vehicle carrier, *KUWANA*, was built by Shin Kochijyuko Co., Ltd. for Hachiuma Steamship Co., Ltd. This vessel has four deck cranes onboard.

**Imabari**
Imabari is a city where numerous shipbuilding, shipping, and ship-related industries are concentrated close together. In recent years, Imabari City has published their own Maritime City Concept with the aim of utilizing the ocean related history, culture, industry, and other special aspects of the Imabari region in order to become a city of which its citizens can be particularly proud. Many vessels have been built in this region. Noteworthy new additions to NK class last year are the *HOKUREN MARU*, a 6,597 dwt RO-RO cargo/vehicles carrier, and the *HOKUREN MARU NO. 2*, a 6,598 dwt RO-RO cargo/vehicles carrier. Both vessels were built by Imabari Shipbuilding Co., Ltd. for Kawasaki Kinkai Kisen Kaisha, Ltd.

**Nagasaki**
Nagasaki is another key shipbuilding region in Japan. Representative of new building activity in 2006, Mitsubishi Heavy Industries, Ltd. Nagasaki Shipyard & Machinery Works built the *IBRI LNG*, a 77,282 dwt, 145,173m³ capacity LNG carrier for Oman Ship Management Company S.A.O.C.
Overseas Newbuilding Highlights

NK has a network of 78 exclusive surveyor offices across the globe outside Japan. This expanding network also plays a major role in supporting NK’s growing presence around the world. This includes newbuilding survey activity overseas. A brief summary is presented here of some of the newbuilding and other highlights for representative offices overseas during the year.

Argentina
The Buenos Aires Office in Argentina oversaw the construction of the MADRISA a 27,112 dwt bulk carrier. This is the fourth in a series of five sister ships contracted to local shipyard Astilleros Rio Santiago, and was built for Madrisa Shipping Company Limited. The office has also been conducting newbuilding surveys fifth bulk carrier in the series, which is expected to be delivered in 2008. The office also surveyed four of a series of twelve river barges built by S.A.B.B. S.A. Shipyard of Argentina for Paraguayan owner Nevemar S.A.

China
ClassNK has eight exclusive surveyor offices in the China region. The regional office in Shanghai in particular had a very busy year in 2006. This included the delivery of eight newbuildings and related plan approvals for these vessels: five Handysize bulk carriers (both single and double hulled), one pure car carrier (5,000 vehicle capacity), one product tanker, and one 9,000 dwt mega block carrier. Notable of these vessels are the COS ORCHID, a 55,539 dwt bulk carrier built by Nantong COSCO KHI Engineering Co., Ltd. for COSCO (Singapore) Pte. Ltd., and the S&B-MO, a 9,330 dwt general cargo (hull block) carrier built by Hangzhou Dongfeng Shipbuilding Co., Ltd. for Sea Plus Management Co., Ltd. of Pusan, Korea. This was the first vessel built by the shipyard to NK class using the Nantong Yahua Shipbuilding facility. The Office also oversaw the construction of the 7,496 dwt oil carrier SPRING, built by Zhengjiang SOPO Shipbuilding Co., Ltd. for Equatorial Marine Fuel Management Services Pte. Ltd. as the first vessel built by this shipyard to NK class. The main drawings were approved by the NK Singapore Office.

The Guangzhou Office also had a busy year with the construction of two oil tankers: the 9,466 dwt EPISODE, built by Guangzhou Hangtong Shipbuilding and Shipping Co., Ltd. for owner HL Maritrans Pte., Ltd., and the 9,480 dwt EAGER, built by Guangzhou Hangtong Shipbuilding and Shipping Co., Ltd. for owner HL Seascape Pte., Ltd. The Dalian Office oversaw the construction of the C H S MAGNIFICENCE, a 173,541 dwt double hull Cape size bulk carrier built by Bohai Shipbuilding Heavy Industry Co., Ltd. for Whole World Shipping Limited. This ship is the fourth vessel in a series of eight double hull Cape size bulk carriers begun in 2004 as the first project in China of its type built to NK class.

NYK VEGA
A 94,000 dwt container carrier built by Hyundai Heavy Industries Co., Ltd. for NYK Shipmanagement PTE. Ltd.
Vietnam
Notable newbuildings constructed under the supervision of the Haiphong Office and Ho Chi Minh Sub-Office during the year include the GRACE CASABLANCA, a 8,703 dwt general cargo / lumber carrier built by Ben Kien Shipbuilding for Kaho Shipping Company Limited as the first ship built by the yard for Japanese owner, Hirai Line Co., Ltd.; the VIEN DONG 5, a 6,509 dwt general cargo ship built by Saigon Shipbuilding Industry Company (SSIC) for owner Vietnam Sea Transport and Chartering Company (VIETRANSCHART), notable for being the first ship built by SSIC to NK class; and the SUN ISLAND, a 10,959 dwt general cargo ship built by Bach Dang Shipyard for Pana Star Line S.A.

Korea
In Korea, where NK has offices in Busan, Seoul, and Ulsan, Hyundai Heavy Industries Co., Ltd. built the NYK VEGA, a 94,000 dwt container carrier, for NYK Shipmanagement Pte. Ltd. This vessel was the first of a new series of container ships with a capacity of 8,100 TEU. In addition, Dae Sun Shipbuilding & Engineering Co., Ltd. built the JOSCO STAR, a 12,820 dwt container carrier, for Jiangsu Ocean Shipping Co., Ltd. Hyundai Heavy Industries Co., Ltd. also built the GRANVILLE BRIDGE, a 71,326 dwt container carrier, for Doun Kisen Co., Ltd.

The Philippines
Tsuneishi Heavy Industries (Cebu), Inc. built the PACIFIC GUARDIAN, a 52,525 dwt bulk carrier, for MK Shipmanagement Co., Ltd. In addition, the yard also built the MEDI LISBON, a 58,710 dwt bulk carrier, for Fukujin Kisen Co., Ltd. This is the fourth sister ship in a series of 58K type bulk carriers.

Singapore
Three 32,937 dwt container carriers were built for Wan Hai Lines Ltd, with the NK Class Notation (PS-DA & FA) (PSCM) at Jurong Shipyard Limited: the Wan Hai 312, the Wan Hai 313, and the Wan Hai 315.

Indonesia
In Indonesia, where NK has offices in Jakarta, Batam, Surabaya, and Balikpapan, PT. PAL Indonesia built the STADT SOLINGEN, a 50,223 dwt bulk carrier, for Reederei M. Lauterjung GmbH. This vessel was the first ship for the owner. Moreover, PT. Palma Progress Shipyard built the LAUTAN 09, a 197 dwt tug boat, for PT. Layar Lintas Java. The ship was one of the most produced of this type.
Survey Activities and Approvals

The Society had a busy year last year carrying out, on average, more than 1,000 surveys and inspections each month. In Japan, a total of 3,392 class maintenance surveys were carried out, while in other areas 9,493 class maintenance surveys are carried out for a grand total of 12,885 class maintenance surveys.

In 2006, sixteen radio service companies were approved around the world bringing to 214 the total number of companies approved by the end of 2006.

In 2006, other newly approved firms totaled:
1. in-water survey of ships: 10
2. thickness measurements on ships: 22
3. surveys and maintenance of fire exiting equipment and systems: 14
4. service on life saving appliances: 5
5. voyage data recorders: 32

Material and equipment approvals during the year are summarized in the following table.

<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Volume / Change in Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Rolled Steel</td>
<td>4,289,576 tons</td>
</tr>
<tr>
<td></td>
<td>Cast/Forged Products</td>
<td>129,867</td>
</tr>
<tr>
<td>Machinery and Marine Equipment</td>
<td>Main Engines</td>
<td>2,264</td>
</tr>
<tr>
<td></td>
<td>Boilers</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>Deck Machinery</td>
<td>2,927</td>
</tr>
<tr>
<td></td>
<td>Engine Room Machinery</td>
<td>28,269</td>
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<tr>
<td></td>
<td>Anchors</td>
<td>1,434</td>
</tr>
<tr>
<td></td>
<td>Chains</td>
<td>10,430</td>
</tr>
<tr>
<td>Freight Containers</td>
<td>Cooling Machine Units</td>
<td>544</td>
</tr>
</tbody>
</table>

Notably, the Society received numerous applications for approval of the manufacturing process for TMCP steel. TMCP is a process originated in Japan that makes it possible to produce high strength plates characterized by high toughness and good weldability. It is also expected that TMCP will become more pervasive due to growing demand in shipbuilding.

MIRACULOUS ACE
A 19,381 dwt vehicles carrier built by Imabari Shipbuilding Co., Ltd. Marugame Headquarters for Mitsui O.S.K. Lines Ltd.

SHAMROCK
A 52,385 dwt bulk carrier built by Tsuneishi Heavy Industries (CEBU) Inc. for “ORION” BULKERS GmbH & Co. KG.
PSC Activities

The number of PSC related surveys and inspections conducted by flag states has been increasing recently at ports around the world. The ClassNK Survey Department recorded and analyzed the issues identified by various PSC regimes and published its Annual Report on Port State Control 2005 in order to improve the quality of NK vessels and the management systems of ship management companies. The ClassNK publication GOOD MAINTENANCE ONBOARD SHIPS was also updated to include amendments to international conventions and has been posted on the NK website. Moreover, in addition to visits to AMSA, Maritime NZ, the USCG, and Canada CG to share ideas, ClassNK also sent delegates to bilateral China-Japan and Korea-Japan meetings on maritime inspection related matters and introduced our activities as part of efforts to further reduce the detention ratio of NK classed ships by PSC.

Technical Services

During 2006, the Society issued Statements of Compliance to 34 vessels under the CAP or Condition Assessment Program, while Statements of Compliance where also issued for the anti-fouling systems of 815 ships, and for the ballast water management plans of to 1,511 ships. Thus, the total number of Statements of Compliance issued as of the end of 2006 for each type of service was 129 ships, 2,447 ships, and 1,611 ships, respectively.

NK also issues both International Air Pollution Prevention Certificates as well as Engine International Air Pollution Prevention Certificates (EIAPP) on behalf of Flag States certifying compliance with MARPOL 73/78 Annex VI. NK also issues voluntary EIAPP Statements of Compliance upon owner request. In 2006, the Society issued 3,173 EIAPP Certificates in accordance with the NOx Technical Code, and 205 EIAPP Statements of Compliance.

The number of vessels registered in the ClassNK Emergency Technical Assistance Service (ETAS) increased dramatically with the coming into force of Regulation 37.4 in MARPOL Annex I (from 1 January 2007) and the requirement for a “Vessel Response Plan” to be kept onboard announced by the USCG in February 2005.

By the end of 2006, a total of 733 vessels were registered for ETAS, including 367 vessels newly registered in 2006. This total includes 632 oil tankers (including chemical
tankers), 40 bulk carriers, 14 LPG carriers, and 47 other assorted vessels for 142 different owners around the world.

Appropriate attention to preservation of the environment is very important in the areas of ship recycling and the re-use of materials and equipment. In December 2003 the IMO adopted “IMO Guidelines on Ship Recycling (Res. A 962(23))”, and vessels that meet the requirements in terms of controlling and managing hazardous materials onboard are eligible for what is known as a “Green Passport”. During 2006, NK issued statements of compliance for the “Green Passport” for the VINCENT THOMAS BRIDGE and VANCOUVER BRIDGE built by Hyundai Heavy Industries, as well as for the CLIPPER SUFFOLK and UNITED TREASURE built by Tsuneishi Corporation of Japan.

PrimeShip-SHAFT

As ships become ever larger in size, propeller shafts have tended to become stiffer and hull structures are more likely to deform as they push size and design limitations. This has been reported as being a notable factor in recent cases of alignment related main bearing damage seen in some ships with large differences in draft, such as oil tankers and bulk carriers. Variations in current shafting design practices among architects can also be a potential factor that could contribute to shafting alignment related problems as design limits are approached. ClassNK has carried out intensive research to address these and related areas of concern and released the English version of THE GUIDELINES ON SHAFTING ALIGNMENT in 2006, reflecting the Society’s wealth of experience and latest research achievements in this field. The Guidelines are a cornerstone of the Society’s PrimeShip-SHAFT service. Optimized positions for shaft bearings can be calculated using the new formulas presented in these Guidelines.
Audit and Registration of ISM Code and ISPS Code related Systems

The Society is also very active in the conduct of ISM Code and ISPS Code related audits as a Recognized Organization on behalf of various Flag Administrations. During 2006 NK audited and issued DOCs to 19 newly registered companies in accordance with ISM Code requirements bringing the total to 573 companies. SMCs were issued to 628 newly registered ships while 525 vessels were deregistered in 2006, bringing the total number of vessels registered with the Society to 4,299 as of the end of 2006. NK currently has ISM Authorizations from 61 countries.

Last year, 533 ships were newly registered to ISPS Code requirements with 412 vessels deregistered, bringing the total number of ships registered with the Society to 3,481 as of the end of 2006. NK currently has ISPS Authorizations from 44 countries. A breakdown of the number of vessels registered by Flag as of the end of 2006 is shown in the following table.

<table>
<thead>
<tr>
<th>Flag</th>
<th>Number of Ships</th>
<th>Flag</th>
<th>Number of Ships</th>
</tr>
</thead>
<tbody>
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<td>BAHAMAS</td>
<td>86</td>
<td>MARSHALL ISLANDS</td>
<td>59</td>
</tr>
<tr>
<td>BELIZE</td>
<td>2</td>
<td>MYANMAR</td>
<td>3</td>
</tr>
<tr>
<td>BERMUDA</td>
<td>3</td>
<td>NETHERLANDS ANTILLES</td>
<td>3</td>
</tr>
<tr>
<td>CAYMAN ISLANDS</td>
<td>2</td>
<td>PANAMA</td>
<td>2,080</td>
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<tr>
<td>CYPRUS</td>
<td>85</td>
<td>PHILIPPINES</td>
<td>68</td>
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<tr>
<td>DOMINICAN REPUBLIC</td>
<td>3</td>
<td>SAUDI ARABIA</td>
<td>3</td>
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<tr>
<td>GEORGIA</td>
<td>3</td>
<td>SINGAPORE</td>
<td>260</td>
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<tr>
<td>GREECE</td>
<td>34</td>
<td>ST. VINCENT AND THE GRENADINES</td>
<td>41</td>
</tr>
<tr>
<td>HONG KONG, CHINA</td>
<td>228</td>
<td>SWITZERLAND</td>
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<tr>
<td>JAPAN</td>
<td>142</td>
<td>THAILAND</td>
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<tr>
<td>LEBANON</td>
<td>1</td>
<td>TURKEY</td>
<td>46</td>
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<tr>
<td>LIBERIA</td>
<td>108</td>
<td>UNITED ARAB EMIRATES</td>
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<tr>
<td>MALAYSIA</td>
<td>3</td>
<td>VANUATU</td>
<td>24</td>
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<tr>
<td>MALTA</td>
<td>128</td>
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<tr>
<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td><strong>3,481</strong></td>
</tr>
</tbody>
</table>

(As of end of 2006)
Assessment and Registration of ISO 9001 Quality and 14001 Environmental Systems

Another vital service offered by NK is the assessment and registration of quality systems based on the ISO 9001 series of quality standards, as well as the assessment and registration of environmental management systems based on the ISO 14001 standard. A total of 21 organizations were newly registered to the ISO 9001 standard in 2006 bringing the total to 371, while 12 organizations were newly registered to the ISO 14001 standard during the year bringing the total to 94. A breakdown of these totals as of the end of 2006 is detailed in the following table.

<table>
<thead>
<tr>
<th>Scope of Activities</th>
<th>Number of Registered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quality Management Systems</td>
</tr>
<tr>
<td>Articles of paper and paperboard</td>
<td>2</td>
</tr>
<tr>
<td>Chemicals, chemical products and fibers</td>
<td>2</td>
</tr>
<tr>
<td>Rubber and plastic products</td>
<td>10</td>
</tr>
<tr>
<td>Basic metals and fabricated metal products</td>
<td>65</td>
</tr>
<tr>
<td>Machinery and equipment</td>
<td>109</td>
</tr>
<tr>
<td>Electrical and optical equipment</td>
<td>31</td>
</tr>
<tr>
<td>Shipbuilding</td>
<td>47</td>
</tr>
<tr>
<td>Building and civil engineering</td>
<td>4</td>
</tr>
<tr>
<td>Water transport, Cargo handling and storage, and Other supporting transport activities</td>
<td>75</td>
</tr>
<tr>
<td>Real estate services</td>
<td>1</td>
</tr>
<tr>
<td>Technical testing and analysis, and Labor recruitment and provision of personnel (including crew manning)</td>
<td>22</td>
</tr>
<tr>
<td>Adult and other education (including crew training)</td>
<td>3</td>
</tr>
<tr>
<td>Sewage and refuse disposal, sanitation and similar activities</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>371</strong></td>
</tr>
</tbody>
</table>

(As of end of 2006)

SANKO JUPITER
A 32,936 dwt bulk carrier built by Kanda Shipbuilding Co., Ltd. for Sanko Ship Management Co., Ltd.

MOL PACE
A 72,968 dwt container carrier built by Koyo Dockyard Co., Ltd.
Cooperative Technical Development

The Society actively participates in a variety of technical development projects with a range of outside organizations in government and industry. A number of these projects are ongoing in nature, such as the floating production, storage and offloading (FPSO) system development project to produce, store, and offload natural gas hydrate (NGH) at sea, being undertaken in cooperation with Mitsui Engineering & Shipbuilding Co., Ltd., the National Maritime Research Institute, and Ocean Engineering Research, Inc. (with support provided by the Ocean Policy Research Foundation). The Society also actively cooperates with Mitsubishi Heavy Industries and NYK LNG Shipmanagement Ltd. in the development of a state-of-the-art hull fatigue strength analysis method for LNG carriers known as Total Life Assessment. ClassNK has also been actively involved in the development and testing of a Super Eco-Ship (SES) as part of national R&D project in cooperation with government and industry. The goal of the project is to design and construct a next-generation coastal ship for domestic service in Japan capable of highly efficient sea transport that also reduces loads on both labor and the environment. The ship design incorporates an optimized “buttock-flow” hull form, a super marine gas turbine (SMGT), and an electrically driven contra-rotating propeller pod. Construction of an actual ship using the SES design began in April 2006 to NK class. The Society will also be playing an active role in assessing the effectiveness of the various control systems and other functions designed to enhance operational efficiency and reduce labor onboard.

Another notable project in which the Society has played an active role is the Non Ballast Water Ships (NOBS) project undertaken in cooperation with the Shipbuilding Research Institute of Japan, Mitsubishi Heavy Industries, Ltd., and IHI Marine United Inc. A special article appears later in this report introducing this project.

NK Quality System Assessments

Last year was a busy year for ClassNK as it underwent a range of audits conducted by various external entities to assess the operations and quality system of the Society. These included an IACS QSCS (Quality System Certification Scheme) Annual Audit conducted at the Head Office and four locations overseas based on the IACS QSCS. Vertical Contract Audits were also carried out on the surveys of 14 ships. In addition,
ClassNK actively engages in a host of training activities both inside and outside the Society. These range from training surveyors within the Society to providing internships and other forms of outside cooperative support to help meet maritime training needs. Some of the more notable programs are briefly introduced below.

**ISM Auditor Training**
The ISM Auditor course was carried out for 11 persons in Japan, and the same course was also carried out at the Singapore Office and the London Office for a total of 23 persons. As a result, the total number of ClassNK exclusive surveyors who have attended the ISM Auditor Training Course since its commencement in 1994 to the end of 2006 is now 568.

**Maritime Security Auditor Training**
As was the case in 2005, MSA Training Courses were held both inside and outside of Japan for a total of 51 persons at the NK Head Office, the Singapore Office, as well as the New York Office. Since its inception in 2004, a total of 335 persons were noted for improvement in each of these audits, the quality system overall was found to be working well overall to achieve the quality goals of the Society. These audits, combined with internal audits carried out of NK locations throughout the year, reflect the Society’s dedicated and continuous efforts to achieve its 2006 Quality Objectives of establishing an effective and carefully monitored organization based survey system, improving the capabilities and competency of each individual employee, and providing service of ever-higher quality.

SGS (Société Générale de Surveillance) surveillance and RvA (Raad voor Accreditatie) audits was also conducted at the Head Office and numerous NK locations during the year. External government audits included an audit of the Shanghai Office by the MCA (Maritime Coast Guard Agency of the U.K.), as well as audits by the Japanese Government of various offices in Japan, by the Greek Government at the Piraeus Office, by the Dutch Government at the Rotterdam Office, and by the Turkish Government at the Istanbul Office. The Society was also audited by EMSA (European Maritime Safety Agency) in early October last year and covered the NK Head Office and three other locations. While certain areas were noted for improvement in each of these audits, the quality system overall was found to be working well overall to achieve the quality goals of the Society. These audits, combined with internal audits carried out of NK locations throughout the year, reflect the Society’s dedicated and continuous efforts to achieve its 2006 Quality Objectives of establishing an effective and carefully monitored organization based survey system, improving the capabilities and competency of each individual employee, and providing service of ever-higher quality.
have attended the course. In Singapore, three surveyors also attended the course from the Maritime Industry Authority (MARINA) of the Philippines.

**Training for the Appointment of Surveyors**
Survey training was provided for a total of 80 surveyors in 2006, including new graduates joining NK during the year. Practical, hands-on training courses were also conducted onboard the Seiunmaru, a training ship of the National Institute for Sea Training, and on marine engines at Yanmar Co. Ltd. for newly appointed surveyors of the Society.

**Cooperation with Training Centers for the Development of Shipbuilding Skills**
A major issue currently facing the maritime industry is the ability to adequately fill personnel development and staffing needs to replace the aging workforce. As part of efforts to address this concern, Training Centers for the Development of Shipbuilding Skills have been established in different parts of Japan under the auspices of the Japan Foundation with support by the Japanese Ministry of Land, Infrastructure, and Transport (MLIT). A new Training Center was established in Nagasaki in 2006 as part of these efforts. The general manager of the ClassNK Nagasaki Branch serves as an advisor to the Training Center.

from NK. This Center is the fifth such Training Center to be opened in Japan following the establishment of similar training centers in Innoshima, Imabari, Oita, and Yokohama.

**Lecture at Eastern Japan Training Center for Shipbuilding Skills**
In addition to cooperating with Training Centers as noted above, NK also dispatched an instructor to give a lecture to 40 persons engaged in shipbuilding following a request from the Eastern Japan Training Center for Shipbuilding Skills.

**Lecture at Marine Technical College of Japan**
Instructors from the Society also gave classes on the ISM Code and ISPS Code to foreign trainees attending the Marine Technical College in Japan at the request of the College. Known as "Kaigi Daigakko", it is the only governmental institute of vocational training for mariners that is under the direct control of the Ministry of Land, Infrastructure and Transport. The goal of the college is to provide education training in technical knowledge and skills as well as to carry out practical research for the technological development of the mercantile marine fleet in Japan.

**Internship Training Program**
Internship training programs were conducted...
at the NK Head Office during the year for a total of 11 graduate students from Osaka University, Osaka Prefecture University, Kumamoto University, Tokai University, Tokyo University of Marine Science and Technology, Hiroshima University, as well as Yokohama National University.

**International Co-operation**

Training on classification surveys during construction for two Vietnam Register exclusive surveyors was carried out at the ClassNK Shanghai Office at the request of VR.

Following a request from Japan International Cooperation Agency (JICA), lectures on the SOLAS and MARPOL conventions were given at the “Group Training Course in International Maritime Conventions and Ship Safety Inspection” held by the Ship Research Centre of Japan (SRC).

In addition, classes on the SOLAS and MARPOL conventions were also given at the request of the Tokyo MOU Secretariat at the “16th Basic Training Course for Port State Control Officers in the Asia-Pacific Region” held by the Tokyo MOU.

The Society also gave classes at a training course for PSC inspectors on SOLAS II-2 and chemical carriers following a request from the Maritime Safety Administration of the People’s Republic of China.

**The Rules**

Since the core of a ship classification society's technical credibility is its rules, ClassNK constantly reviews and updates its the many technical Rules, Regulations and Guidance on a regular basis. In addition to keeping the rules up to date with constantly changing statutory requirements, the Society also focuses on revising its rules to incorporate the latest results of its research and development activities. A representative list of the numerous areas revised in the technical Rules and Guidance by the Society during 2006 is presented below.

1) **Rules and Guidance for the Survey and Construction of Steel Ships**

(1) New Parts related to IACS CSRs for Bulk Carriers and Double Hull Oil Tankers (Rules Part CSR-B and CSR-T), and a partial revision related to their application and class notations (Rules Part A)
(2) Additional Safety Measures for Bulk Carriers (Rules and Guidance Part A, B, C, U, CS, and D)

(3) Hold Frames of Existing Bulk Carriers (Rules Part C)

(4) Class Surveys (Rules and Guidance Part B)

(5) Preparation for Surveys of Oil Tankers and Bulk Carriers (Guidance Part B)

(6) Cargo Hold Construction (Guidance Part C)

(7) Arrangement of Forecastle for Bulk Carriers (Rule and Guidance Part C)

(8) Bow Flare Slamming Pressure (Guidance Part C)

(9) Width of the Double-Side Skin Constructions of Bulk Carriers (Guidance Part C)

(10) Securing Device for Weather Tight Steel Hatches Cover (Guidance Part C)

(11) Allowable Stress for Steel Hatches Cover (Guidance Part C)

(12) Means of Access (Rules Part C and CS, Guidance Part B and C)

(13) Structural Members of Cargo Areas in Bulk Carriers (Rules and Guidance Part C)

(14) Damage Stability Requirements for Bulk Carriers and the Application of Damage Stability Computers (Guidance Part C and U)

(15) Water Level Detectors and Dewatering Arrangements and Preparation for Surveys on Bulk Carriers (Rules and Guidance Part B)

(16) Revisions related to the totally amended IBC Code (Rules Part S, Guidance Part B and S)

(17) Internal Examinations of Spaces and Tanks for Tankers and Ships Carrying Dangerous Chemicals in Bulk (Rule and Guidance Part B)

(18) Condition Monitoring System Used in the Planned Machinery Maintenance Scheme (PMS) (Guidance Part B)

(19) Alignment of Main Propulsion Shafting (Rules and Guidance Part D)

(20) Calculation of Crankshafts (Rule and Guidance Part D)

(21) Brittle Crack Arrest Properties (Rules and Guidance Part K)

(22) Aluminium Alloys (Rules Part K and M, Guidance Part K)

(23) Non-Destructive Inspection of Welded Joints of Hatch Side Coamings (Guidance Part M)

(24) Approval Test of Welding Consumables (Rules Part M)

(25) Control Standard for Welding for Rolled Steels for Hull (Guidance Part M)


(27) Manufacture of Anchors (Rules and Guidance Part L)
(28) Ice Class (Rules and Guidance Part C)
(29) Boiler Surveys (Rules and guidance Part B)
(30) Uninterruptible Power Systems (Rules and guidance Part H)
(31) Service Supply from Emergency Source of Electrical Power to Life Saving Appliances (Rule Part H)
(33) Regulation V/23.5 of SOLAS Convention (Guidance Part C)
(34) Piping Systems (Rules and Guidance Part D)
(35) Fire Protection and Fire Fighting (Rules Part D and R, Guidance Part R)
(36) Drawings to be Maintained onboard Ship (Rules Part B and P, Guidance Part B)
(37) Towing and Mooring Fittings (Rules Part B, C and CS, Guidance C)
(38) Navigation Bridge Visibility (Guidance Part W)
2) Rules and Guidance for Marine Pollution Prevention Systems Incorporation of amendments to MARPOL Annexes I, II, and VI, etc.
3) Rules and Guidance for Safety Equipment
4) Rules and Guidance for Radio Installations
5) Rules and Guidance for High Speed Craft

6) Rules and Guidance for the Survey and Construction of Passenger Ships
7) Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Technical Seminars

Providing up to date technical information to NK clients is an important function which is achieved through a variety of methods, one of which is technical seminars and meetings. ClassNK technical seminars were held in a total of five locations across Japan, starting with Tokyo, followed by Fukuoka, Onomichi, Imabari, and Kobe. There were numerous participants from among shipowners, shipyards, machinery and equipment manufacturers, government, and other groups in attendance at each session. The annual ClassNK 2006 Technical Research Conference, which presents the results of technical research being conducted by the Society, was held in December 2006 and was attended by nearly 200 persons. Technical seminars were also held at numerous locations overseas including New York, Hong Kong, Shanghai, Haiphong, Busan, Glasgow, Piraeus, and Istanbul. Technical presentations also feature as an important part of most NK
overseas committee meetings, as well. In addition, local NK staff are often asked to share their expertise with local authorities.

**General**

**ClassNK Award**
The "ClassNK100 Awards" were originally established to mark the 100th anniversary of the founding of the Society. Since renamed the ClassNK Award, the awards are issued each year in recognition of outstanding postgraduate research by students at selected participating universities. A certificate of merit and monetary award are presented as part of the award. Awards were presented to students from the following universities in 2006: Seoul National University and Pusan National University in Korea, Shanghai Jiao Tong University in China, as well as the Indian Institute of Technology in Chennai and Cochin University in India.

**Design Contest**
The Society also contributed a special award to the 2nd China University Architecture and Ocean Engineering Design Contest sponsored by Shanghai Jiao Tong University as part of expanding the scope of the ClassNK Award.
<table>
<thead>
<tr>
<th>Title of Research</th>
<th>Outline of Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study on the structural reliability of ships (Last year of three-year project)</td>
<td>Structural reliability assessments were carried out on the ultimate limit states of several tankers and bulk carriers using pilot models of each type of ship. A reliability assessment method was then developed regarding the indeterminateness of static and wave longitudinal bending moments and hull girder ultimate strength with good accuracy. Knowledge obtained over the three-year period of the study was compiled as technical information.</td>
</tr>
<tr>
<td>Study on the practical use of FSA (First year of three-year project)</td>
<td>Formal Safety Assessment (FSA) discussed at the IMO is a tool based on risk analysis techniques that is used in the rule-making process. Risk analysis methods include many technical elements. An extensive literature survey was conducted on the technical elements of risk analysis such as structural reliability analysis (SRA), failure modes and effect analysis (FMEA), safety analysis techniques, and human reliability analysis (HRA), amongst others.</td>
</tr>
<tr>
<td>Study on the life assessment of ship structures (First year of three-year project)</td>
<td>A Hull Fatigue Management System (HFMS) capable of estimating residual fatigue life through the use of fatigue damage sensors was investigated. A new hotspot stress estimation method based on FEM analysis results was also investigated with the aim of enhancing the accuracy of fatigue strength assessments. Corrosion protection methods to prevent aging deterioration were surveyed, as well.</td>
</tr>
<tr>
<td>Study on wave loads acting on ship structures (Last year of three-year project: Third stage)</td>
<td>A series of calculations of hull girder wave loads on various container ships was carried out using the Rankine source method (a non-liner analysis method) focusing on the non-liner effect. In addition, the effect of bow flare shape on wave bending moment was also studied.</td>
</tr>
<tr>
<td>Study on the ultimate strength of large scale hull structures (First year of three-year project)</td>
<td>Simulations of the hull girder collapse of a bulk carrier were carried out under various combinations of longitudinal bending load and cargo load conditions in holds using a non-liner FEM (DYTRAN). In addition, Idealized Structural Unit Method (ISUM) elements applicable to in-plane bending load cases were developed, and their applicability was verified by comparison with the results of double bottom collapse analysis based on non-liner FEM analysis.</td>
</tr>
<tr>
<td>Study on condition monitoring methods of marine engines and machinery (First year of three-year project)</td>
<td>In order to examine appropriate monitoring and sensing techniques for condition monitoring systems on main engines and machinery in an engine room, sensing techniques using high frequency pick up sensors and a monitor to count number of particles in the lubrication oil scored due to wear down were tested to investigate the conditions necessary for effective monitoring with appropriate alarms to avoid failure of the main bearings in the main engine.</td>
</tr>
<tr>
<td>Title of Research</td>
<td>Outline of Research</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Study on the application of RCM/RBM to marine machinery (First year of three-year project)</td>
<td>Initial procedures and computer systems for conducting Risk-Based Inspection (RBI) on the main engine were developed and studied with the aim of developing appropriate procedures and computer systems for the RBI of machinery onboard ship. In addition, draft guidelines on the design and maintenance of pipes against flow-accelerated corrosion were completed.</td>
</tr>
<tr>
<td>Study of analytical methods relating to combustion characteristics of marine fuel oils and degradation of lubricating oils of 4-stroke diesel engines (Second year of three-year project)</td>
<td>Fuel oil combustion tests and data analysis as well as lubricating oil analysis were carried out on the combustion characteristics of marine fuel oils and degradation of lubricating oils with the aim of developing diagnostic techniques to protect engines from abnormal combustion problems attributable to fuel oil or lubricating oil. Some indications based on the nature of the oil were found for critical values that can be used in checking the characteristics of the oil.</td>
</tr>
<tr>
<td>Study on the strength assessment of main propulsion systems (Last year of three-year project: Second stage)</td>
<td>Japanese and English editions of the Guidelines on Shafting Alignment taking into account Variations in Bearing Offsets while in Service were published based on the results of the research conducted in this project.</td>
</tr>
<tr>
<td>Study on corrosion occurring in welded joints (First year of two-year project)</td>
<td>The excessive corrosion of steel due to contact of stainless pipes in a seawater environment was analyzed using the boundary element method, and the deterioration effect of coatings on the corrosion rate of the steel structure was examined. An effective anti-corrosion method was studied using this technique for the damage example. In addition, long-term seawater immersion tests of loaded steel plates (MS and HT32 steel) were conducted in order to investigate the effect of plastic strain on corrosion.</td>
</tr>
<tr>
<td>Study on the strength of welded joints (Last year of three-year project: Second stage)</td>
<td>The effect of corrosion on the ultimate strength of stiffened plates, which had grooving corrosion at the fillet welded joints subjected to shear and bending due to lateral pressure, was investigated by experiments and FE analyses. Methods of assessing the fatigue strength of load-carrying stainless steel fillet welded joints were examined based on fatigue tests and a review of the literature.</td>
</tr>
<tr>
<td>Study on the corrosion of ship structural members (Last year of two-year project: Second stage)</td>
<td>A probabilistic simulation method was developed to predict the thickness diminution behavior of pitting corroded plates, and a series of FE analyses was performed to investigate the ultimate strength reduction behavior of pitted plates. Furthermore, a series of tensile tests on actual pitting corroded members was conducted. Based on the results of the analyses and experiments, a method for evaluating the equivalent thickness loss of pitted plates, defined as the thickness loss of uniformly corroded members with the same strength as the pitted plate, was proposed based on the visually determined DOP (Degree Of Pitting Intensity) approach.</td>
</tr>
<tr>
<td>Field tests on an actual ship</td>
<td>A series of detailed stress measurements of a large container ship was undertaken.</td>
</tr>
</tbody>
</table>
NOBS: A New Design Approach to Ballast Water Management

Background
Ballast plays a vital role in ensuring adequate ship stability while a ship is underway in the unladen or ballast condition. This is particularly important for conventionally designed bulk carriers and tankers that often carry cargo in only one direction and may go unloaded on the return voyage. The main purpose of ballast is to maintain proper trim and to prevent the occurrence of bow slamming and propeller racing that would otherwise result from insufficient draft due to the ship sitting higher in the water when unloaded.

Various problems arise from the use of ballast water, however. More than 10 billion tons of ballast water is transported by merchant ships across vast distances each year as they ply from one part of the world to another. This figure has been increasing as the size of the global fleet continues to grow in both the number and size of ships in use. A major problem with the carriage of so much ballast water is that in the process, a host of harmful aquatic organisms and species indigenous to one area are also transported and introduced into other parts of the world where they are non-indigenous, upsetting the ecology of the new area. This has increasingly harmful effects on the ecological balance of the marine area where the ballast water is discharged as new cargo is taken onboard.

Efforts by the IMO in response to growing awareness of the need to combat these environmental problems and the economic and ecological disruption they cause have led to the adoption of the International Convention for the Control and Management of Ship’s Ballast Water and Sediments in 2004. The Convention sets forth requirements for the handling of ballast water, including the exchange of ballast water at sea and the use of ballast water treatment systems to eliminate the transfer of harmful organisms from one area of the ocean to another. The eventual goal is to phase out the use of ballast water exchange by 2016 and to replace it with a fairly strict treatment standard. Treatments currently being examined include UV exposure, biochemical treatment, and various types of filtration methods, among others. The expectation is that the technologies and methods of treatment will come to satisfy the treatment standard set forth in the Convention by the time it comes into final effect in 2016.
The NOBS Design Concept
A completely different approach from dealing with ballast water directly is to redesign the ship itself so as to remove the need to rely on ballast water, except in certain special circumstances. This is the basic concept behind the Non Ballast Water Ship or NOBS concept. This innovative concept essentially consists of designing the ship so that its centerline sits more deeply in the water than in the more conventional flat bottom design of most commercial ships currently in service. The aim of the approach is to maintain sufficient draft without using any ballast water while unloaded to avoid bow slamming and propeller racing while ensuring sufficiently safe operation when underway in most sea conditions. This is achieved through the use of a transversely raked bottom design. The resulting decrease in displacement is compensated for by increasing the breadth, length, and draft of the vessel. A key advantage of the NOBS design is that it basically eliminates the need for expensive ballast water treatment systems and associated operational costs, although two small redundant ballast tanks are incorporated in the design for use in adjusting trim and passage through extreme seas.

Development of the novel NOBS design first began in 2001 by the Shipbuilding Research Center of Japan (SRC). R&D into the design entered a new stage in 2003 with the start of a three-year joint project using tank tests under the auspices of the SRC. The project has been promoted by the Japan Ship Technology Research Association with support from the Nippon Foundation and undertaken in cooperation with Mitsubishi Heavy Industries, IHI Marine United Inc., the SRC, and ClassNK, which has played both leading and technical roles in the project. A main goal of the project has been to determine the practical feasibility of the NOBS design in terms of satisfying requirements for safe operation and existing regulatory and other relevant standards, seakeeping performance, and economic viability by studying the application of the design to a Suezmax tanker and VLCC.

**Development of NOBS**

(Illustration of NOBS Section)

1. Development of most suitable hull design of NOBS
2. Development of propulsion system for shallow draught
3. Development of system to expected wave impact pressure
Research Results

In order to determine the feasibility of the NOBS design to actual ships, a range of tank tests were conducted on model ships built based on the design and compared with a Suezmax tanker and a VLCC of the same deadweight with respect to eight specific design objectives. Factors compared included propulsion efficiency in still water, resistance in waves, dynamic motion in waves, as well as response to wave loads. Each objective was found to be met or exceeded, as summarized below.

1. The frequency and impact pressure of forward bottom slamming and propeller racing in the NOBS design in the unloaded condition was found to be similar to the values for the conventional ships tested in the normal ballast condition. These results demonstrate that a NOBS is capable of operating safely as an ocean going vessel without ballast water under normal sea conditions just as a conventional ship in the ballast condition with a ballast water displacement of 30-40%.

2. It was also confirmed that a NOBS maintains the draft necessary for safe navigation in very rough sea conditions with approximately one-quarter the ballast water that a conventional oil tanker carries.

3. While a NOBS did not perform quite as well as a conventional ship in the loaded condition in terms of propulsive performance, performance was notably better in the unloaded condition. Overall, performance was shown to improve by as much as 6.4% on average. Thus, it was determined that application of the NOBS design would yield energy savings of at least 5% on average compared with a conventional ship in terms of both main engine power and fuel consumption.

4. The strength of the NOBS hull structure was found to be satisfactory and comply with all regulatory and class requirements for every expected voyage and condition. ClassNK’s PrimeShip-HULL application was used to analyze the longitudinal, transverse, and fatigue strength characteristics of the NOBS design and then compare the results with the comparable values for the conventional tankers studied in the project with respect to the applicable class rule requirements for such tankers. Example results for different sea conditions as well as the stress and buckling evaluations obtained are shown in the following graphs.
5. The characteristics for ship motion, wave resistance, and longitudinal bending moment in waves of the NOBS were found to be comparable to the characteristics for the conventional ships studied, thereby confirming the seaworthiness of the NOBS design.

6. The broader width of the NOBS and transverse hull form help to maintain the equilibrium of the ship against rolling. Actual tests showed that the NOBS had a significantly larger extinction ratio in rolling motion compared to the conventional box-type hull forms, thereby making a bilge keel unnecessary.

7. The water tank tests demonstrated that the NOBS has favorable maneuverability characteristics capable of maintaining a stable heading in compliance with IMO standards for ship maneuverability.

8. Although up to as much as 10% more steel would be required both for the broader hull form and to reinforce certain areas of the hull structure compared with conventional designs, the improvements in propulsive performance lower fuel costs are expected to more than compensate for this demerit. And of course, there no longer be any need for any large-scale ballast water treatment system with a NOBS, which would be a major savings in and of itself.

All told, the innovative NOBS concept proposed at the start of the project was indeed found to satisfy the objectives initially set forth for the design. Hence, it was determined that the NOBS design is practical for large sized tankers and is well capable of enabling safe navigation without the need for ballast water except in the most extreme sea conditions. Although studies still need to be conducted on the application of the NOBS concept to other types of ships such as bulk carriers, container ships, and middle-sized vessels of various types, initial results thus far show the NOBS concept to be a very promising alternative approach to ballast water management.

While other technical and practical issues still need to be addressed such as how some ports will accommodate the broader beams of such vessels and the fact that blocks of different size will need to be arranged during construction, drydocking and repair, it can be expected that these issues can be readily resolved as the NOBS concept becomes a truly viable design. However, the greatest benefit of the NOBS concept is that it would be free from the requirements for ballast water management and treatment, and as such can be expected to contribute greatly to preserving the marine environment as a totally new environmentally friendly ship type of the next generation.

Main Benefits of NOBS Design

Prevention of Marine Pollution
- Ballast-free hull form
  • Prevents transfer of ballast water and invasive organisms to other sea areas.

Safety
- Safe operation without water ballast
  • Ship motion and bow slamming are on same level as similar sized conventional ship.
  • Broader transverse hull form maintains equilibrium against rolling.
  • Maneuverability complies with IMO standards.

Economy
- More than 6% power/propulsion savings
  • Increased building costs due to greater steel use offset by improved propulsion efficiency.

Tank test of NOBS design for a Suezmax tanker in the non-ballast condition
ClassNK has always been an internationally oriented Society. In addition to 21 offices in Japan, the Society has over 78 service sites in 42 countries and territories overseas. An important aspect of NK’s international activities is related to the Society’s capacity to undertake statutory surveys on the behalf of national Administrations around the globe. The number of States that have authorized ClassNK to carry out surveys and issue certificates on their behalf based on international conventions was 106 as of December 2006. This includes the addition of authorization by the MCA of the United Kingdom.

Another important aspect of the Society’s international activities is NK’s contribution to the International Maritime Organization (IMO). NK participated in the following meetings during 2006 either as a member of the Japanese Government delegation or a representative of IACS:

- Maritime Safety Committee (MSC) – 81st and 82nd sessions
- Marine Environment Protection Committee (MEPC) – 54th and 55th sessions
- Sub-Committee on Ship Design and Equipment (DE) – 49th session
- Sub-Committee on Bulk Liquids and Gases (BLG) – 10th session
- Sub-Committee on Fire Protection (FP) – 50th session
- Sub-Committee on Safety of Navigation (NAV) – 52nd session
- Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) – 49th session
- Sub-Committee on Flag State Implementation (FSI) – 14th session
- Sub-Committee on the Carriage of Dangerous Goods, Solid Cargoes and Containers (DSC) – 11th session

The outcomes of NK participation in major meetings such as MEPC and MSC are conveyed to ClassNK clients through a variety of methods, including “NK Technical Information” bulletins and providing updates on the Society’s website under “IMO International Convention Calendar”.

Another key aspect of NK’s international activities is the Society’s active involvement in IACS related activities.

The IACS Common Structural Rules (CSR) for bulk carriers and tankers came into effect in April 2006 and were incorporated into the Rules of the Society, accordingly. ClassNK played a significant role in the development of the CSR for bulk carriers, in particular. The Society actively participates in the review and updating of the CSR undertaken by IACS as part of the IACS CSR maintenance scheme, and updates its own Rules on a regular basis.

ClassNK participated in the following IACS meetings in 2006 (numbers after each item indicate number of times meetings took place):
Council: 2
Quality Committee: 2
General Policy Group: 2
Panel Meetings (total for all four Panels): 9
Project Team Meetings: 13
Expert Group Meetings: 3
Overseas Committee meetings are an important avenue for the two-way exchange of information and advice between NK and key industry and regional stakeholders in local regions around the world. A full list of NK Committee meetings held during 2006 is summarized in the following table.

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<th>NK Committee Meetings Held during 2006</th>
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* For ships other than passenger ships.

**Abbreviations:**

- ● Authority has been delegated.
- * Authority has been delegated subject to some conditions.
- LL International Load Line Certificate
- SC Cargo Ship Safety Construction Certificate
- SE Cargo Ship Safety Equipment Certificate
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</table>

SR: Cargo Ship Safety Radio Certificate  
SMC: Safety Management Certificate  
ISPS: International Ship and Port Facility Security Certificate  
IOPP: International Oil Pollution Prevention Certificate  
NLS: International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk  
Branches in Japan
### ADVISORY COUNCIL

<table>
<thead>
<tr>
<th>Members</th>
<th>Group Chairman</th>
<th>Cement</th>
</tr>
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<tbody>
<tr>
<td>Chang Yung-fa</td>
<td></td>
<td>Evergreen Group</td>
</tr>
<tr>
<td>Frank W. K. Tsao</td>
<td></td>
<td>IMC Group of Companies</td>
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<tr>
<td>Sumate Tanthuwanit</td>
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<td>Regional Container Lines Group</td>
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### BRITISH COMMITTEE

<table>
<thead>
<tr>
<th>Chairman</th>
<th>Managing Director</th>
<th>IMIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. G. Davis</td>
<td>Managing Director</td>
<td>International Maritime Industries Forum</td>
</tr>
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</table>

### CHINA COMMITTEE

<table>
<thead>
<tr>
<th>Chairman</th>
<th>Executive Vice President</th>
<th>China Ocean Shipping (Group) Company (COSCO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li Jianhong</td>
<td>Executive Vice President</td>
<td>China Ocean Shipping (Group) Company (COSCO)</td>
</tr>
</tbody>
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### GREEK COMMITTEE

<table>
<thead>
<tr>
<th>Chairman</th>
<th>Managing Director</th>
<th>Transmed Shipping Ltd.</th>
</tr>
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<tbody>
<tr>
<td>Charalambos N. Mylonas</td>
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<td>A. M. Nomikos Transworld Maritime Agencies S.A.</td>
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<table>
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<tr>
<th>Members</th>
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</tr>
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<tbody>
<tr>
<td>Markos A. Nomikos</td>
<td>Managing Director</td>
<td>A. M. Nomikos Transworld Maritime Agencies S.A.</td>
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<tr>
<td>Michael D. Chandris</td>
<td>Managing Director</td>
<td>Transmed Shipping Ltd.</td>
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<tr>
<td>George J. Souravlas</td>
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<td>Anna G. Dracopoulos</td>
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<td>Prokopis N. Karmessis</td>
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<td>Kriton Lendoudis</td>
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<td>Chikas J. Gournas</td>
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<td>Dimitris Z. Kritsas</td>
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<td>Panagiotis C. Laskaridis</td>
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<td>Theodore P. Angelopoulos</td>
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<td>Thanos Crassaris</td>
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<tr>
<td>George S. Livanos</td>
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<tr>
<td>Constantinios J. Martinos</td>
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<tr>
<td>Panagiotis N. Tsakos</td>
<td>Managing Director</td>
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<tr>
<td>Michael M. Scufalos</td>
<td>Managing Director</td>
<td>Transmed Shipping Ltd.</td>
</tr>
</tbody>
</table>
### HONG KONG COMMITTEE

**Chairman**
Andrew Y. Chen
Chairman & Managing Director
Grand Seatrade Shipping Company Ltd.

**Vice Chairman**
Xu Zunwu
Vice President
COSCO (Hong Kong) Group Ltd.

**Honorary Chairman**
M. H. Liang
Chairman
Island Navigation Corp.Int’l Ltd.

**Members**
Robert Alexander Ho
President
Fairmont Shipping (HK) Ltd & Affiliates

Huang Shao Jie
Director & President
Hong Kong Shipping Co., Ltd.

Arthur Bowring
Managing Director
Hong Kong Shipowners Association

Frank W. K. Tsao
Group Chairman
IMC Group of Companies

Steve G. Hsu
Group Chairman
Ocean Longevity Shipping and Management Co., Ltd.

Kwai Sze Hoi
Chairman & President

Richard Hext
Chief Executive Officer
Pacific Basin Shipping (HK) Ltd.

C. C. Liu
Chairman
Parakou Shipping Ltd.

M. T. Yung
Director General Manager
Patt Manfield & Co., Ltd.

Peter Cheng
Managing Director
Peter Cheng Naval Architect & Marine Consultant Ltd.

Raymond Pao
President
Regent Shipping Ltd.

Li Hua
Deputy Managing Director
Sinotrans Shipping Limited

Kenneth K.W. Lo
Managing Director
Teh-Hu Cargocean Management Co., Ltd.

Edward S. C. Cheng
Chairman
Unique Shipping (H.K.) Ltd.

C.A.J. Vanderperre
Managing Director
Univan Ship Management Ltd.

David C. C. Koo
Deputy Managing Director
Valles Steamship Co., Ltd.

Sabrina S. M. Chao
Managing Director
Wah Kwong Shipping Holdings Ltd.

Jim Nelson
Managing Director
Wallem Shipping Management Ltd.

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### INDIAN COMMITTEE

**Chairman**
Arun Mehta
Chairman & Managing Director
Varun Shipping Company Limited

**Vice Chairman**
R. L. Pai
Group Sr. Vice President
Reliance Industries Limited

Ashok V. Chowgule
Executive Director
Chowgule & Company Ltd.

Ajoy Chatterjee
Chief Surveyor with the
Directorate General of Shipping Ministry of Shipping, Road Transport & Highways

**Members**
Madhusudan P. Dhanuka
Executive Director
GEE Limited

Atul J. Agarwal
Joint Managing Director
Mercurato Lines Limited

H. Ansari
Additional Director
National Law University

S. Govindrajan
Managing Director
Progressive Shipping

Consultancy Services (PVT) Ltd.

K. M. Sheth
Executive Chairman
The Great Eastern Shipping Co., Ltd.

R. K. Mitra
Director
The Shipping Corporation of India Ltd.

---

### INDONESIA COMMITTEE

**Chairman**
Widihardja Tanudjaja
President Director
PT. Berlian Laju Tanker Tbk

Bobby R. Mamahit
Director
Directorate General of Sea Transportation

Choy Ngee Sheng
Director
GBLT Shipmanagement Pte. Ltd.

Oentoro Surya
Chairman
INSA (Indonesia National Shipowners Association)

Joewanto Karijodimedjo
Chairman
IPERINDO (Indonesia Shipbuilding & Offshore Industry Association)

**Members**
Adiwin Adiwibowo
Senior Vice President of Shipping
PERATAMINA SHIPPING

Supardi Somantri
President Director
PT. Admyana

Andy A. Mallian
Fleet Director
PT. Arpeni Pratama Ocean Line Tbk.

Kasim Arifin
President Director
PT. Bumi Perkasa Bahiera

Djoko Mulyanto
Fleet Director
PT. Djakarta Lloyd

Suyoto
President Director
PT. Dok & Perkapalan Kodja Bahari (PERSERO)

Hendrarto
General Manager
PT. Gesuri Lloyd

H. Soenarto
President Director
PT. Gurita Lintas Samudera

Teguh Arya Putra
President Director
PT. Humpuss Intermoda Transportasi Tbk.

Adwin H. Suryahadi Pradjo
President Director
PT. PAL Surabaya

Asmary Herry
Executive Director
Samudera Shipping Line Ltd.
### KOREA COMMITTEE

**Chairman**
- Jong-Kew Park

**Members**
- Sang-Tae Nam
- Soon-Ick Hong
- Kil-Seon Choi
- Hyun Yung-Won
- Jae-Byoung Song
- Soo-Hyun Kang
- Jin-Bang Lee
- Jing-Wan Kim
- Jeong-Hwa Lee
- Jong-Chul Lee

### MALAYSIAN COMMITTEE

**Chairman**
- Shamsul Azhar Abbas

**Vice Chairman**
- Nordin Mat Yusoff

**Members**
- Lim Leng-Pin
- Stein Eriksen
- Billy Tan Gim Hoe
- David Tan
- Halim Mohammad
- Dennis Liong
- Wan Yusoff Wan Hamat
- Muhamad Azmi Alwi
- A. Aziz Ishak
- Elias Kadir

### PHILIPPINE COMMITTEE

**Chairman**
- Arben E. Santos

**Members**
- Roy R. Alampay
- Vicente T. Suazo, Jr.
- Rogelio A. Torres
- Ko-Lin Toh
- Michael G. Bernardino
- Doris Magsaysay Ho
- Edgardo G. Lacson
- Kenji Kawano

### SINGAPORE COMMITTEE

**Chairman**
- David T. E. Lim

**Members**
- Tong Chong Heong
- Tay Lim Heng
- Aloysius Seow F S
- Teo Joo Kim
- Teo Cho Keng
- K. K. Tan

### TAIWAN COMMITTEE

**Chairman**
- Loh Yao-fon

**Members**
- Danny Wang
- Kuang-Nan Fan
- Donald K. L. Chao
- Jei-Yuan Chen
- Shang-Wen Liao
- Huang Chin-san
- Joseph J. M. Jhu
- Huang Mei-Hsiung

---

**KSS Line Ltd.**

**Daewoo Shipbuilding & Marine Engineering Co., Ltd.**

**Hanjin Heavy Industries & Construction Co., Ltd.**

**Hyundai Heavy Industries Co., Ltd.**

**Hyundai Merchant Marine Co., Ltd.**

**Hyundai Mipo Dockyard Co., Ltd.**

**Hyundai Samho Heavy Industries Co., Ltd.**

**Korea Line Corporation**

**Samsung Heavy Industries Co., Ltd.**

**SK Shipping Co., Ltd.**

**STX Pan Ocean Shipping Co., Ltd.**

**Aurora Tankers Sdn. Bhd.**

**Barber Ship Management Ltd.**

**Ecoship Sendirian. Berhad**

**Everise Maritime Sdn. Bhd.**

**Halim Mazzin Bhd.**

**Hub Shipping Sdn. Bhd.**

**Malaysia Marine & Heavy Engineering Sdn. Bhd.**

**Neptline Berhad**

**Petronas Maritime Service Sdn. Bhd.**

**Sutrajaya Shipping Sdn. Bhd.**

**Southwest Maritime Group of Companies**

**Baliwag Navigation, Inc.**

**Republic of the Philippines**

**Shipping Lines, Inc.**

**Keppel Philippines Marine, Inc.**

**Loadstar International Shipping, Inc.**

**Magsaysay Maritime Corporation**

**MIS Maritime Corporation**

**Tsuneishi Heavy Industries (Cebu), Inc.**

**Neptune Orient Lines Ltd.**

**Keppel FELS Limited**

**Maritime and Port Authority of Singapore**

**Ocean Tankers (Pte) Ltd.**

**Pacific Carriers Limited**

**Pacific International Lines (Pte) Ltd.**

**SembCorp Marine Limited**

**Evergreen Group**

**Cheng Lie Navigation Co., Ltd.**

**China Shipbuilding Corporation**

**China Steel Express Corporation**

**Chinese Petroleum Corp.**

**Eastern Media International Corporation**

**Evergreen International Corp.**

**First Steamship Group**

**Glory Navigation Co., Ltd.**
### TURKISH COMMITTEE

- **Chairman**: Yalcin Sabanci, Chairman, Yasa Holding S.A.
- **Members**:
  - Necdet Aksoy, Chairman, Akmar Holding S.A.
  - Ali Umur, President, Aktif Shipping
  - Kenan S. Sumra, Superintendent Engineer, (QMR) Aygaz Anonim Sirketi
  - Esref Cerrahoglu, Chairman, Cerrahgil A. S.
  - Akin Falay, Managing Director, Cornships Management and Agency Inc.
  - Serdar Akcali, Managing Director, Denak Ship Management & Agency
  - Orhan Karademir, General Manager, Ditas Tanker and Marine Operations
  - Sadan Kaptanoglu, Technical Manager, Cerrahgil A. S.
  - Suha Izmirligil, General Manager, Phulsawat Navy Co., Ltd.
  - Bedri Ince, Chairman, Ince Shipping and Trading Co. Inc.
  - Murat Edip Karahasan, Managing Director, Karahasan Group of Shipping Companies
  - Tamer Kiran, General Manager, KIRAN Group of Shipping Companies
  - Faruk Miras, Managing Director, Moliva Shipping Inc.
  - Huseyin Yardimci, Managing Director, Nemsat Nemrut Liman Isletmeleri A. S.
  - Serif Ozdaglar, Managing Director, Odin Shipmanagement
  - Murat Dortbudak, Executive Vice President, Odin Shipmanagement

### THAI COMMITTEE

- **Chairman**: Sutep Tranantasin, Executive Vice President, Regional Container Lines Public Co., Ltd.
- **Members**:
  - Warawan Nganthavee, Managing Director, Asian Marine Services Public Co., Ltd.
  - Bhumindr Harinsuit, Managing Director, Bhureemas Navee Co., Ltd.
  - Wirat Chanatis, Managing Director, Jutha Maritime Public Co., Ltd.
  - Chanet Phensiriwattana, Managing Director, Italthai Marine Ltd.
  - Suraphon Meesathien, Managing Director, Nathali Co., Ltd.
  - Amwaes Phulsawat, Director, Phulsawat Navy Co., Ltd.
  - Jaipal Mansukhani, General Manager, Phulsawat Navy Co., Ltd.
  - Wittawat Svasti-Xuto, Vice President, Precious Shipping Public Co., Ltd.
  - Voravit Visitsitichakorn, Managing Director, Sang Thai Shipping Co., Ltd.
  - Ungpun Amornvat, Managing Director, Thaioil Marine Co., Ltd.
  - Yodchaisuwan Phatsawat, General Manager, Thoresen & Co., (Bangkok) Ltd.

### CHINA TECHNICAL COMMITTEE

- **Chairman**: Lu Zhi-Ping, Honorary President, Shanghai Merchant Ship Design & Research Institute
- **Members**:
  - Zhang Yongjian, General Manager, China Ocean Shipping (Group) Company
  - Luan Fukai, Senior Manager, China Ocean Shipping (Group) Company
  - Chen Zhengjie, Director, China Ocean Shipping (Group) Company
  - Zhao Zhanjun, Managing Director, China Ship Design & Research Center Co., Ltd.
  - Cao Zhenfeng, Vice President, China Shipbuilding Trading Co., Ltd.
  - Li Yueqiang, Deputy Manager, China Shipping (Group) Company
  - Mao Shidong, Deputy General Manager, China Shipping Container Lines Co., Ltd.
  - Pu Li Fei, General Manager, China Shipping Development Co.
  - Wang Guorong, General Manager, China Shipping International Trading Co., Ltd.
  - Qiu Xin Yao, General Manager, COSCO Bulk Carrier Co., Ltd.
  - Harvey Chiu, Chairman, COSCO Ship Management Co., Ltd.
  - Michael M. K. Hsiao, Chairman, Mingtai Navigation Co., Ltd.
  - Lan Juin Der, Chairman, Shih Wei Navigation Co., Ltd.
  - Mathias K. Y. Chen, Chairman, Sincere Industrial Corporation
  - Fred C. P. Tsai, President, Sincere Navigation Corporation
  - I. Y. Chang, C.E.O., Managing Director, Taiwan Navigation Co., Ltd.
  - Nobuyoshi Morimoto, President, TMT Co., Ltd.
  - C. K. Ong, Chairman, U-Ming Marine Transport Corp.
  - C. C. Lin, Chairman, Unison Marine Corporation
  - Chao-Hon Chen, Chairman, Wan Hai Lines Ltd.
  - Lan Chun Sheng, Senior Vice President, Wisdom Marine Lines S.A.
  - David C. H. Liu, Chairman, Yang Ming Marine Transport Corp.
HONG KONG TECHNICAL COMMITTEE

Chairman
Peter Cheng
Managing Director
Peter Cheng Naval Architect & Marine Consultant Ltd.

Members
Marcel Liedts
Deputy General Manager
Anglo-Eastern Group
Y. Q. Huang
Group Managing Director
Associated Maritime Co. (HK) Limited
Vishal Khurana
Deputy General Manager
Chellaram Shipping (HK) Ltd.
Yan Zhi Chong
Director & Chief Executive
China Shipping (H. K. ) Marine Co., Ltd.
Wang Yonggu
Managing Director
COSCO (HK) Shipping Co., Ltd.
B. N. Prasad
Managing Director
Eurasia International (China) Limited Partnership
Kishore S. Rajvanshy
Managing Director
Fleet Management Limited
Lau Pong Sze
Managing Director
Gold Bridge Shipping Ltd.
Y. H. Shum
Managing Director
Goldbeam International Limited
K. H. Li
Director-General
IMC Pan Asia Alliance Pte Ltd.
Jagmeet S. Makkar
Director-General
KC Maritime Ltd.
S. S. Tse
Director-General
Lihai International Shipping Ltd.
Bibhash Chaudhuri
Deputy General Manager
New Asian Shipping Company, Limited
James S. C. Tai
General Manager
Orient Overseas Container Line Ltd.
C. Kocherla
General Manager
Pacific Basin Shipping (HK) Ltd.
Kenneth Koo
General Manager
Tai Chong Cheang Steamship Co. (HK) Ltd.
W. L. Hung
General Manager
Wah Kwong Ship Management (HK) Ltd.
### KOREA TECHNICAL COMMITTEE

**Chairman**  
Sung-Won Kang  
Sang Woo Lee  
Duck-Yull Lee  
Kyoo-Won Park  
Soo-Geun Lee  
Hyun-Sang Shim  
Jae-Sung Choi  
Hyung-Yong Lee  
H. K. Leem  

**Members**  
Professor, College of Engineering  
Executive Director  
Executive Director  
Executive Vice President  
Director  
Director  
Vice President  
Senior Vice President  

Pusan National University  
Dae Sun Shipbuilding & Engineering Co., Ltd.  
Daewoo Shipbuilding & Marine Engineering Co., Ltd.  
Hanjin Heavy Industries & Construction Co., Ltd.  
Hyundai Heavy Industries Co., Ltd.  
Hyundai Samho Heavy Industries Co., Ltd.  
Korea Maritime University  
Samsung Heavy Industries Co., Ltd. Geoje Shipyard  

### SINGAPORE TECHNICAL COMMITTEE

**Chairman**  
Goh Teik Poh  
Totsukazu Saito  
K. K. Kumar  
Lim Tau Kok  
Ng Sing Chan  
Kenneth Kee  
Joe Ng Guan Tee  
Tadic Tonci  
Naresh Chand  
Arun K. Ahluwalia  

**Members**  
Senior Vice President  
Director, General Manager  
Managing Director  
Fleet Manager  
General Manager  
Managing Director  
Managing Director  
General Manager  
Technical Director  

APL Co. Pte Ltd.  
"K" Line Ship Management (Singapore) Pte Ltd.  
Altus Shipping and Logistics Pte. Ltd.  
BW Shipping Managers Pte Ltd.  
COSCO (Singapore) Pte Ltd.  
Executive Ship Management Pte Ltd.  
IMC Pan Asia Alliance Pte. Ltd.  
Jurong Shipyard Pte Ltd.  
Keppel Shipyard Limited  
(A member of the Keppel Group)  
Maritime & Port Authority of Singapore  
MOL Tankship Management (Asia) Pte. Ltd.  
NYK Shippmangement Pte Ltd.  
Ocean Tankers (Pte) Ltd.  
PACC Ship Managers Pte Ltd.  
Pacific International Lines Pte Ltd.  
Pan-United Shipyard Pte Ltd.  
Petroships Pte Ltd.  
Stellar Shippmanagement Services Pte Ltd.  
Tanker Pacific Management (Singapore) Pte Ltd.  
Planning United Ocean Ship Management Pte Ltd.  
V. Ships Asia Pte. Ltd.  

### TAIWAN TECHNICAL COMMITTEE

**Chairman**  
Huang Shiun-kwo  
K. C. Lin  
Hsiung Lee  
J. Z. Fang  
C. S. Chen  
Michael L. Y. Pan  
Lee You-tou  
Johnny J. Ho  
Anthony Lin  
Guo I-Lung  
K. J. Leu  
Dave Ding-Hang Lee  
C. K. Lin  
Y. Y. Ho  
Tommy T. M. Li  
Young Perng-Terng  
N. K. Chu  
Chen Teng  
Robert Y. P. Kao  
J. R. Kuo  
Hawk Huang  

**Members**  
Senior Officer  
Senior Manager  
Vice President  
General Manager  
Executive Vice President  
Executive Vice President  
Executive Vice President  
Vice President  
Vice President  
Vice President  

Evergreen Marine Corp. (Taiwan) Ltd.  
Cheng Lie Navigation Co., Ltd.  
China Steel Express Corporation  
Chinese Petroleum Corporation  
Deryoung Maritime Co., S.A.  
Eastern Media International Corporation  
Evergreen Marine Corp. (Taiwan) Ltd.  
First Steamship Co., Ltd.  
formosa Plastics Marine Corporation  
Glory Navigation Co., Ltd.  
Hsin Chien Marine Co., Ltd.  
Kee Yeh Co., Ltd.  
Mingtai Navigation Co., Ltd.  
Shih Wei Navigation Co., Ltd.  
Sincere Industrial Corp.  
Ta Tong Marine Co., Ltd.  
Ta-Ho Maritime Corporation  
Taiwan Navigation Co., Ltd.  
U-Ming Marine Transport Corp.  
Unison Marine Corp.  
Wan Hai Lines Ltd.  

# Board of Directors

## Directors

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. Ogawa</td>
<td>Chairman and President</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>Y. Tsudo</td>
<td>Executive Vice President</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>N. Ueda</td>
<td>Executive Vice President</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>T. Kaji</td>
<td>Managing Director</td>
<td>Nippon Kaiji Kyokai</td>
</tr>
<tr>
<td>K. Yamanaka</td>
<td>Managing Director</td>
<td>Nippon Kaiji Kyokai</td>
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<tr>
<td>A. Ashida</td>
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<tr>
<td>M. Furukawa</td>
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<td>Hitachi Zosen Corporation</td>
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<tr>
<td>Dr. S. Hayama</td>
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<td>The University of Tokyo</td>
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<td>Tokio Marine &amp; Nichido Fire Insurance Co., Ltd.</td>
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<td>Dr. H. Itagaki</td>
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<td>Yokohama National University</td>
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<tr>
<td>H. Maekawa</td>
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<td>Kawasaki Kisen Kaisha</td>
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<td>K. Miyahara</td>
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<td>Nippon Yusen Kabushiki Kaisha</td>
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<td>T. Motoyama</td>
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<td>Mitsui Engineering &amp; Shipbuilding Co., Ltd.</td>
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<tr>
<td>Dr. Y. Nakagawa</td>
<td>Executive Vice President</td>
<td>Ishikawajima-Harima Heavy Industries Co., Ltd.</td>
</tr>
<tr>
<td>T. Nishioka</td>
<td>Chairman</td>
<td>The Shipbuilders’ Association of Japan</td>
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<tr>
<td>Dr. T. Nomoto</td>
<td>Professor Emeritus</td>
<td>The University of Tokyo</td>
</tr>
<tr>
<td>T. Ohashi</td>
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<td>Kawasaki Heavy Industries, Ltd.</td>
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<tr>
<td>Dr. H. Ohtsubo</td>
<td>Professor</td>
<td>Hosei University</td>
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<tr>
<td>K. Sugimoto</td>
<td>President</td>
<td>Ino Kaiun Kaisha, Ltd.</td>
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<td>K. Suzuki</td>
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<tr>
<td>K. Tsukuda</td>
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<td>Mitsubishi Heavy Industries, Ltd.</td>
</tr>
<tr>
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<td>The University of Tokyo</td>
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## Auditors

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Company</th>
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<tbody>
<tr>
<td>N. Ishii</td>
<td>Former Managing Executive Director</td>
<td>Nippon Yusen Kabushiki Kaisha</td>
</tr>
<tr>
<td>K. Kondo</td>
<td>Senior Executive Officer</td>
<td>Mitsui Sumitomo Insurance Co., Ltd.</td>
</tr>
<tr>
<td>H. Nagai</td>
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<tr>
<td>H. Bada</td>
<td>President</td>
<td>JFE Steel Corporation</td>
</tr>
<tr>
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<td>The University of Tokyo</td>
</tr>
<tr>
<td>T. Fujita</td>
<td>President</td>
<td>Kyoei Tanker Co., Ltd.</td>
</tr>
<tr>
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<td>President</td>
<td>Kyokuyo Co., Ltd.</td>
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<tr>
<td>K. Furukawa</td>
<td>President</td>
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</tr>
<tr>
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</tr>
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<td>President</td>
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<tr>
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<td>Imabari Shipbuilding Co., Ltd.</td>
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<td>IHI Marine United Inc.</td>
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<td>President</td>
<td>Taiheiyo Kaiun Co., Ltd.</td>
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<tr>
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<td>Professor</td>
<td>Yokohama National University</td>
</tr>
<tr>
<td>Y. Inubushi</td>
<td>President</td>
<td>Kobe Steel, Ltd.</td>
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<td>S. Inui</td>
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<td>N. Kakizoe</td>
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<td>Sumitomo Heavy Industries Marine &amp; Engineering Co., Ltd.</td>
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<td>President</td>
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<td>Professor</td>
<td>Yokohama National University</td>
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<td>T. Matsui</td>
<td>President</td>
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<td>K. Matsuzawa</td>
<td>President</td>
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<td>Daizo Corporation</td>
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<tr>
<td>A. Mimura</td>
<td>President</td>
<td>Nippon Steel Corporation</td>
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<td>H. Morishima</td>
<td>President</td>
<td>Sasebo Heavy Industries Co., Ltd.</td>
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<tr>
<td>M. Nagata</td>
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<td>The Japan Steel Works, Ltd.</td>
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<tr>
<td>T. Nagumo</td>
<td>Chairman</td>
<td>Sanoyas Hishino Meisho Corporation</td>
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<tr>
<td>T. Namura</td>
<td>President</td>
<td>Namura Shipbuilding Co., Ltd.</td>
</tr>
<tr>
<td>C. Nomura</td>
<td>President</td>
<td>Daichi Chuo Kisen Kaisha</td>
</tr>
<tr>
<td>M. Obata</td>
<td>President</td>
<td>Japan Railway Construction, Transport &amp; Technology Agency</td>
</tr>
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<td>T. Okubo</td>
<td>President</td>
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<td>M. Sato</td>
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<td>S. Sudo</td>
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<td>Nissay Dowa General Insurance Co., Ltd.</td>
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<td>E. Sugiyama</td>
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<td>Dr. Y. Sumi</td>
<td>Professor</td>
<td>Yokohama National University</td>
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<tr>
<td>S. Takeuchi</td>
<td>President</td>
<td>Universal Shipbuilding Corporation</td>
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<tr>
<td>T. Taniguchi</td>
<td>President and Director</td>
<td>Kawasaki Shipbuilding Corporation</td>
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<tr>
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<td>Professor Emeritus</td>
<td>Seikei University</td>
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<td>H. Tomono</td>
<td>President</td>
<td>Sumitomo Metal Industries, Ltd.</td>
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<tr>
<td>S. Tsuji</td>
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<td>Taiheiyo Kisen Kaisha, Ltd.</td>
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<tr>
<td>M. Tsuji</td>
<td>Chairman</td>
<td>Japanese Marine Equipment Association</td>
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<tr>
<td>K. Uchida</td>
<td>President</td>
<td>Meiji Shipping Co., Ltd.</td>
</tr>
<tr>
<td>G. Yanai</td>
<td>President</td>
<td>Fuji Electric Systems Co., Ltd.</td>
</tr>
<tr>
<td>T. Yoshizawa</td>
<td>President</td>
<td>Yuyo Steamship Co., Ltd.</td>
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# Classification Committee

**Chairman**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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</tr>
</thead>
<tbody>
<tr>
<td>K. Ogawa</td>
<td>Chairman and President</td>
<td>Nippon Kaiji Kyokai</td>
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**Vice Chairman**

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Y. Tsudo</td>
<td>Executive Vice President</td>
<td>Nippon Kaiji Kyokai</td>
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**Members**

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<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>A. Aoyagi</td>
<td>Naval Architect, General Manager</td>
<td>Mitsubishi Heavy Industries, Ltd.</td>
</tr>
<tr>
<td></td>
<td>Ship &amp; Ocean Engineering Dept.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shipbuilding &amp; Ocean Development Headquarters</td>
<td></td>
</tr>
<tr>
<td>O. Handa</td>
<td>Managing Director</td>
<td>The Japanese Shipowners' Association</td>
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<td>S. Kanai</td>
<td>General Manager Commercial Lines</td>
<td>Tokio Marine &amp; Nichido Fire Insurance Co., Ltd.</td>
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<td>Claims Department</td>
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<tr>
<td>K. Kiriake</td>
<td>General Manager Technical Affairs Department</td>
<td>The Shipbuilders' Association of Japan</td>
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<tr>
<td>Dr. H. Kitada</td>
<td>Managing Director</td>
<td>Nippon Kaiji Kyokai</td>
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<tr>
<td>T. Matsubara</td>
<td>Corporate Officer and</td>
<td>Nippon Yusen Kabushiki Kaisha</td>
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<td></td>
<td>General Manager Technical Group</td>
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<tr>
<td>S. Miyamoto</td>
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<td>Japan Airport Terminal Co., Ltd.</td>
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<td>O. Niho</td>
<td>General Manager Basic Design</td>
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<td>Marine Claim Department</td>
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### Technical Committee

**Chairman**  
Dr. H. Itagaki  
Professor Emeritus  
Yokohama National University

**Members**

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
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<tbody>
<tr>
<td>T. Abe</td>
<td>Officer Steel Casting &amp; Forging Division</td>
<td>Kobe Steel, Ltd.</td>
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<tr>
<td>Dr. S. Hayama</td>
<td>Professor Emeritus</td>
<td>The University of Tokyo</td>
</tr>
<tr>
<td>Dr. M. Horigome</td>
<td>President</td>
<td>Hiroshima National College of Maritime Technology</td>
</tr>
<tr>
<td>S. Iijima</td>
<td>Director, Senior Vice President, General Manager Shipbuilding &amp; Ocean Development Headquarters</td>
<td>Mitsubishi Heavy Industries, Ltd.</td>
</tr>
<tr>
<td>Dr. Y. Inoue</td>
<td>Professor</td>
<td>Yokohama National University</td>
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<tr>
<td>T. Ishiguro</td>
<td>Technical Superintendent</td>
<td>The Japan Steel Works, Ltd.</td>
</tr>
<tr>
<td>T. Iwasaki</td>
<td>Managing Director, General Manager of Ship &amp; Ocean Project Hq.</td>
<td>Mitsui Engineering &amp; Shipbuilding Co., Ltd.</td>
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<tr>
<td>Y. Kato</td>
<td>Managing Director, General Manager of Shipyard</td>
<td>Sasebo Heavy Industries Co., Ltd.</td>
</tr>
<tr>
<td>M. Kawasaki</td>
<td>Member of Marine Safety &amp; Environment Committee</td>
<td>The Japanese Shipowners’ Association</td>
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<tr>
<td>H. Kawasaki</td>
<td>Plate Division</td>
<td>Nippon Steel Corporation</td>
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<td>M. Kishimoto</td>
<td>Director Chief General Manager</td>
<td>Sumitomo Heavy Industries Marine &amp; Engineering Co., Ltd.</td>
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<tr>
<td>Dr. H. Kobayashi</td>
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### Quality Committee

**Chairman**  
Dr. H. Sakai  
Professor Emeritus  
The University of Tokyo

**Members**

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<td>Director</td>
<td>The Association of Consumer Affairs Professionals</td>
</tr>
<tr>
<td>E. Kudo</td>
<td>Supporting Member</td>
<td>Japan Environmental Disaster Information Center (NGO)</td>
</tr>
<tr>
<td>Y. Midorikawa</td>
<td>Managing Director</td>
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<td>Dr. N. Ooka</td>
<td>Chairman of ISO Committee</td>
<td>The Japanese Society for Non-Destructive Inspection</td>
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<td>T. Seino</td>
<td>General Manager</td>
<td>The Japanese Shipowners’ Association</td>
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<td>N. Takei</td>
<td>General Manager</td>
<td>The Marine &amp; Fire Insurance Association of Japan, Inc.</td>
</tr>
<tr>
<td>H. Yoshida</td>
<td>Managing Director</td>
<td>Japanese Marine Equipment Association</td>
</tr>
</tbody>
</table>
Regional Contacts

Head office

• Administration Center
  Nippon Kaiji Kyokai
  4-7 Kioi-cho, Chiyoda-ku
  Tokyo 102-8567, Japan
  Tel: +81-3-3230-1201
  Fax: +81-3-5226-2012
  E-mail: bnd@classnk.or.jp
  (Business Department)
  www.classnk.or.jp

Middle East and Black Sea

• Piraeus Office
  Nippon Kaiji Kyokai
  Possidonos Av. & 1-3 Pindou Str.
  183 44 Moschato, Piraeus, Greece
  Tel: +30-210-4832404
  Fax: +30-210-4832405
  E-mail: pr@classnk.or.jp

Europe and Africa

• London Office
  Nippon Kaiji Kyokai
  6th Floor, Finsbury Circus House
  12-15 Finsbury Circus
  London, EC2M 7EB
  United Kingdom
  Tel: +44-20-7628-5102
  Fax: +44-20-7628-3691
  E-mail: ln@classnk.or.jp

The Americas

• New York Office
  Nippon Kaiji Kyokai
  One Parker Plaza, 11th Floor
  400 Kelby Street, Fort Lee
  N.J. 07024, U.S.A.
  Tel: +1-201-944-8021
  Fax: +1-201-944-8183
  E-mail: ny@classnk.or.jp

Asia and Oceania

• Singapore Office*
  Nippon Kaiji Kyokai
  101 Cecil Street
  #21-01 Tong Eng Building
  Singapore, 069533
  Tel: +65-6222-3133
  Fax: +65-6225-5942
  E-mail: sp@classnk.or.jp
  *Other than Chinese Mainland

• Shanghai Office*
  Nippon Kaiji Kyokai
  Rm. 2208, International Trade Center
  2201 Yan-an West Road, Shanghai
  200336, China
  Tel: +86-21-62703089
  Fax: +86-21-62195699
  Email: sc@classnk.or.jp
  *Chinese Mainland

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Tel: +81-3-5226-2040
Fax: +81-3-5226-2039
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