

ClassNK Magazine

2000
52nd
Edition



ClassNK

Striving towards a safer maritime world

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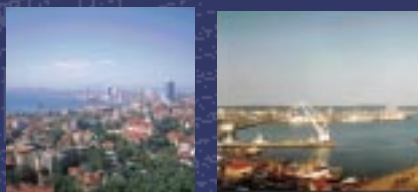
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Chairman's Message



Tadashi Mano
Chairman and President

Welcome to the year 2000, 52nd edition of the *ClassNK Magazine*. It is usually one of my small pleasures to be among the first to read the stories in each year's magazine, and this year was no different.

As usual the magazine is a very readable balance of the "need to know" with the "nice to know." With less than two years to go until implementation of Phase II of the ISM Code, I recommend the article about research NK has recently undertaken, into the common non-conformities identified in company/ship audits and PSC during the implementation of Phase I of the Code. I hope it will be an important reminder to all, of the importance of this area. There are also related articles on the Society's ISO 14001 Environmental Management System audit activities and an innovative new program of involvement in auditing a new customized ship navigation management safety program, which has been independently developed by an NK client. All of these articles reflect the growing importance of these types of activities in general and in particular to the Society. In the wake of recent tragedies such as the *Erika* and *Treasure*, there can be no doubt that these types of self regulation and self policing activities will increase for NK.

On a more technical note readers are introduced to the benefits of the Primeship suite of software products for ship design, and there is an interesting story on the world first re-liquefaction plant being installed on a new LNG carrier being built to NK class. Our involvement with this project is particularly interesting because I believe it is indicative of a trend in the type of work that will be increasing in Japanese shipbuilding, i.e. a trend towards fewer, but bigger

more sophisticated ships being built. I believe that NK's expertise in such areas will be the backbone of our future growth.

The same LNG carrier features in this year's Focus on Japan story, about one of my favorite places in Japan, Nagasaki. Nagasaki was, I feel, a most appropriate choice in this, the 400th year of Japan-Holland relations, and also as the birthplace of modern shipbuilding in Japan, not to mention as home to one of NK's oldest and busiest domestic offices. There is also an interesting and informative update on the MEGA-FLOAT project that has such great potential to alleviate some of Japan's land shortage problems.

The Society continues to grow, now with more than 6,450 ships of more than 109 million gt, and with the growth comes the necessary increase in the number of new offices. Alan Perry, formerly of Santa Claus fame in the London Office, but now GM of the new Durban office in South Africa, writes of the challenges and delights of working in this rapidly changing part of the world. Our new office in Qingdao, NK's fifth exclusive office in China, is also featured, further increasing our commitment to this growing and important market.

Lastly, but certainly not least, the Society is once again this year honored to hold the Chair of IACS, which will be very ably filled by our Executive Vice President Mr. Masataka Hidaka. We offer him our warmest congratulations and every support.

I hope you enjoy this edition of *ClassNK Magazine* as much as I have.

A handwritten signature in dark ink, appearing to read "Tadashi Mano". The signature is written in a cursive style with some flourishes.

Tadashi Mano
Chairman and President.

PRIMESHIP-HULL

“PrimeShip” is the name of ClassNK’s integrated group of systems and services for the entire lifetime care of a ship.

Some are designed to contribute technical support and care for ships in service while others are intended to be used in the design stages through the

classification survey undertaken during new construction.

The components of the PrimeShip introduced in this issue of the *ClassNK Magazine* are those developed for the purpose of providing help to people designing ship structures.

PrimeShip-HULL is the name of this group of software applications to be used in the design stages. Traditionally, where class rules are concerned, shipbuilding design, has been done in accordance with specific provisions or scantling formulae applicable in the rules and/or their supplementary provisions. Following the development of computer technology to the high levels we see nowadays, it has become more practically feasible for designers to make use of actual structural analysis assessment during the design stages. ClassNK provides shipbuilding designers with very efficient software applications to help them with both rule/formulae based or structural

analysis oriented design. PrimeShip-HULL consists of PrimeShip-BOSUN, IPCA, NASTASS and ASSAS.

PrimeShip-BOSUN (which stands for Basic-design Omnibus Program System Using NK-rules) is for use in rules or formula based structural designing. It is interactive PC-based software which supports structural design of most kinds of cargo carriers, including Bulk carriers, Ore carriers, Container carriers, Double hull tankers and so called General cargo carriers. Running under the MS Windows operating systems, the software package incorporates interactive easy data input and scantling calculation. The package will help designers in both the basic and detailed design process, enabling them to optimize structural scantlings. At the same time, use of the BOSUN minimizes the time and amount of paper work in the approval process as well as the potential for error or oversight much more likely in the old fashioned approval procedures. Also available is CS-BOSUN, the little brother to BOSUN in the PrimeShip line-up specifically for rule-based design evaluation of ships less than 90 meters in length.

Not only for the designers but also for the end users of ships, PrimeShip-IPCA is another program package for determining performance capability. Working

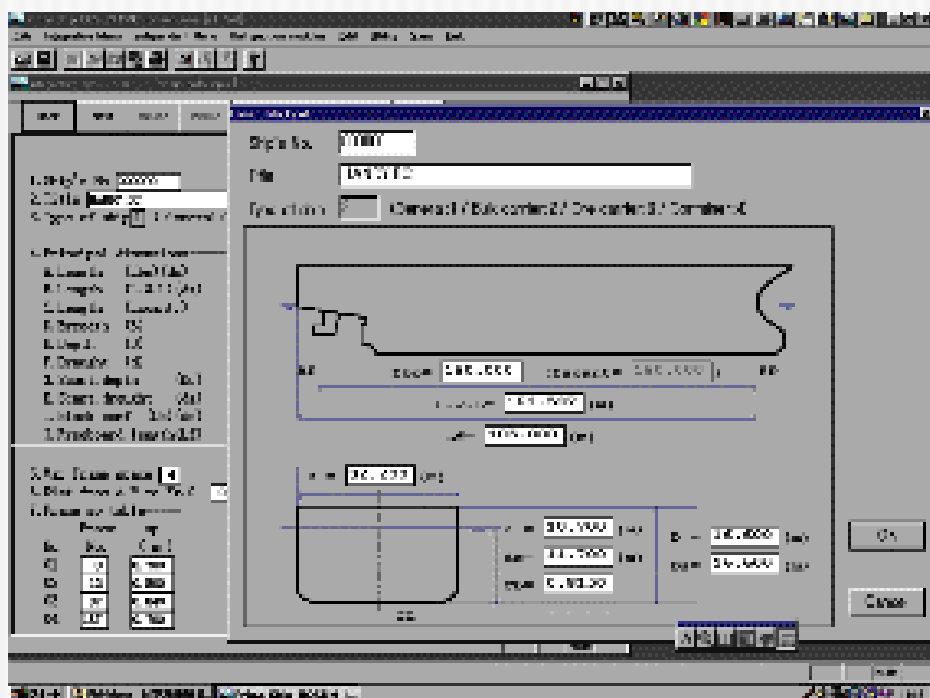
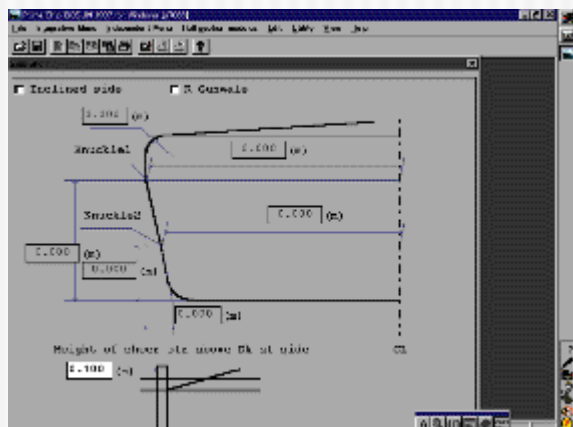
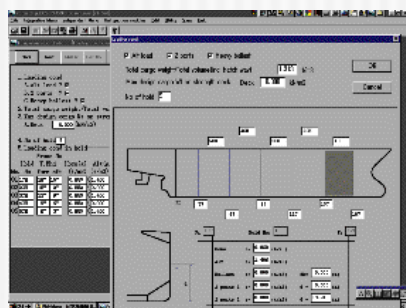
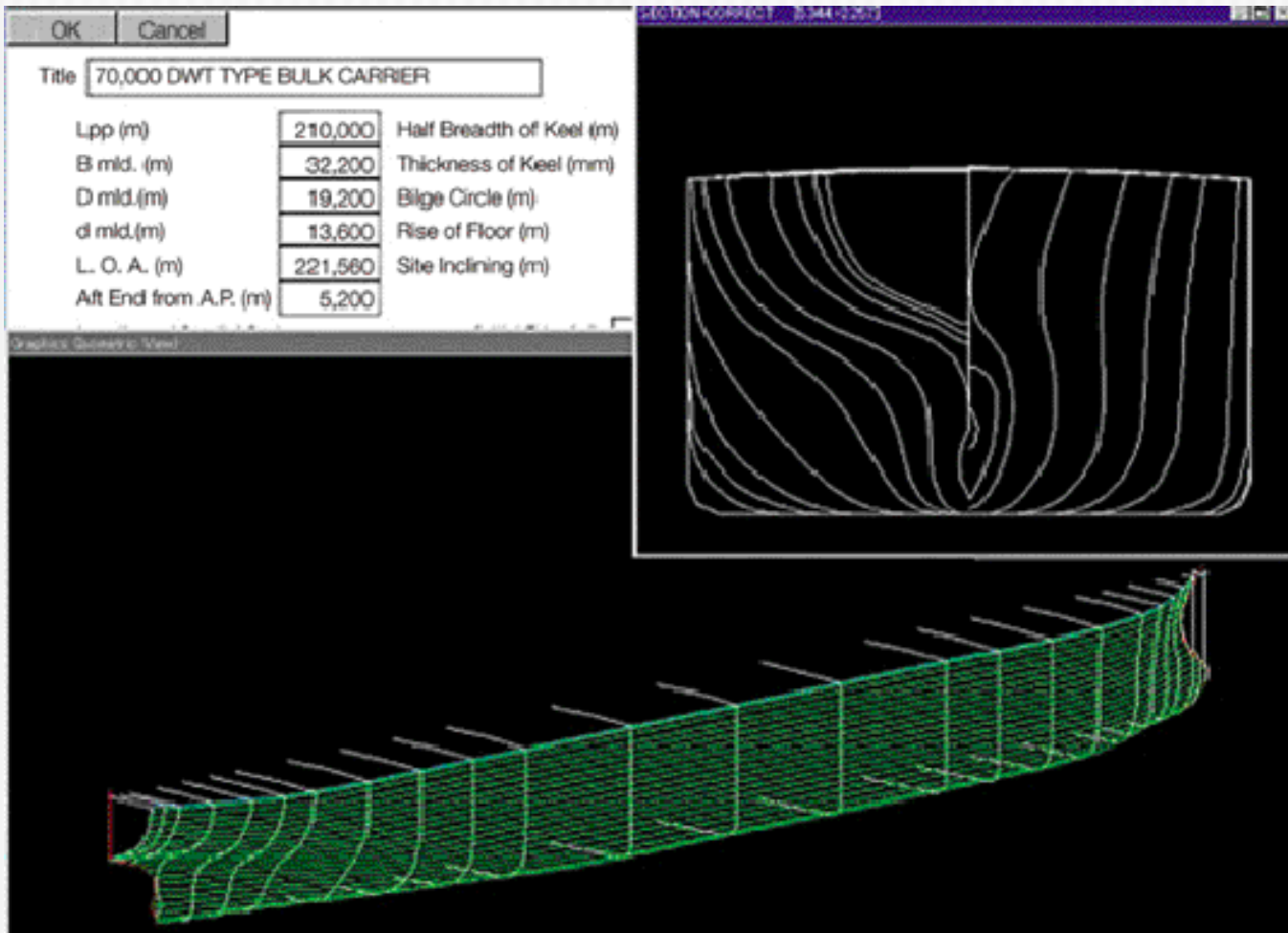
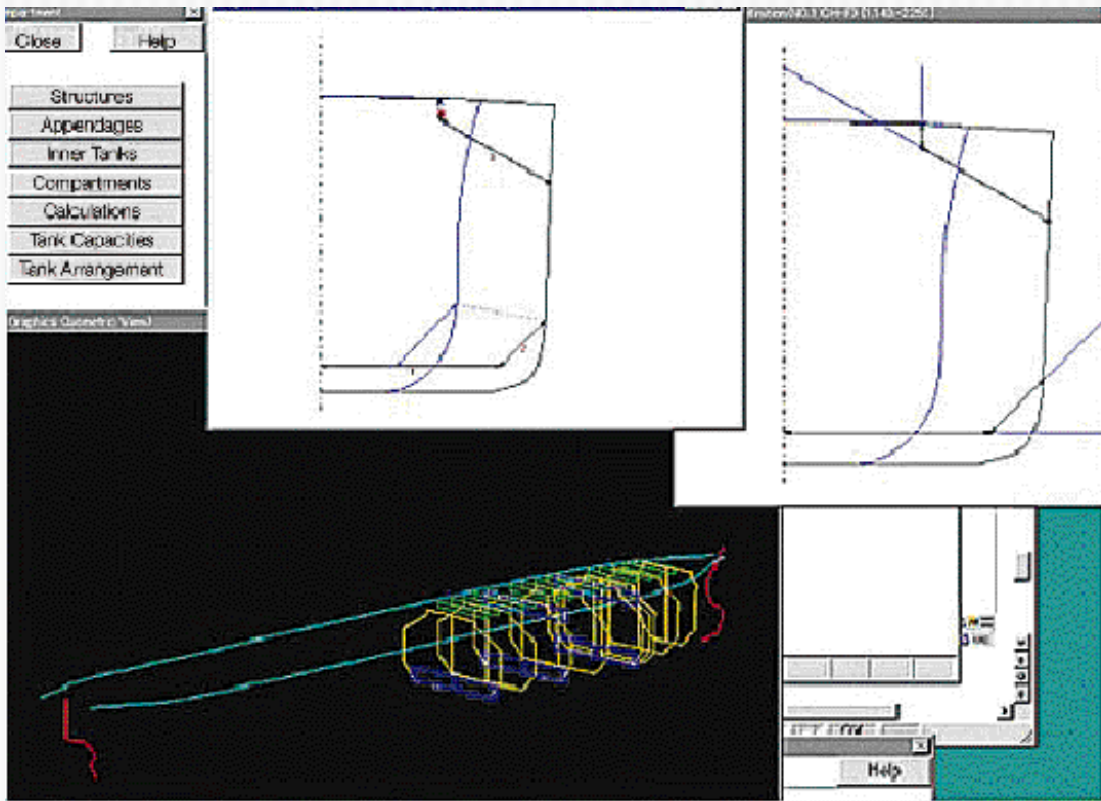
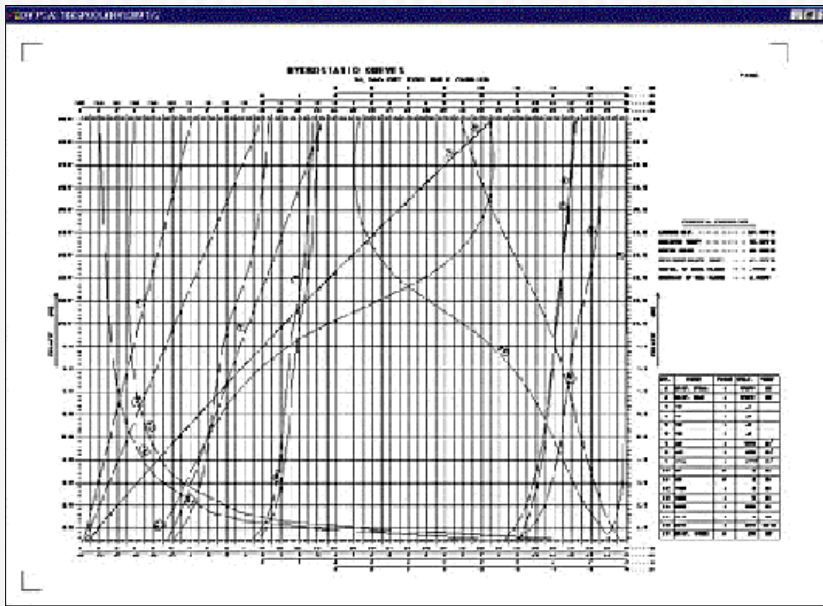


Fig.1 Data Input Screens of PrimeShip-BOSUN (Basic, Outline and Structural). Basic data entry is quick and easy with the screen format shown here. The data layers are hierarchical so the data in the upper two layers (basic and outline) are automatically shared from the lower one.

Fig.2 Hull Form and Compartment Display of IPCA

The data, input for each ship, are kept in a dedicated database and handled in a uniform manner so that a user does not have to re-enter the same data every time a job is executed.





interactively on MS Windows operation systems, it can handle ship's trim, stability, longitudinal bending moment and shearing force together with loading/unloading sequence, freeboard and grain heeling moment, etc. The software also covers bulk carrier safety requirements. The ship-board-use oriented application of IPCA is called "Onboard-IPCA calculation engine," while the application intended for designers is called "Design-IPCA." In combination with the service package PrimeShip-ETAS (Emergency Technical Assistance Service), the software will be an extremely reliable tool in any emergency for which a ship-owner wants to be prepared.

The aforementioned two programs are for working on specific requirements and scantling formulae in the Rules and Guidance. For designers involved in so called "design by analysis," two different programs have been developed. PrimeShip-NASTASS is a structural analysis tool that is interactive and user-friendly. It offers custom-built modeling systems for frequently analyzed ship types such as Tankers, Bulk carriers and Container carriers, besides it's general-purpose modeling system.

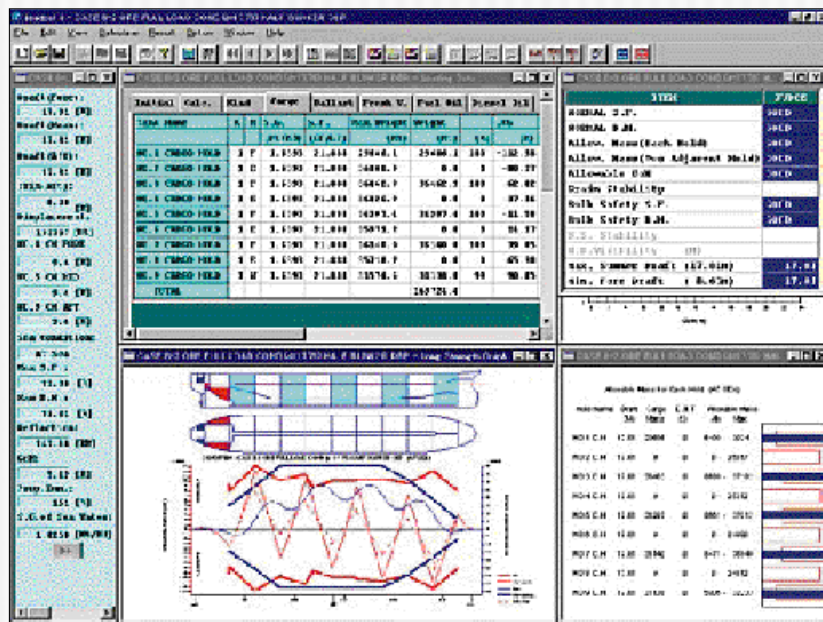
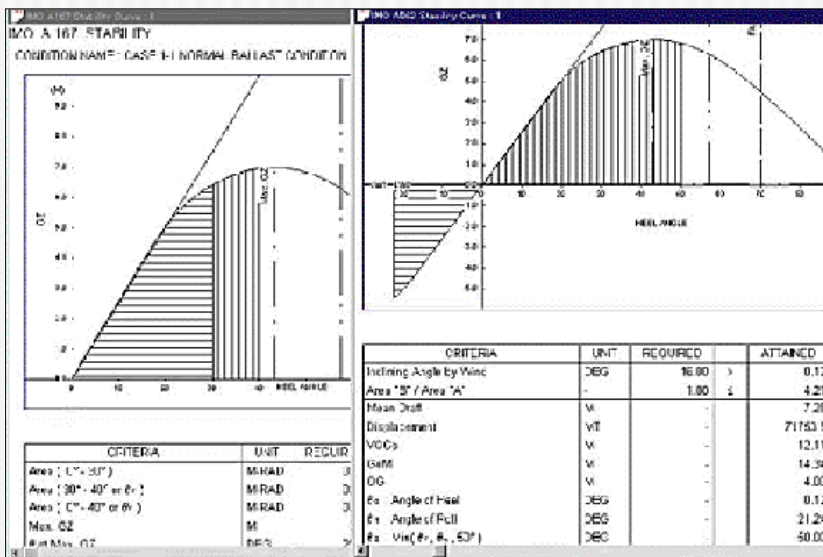


Fig.3 Hydrostatic Curves, Intact Stability Results and Loading Planning Results. (Actual Screen Images)

Hydrostatic curves and intact stability results are two basic elements in the design stage functions. A third, the loading planning result, is an example from the onboard application functions. It is also possible for a user to execute damage stability and longitudinal strength evaluations. Bulk carrier safety requirements are also included within the scope of the software's onboard applications.

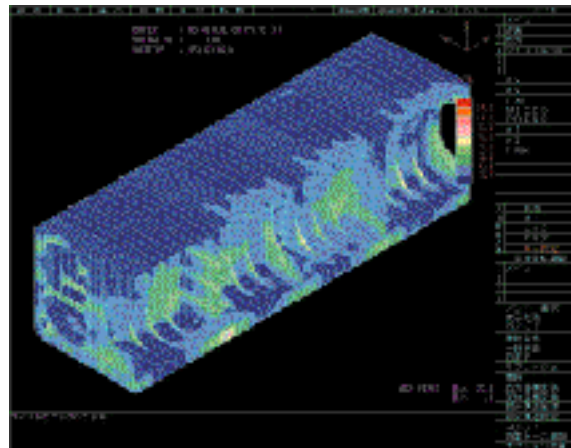
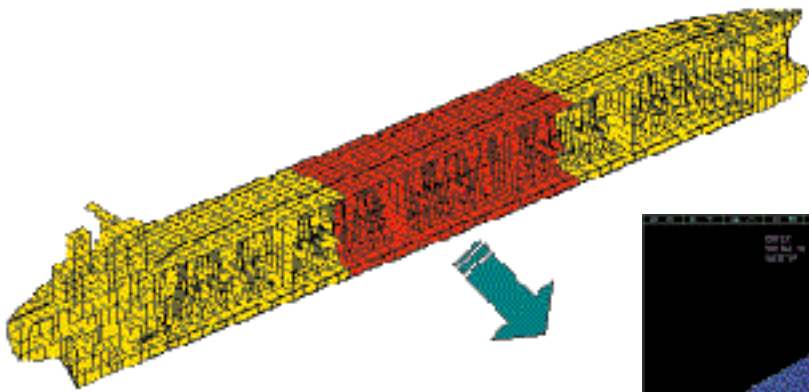
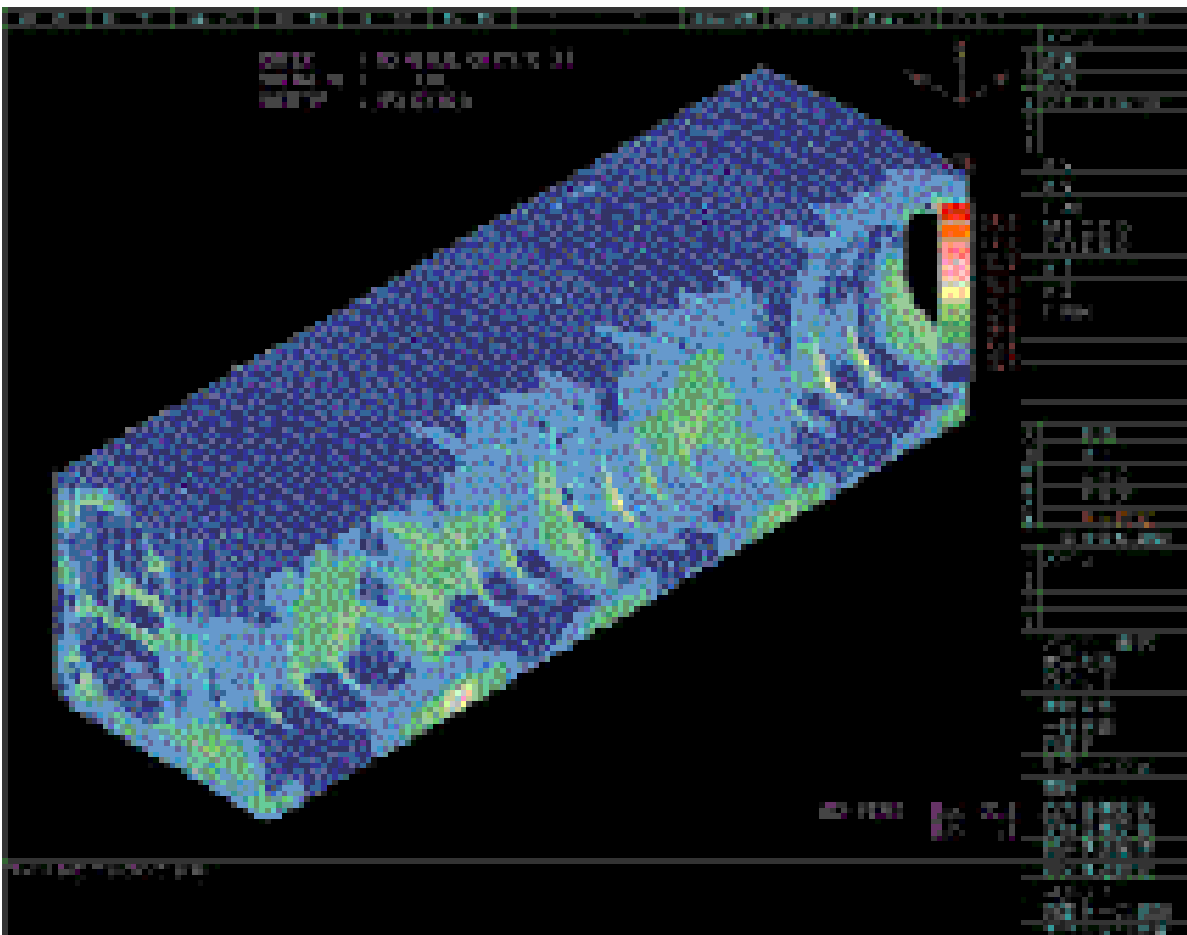


Fig.4 NASTASS: Calculation Result.
In NASTASS, load calculation is based on rule requirements. This model is from a recent double hull VLCC, and highly stressed areas can be readily recognized on the display by color coding.



NASTASS interfaces with an even more advanced PrimeShip design-by-analysis tool, called PrimeShip-ASSAS. This “advanced ship structural analysis and validation system,” based on the “Designed by Application of Total Analysis” (DATA) concept, is a software package intended for advanced total analysis. The software will handle design evaluation in modeling the structure, assess in-wave-motion

and loads using long term wave data, evaluate the structural design from a global model, down to detailed structure analysis for hotspot stress. Through the complete process, one can evaluate an entire structure including yield strength, buckling and fatigue strength.

With the availability of these software applications, ClassNK aims to ensure that ships built for its register,

will all be designed to the most up-to-date standards. Thus, in combination with the other software and service packages, as well as routine survey activities, the Society’s strategy is to make sure that all its ships are kept up to the standard desired and appreciated.

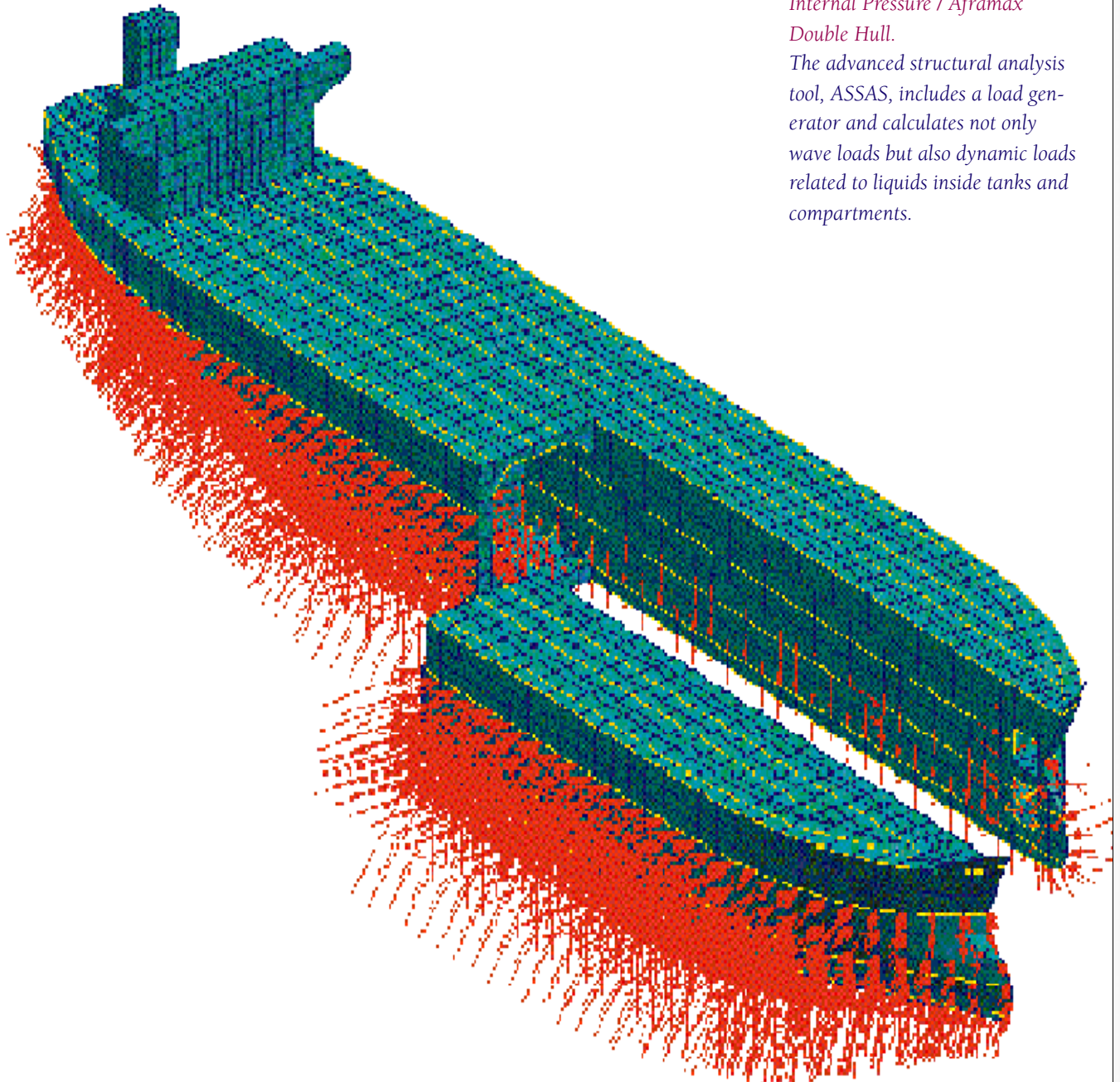


Fig.5 ASSAS: Wave Load and Internal Pressure / Aframax Double Hull.

The advanced structural analysis tool, ASSAS, includes a load generator and calculates not only wave loads but also dynamic loads related to liquids inside tanks and compartments.

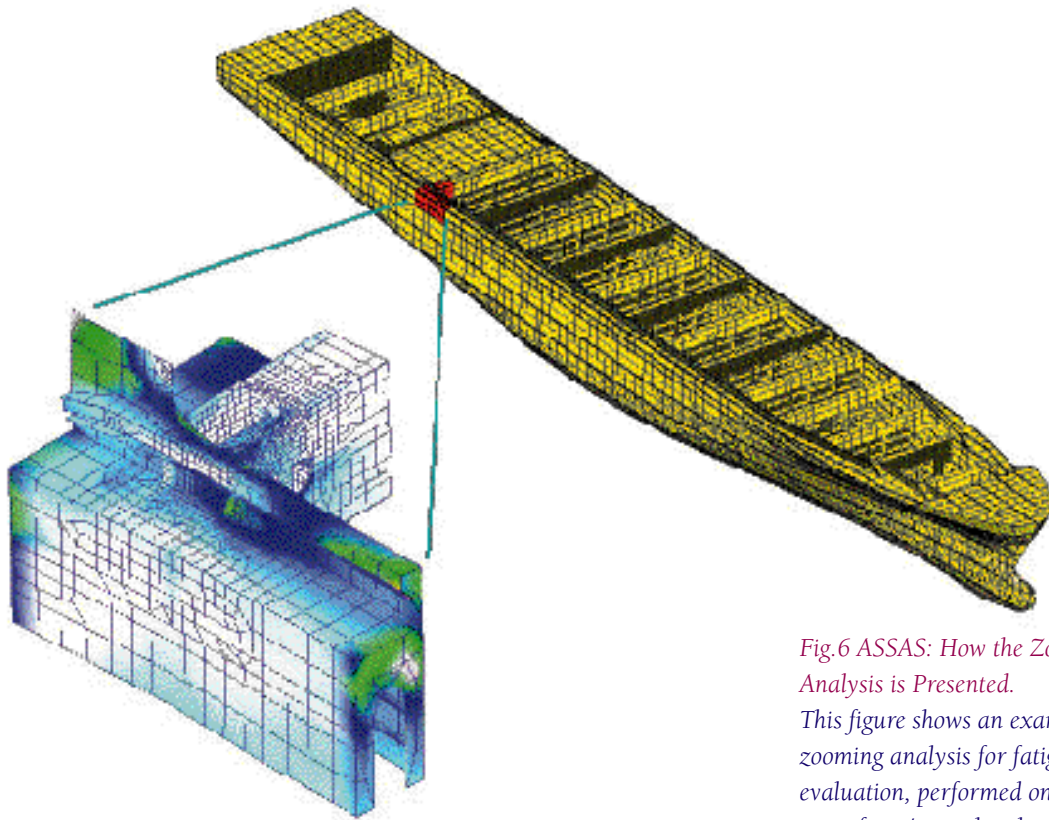
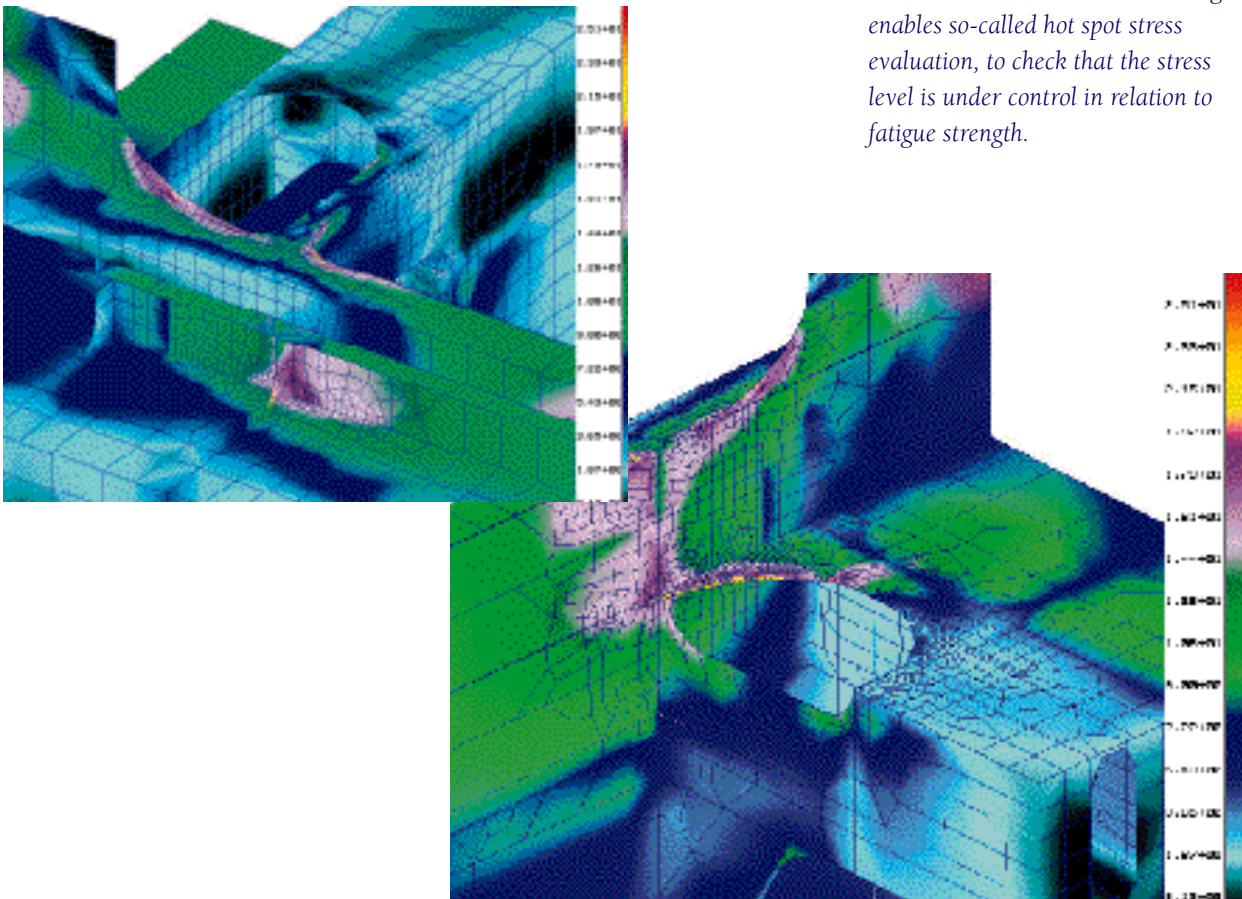


Fig.6 ASSAS: How the Zooming Analysis is Presented.

This figure shows an example of zooming analysis for fatigue strength evaluation, performed on the engine room front/cargo hatch end corner of a recent container carrier. Zooming enables so-called hot spot stress evaluation, to check that the stress level is under control in relation to fatigue strength.



Nagasaki, Japan's "Window to the World"

Japan being a country of such fascinating diversity, geographically, climatically, culturally, in fact in almost every way, the task of choosing each year's target for this magazine's "Focus on Japan" is never easy. This year, the task fell largely to me, and I chose Nagasaki, historically Japan's "window to the world." Like me, my Marketing and Publicizing Department colleague Matsui san, despite growing up in Western Japan and travelling most of its nether reaches, had never been there, so enthusiastically endorsed my choice.

Publishing deadlines being as they are, we were left little choice but to venture forth plum in the middle of Nagasaki's rainy season. Thus it was with some trepidation that I noticed the weather advice on the departures board at Tokyo's Haneda Airport; Nagasaki, 28 degrees and rain!! Pleasingly, it seems that Japanese weather forecasters are no more accurate than those I'm used to in Australia, and we landed one hour and forty minutes later into a slightly overcast 25 degrees.

A postcard picturesque port town of around 450,000, Nagasaki is located at the western extremity of Kyushu, the westernmost and southernmost of Japan's four main islands. Just a tiny fishing village until being opened to foreign trade in 1571, the town quickly developed into a center of international trade and became Japan's window to the world. At first it was the Portuguese who introduced a wide range of goods and technology that

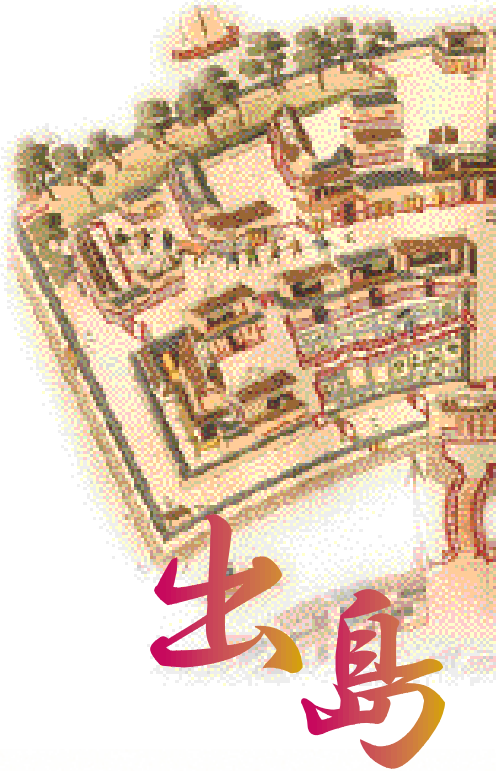
were totally new to the Japanese. However, the era of Portuguese trade and the associated Christian influence was short lived, after a series of political and religious struggles resulted in the expulsion of the Portuguese in 1639. Only a small group of Dutch and Chinese, who promised to stay clear of Christianity, were allowed to remain in Nagasaki, and were confined largely to a small artificial island called "Dejima". Nevertheless during the 200 or so years of National isolation imposed by the Tokugawa Shogunate from the early 1640s to the late 1850s, Nagasaki flourished as Japan's only point of access to the outside world.

After Japan reopened its doors to the world, Nagasaki lost its monopoly on trade but still grew with the reinvigorated activities of ambitious merchants and industrialists from Britain, France, America and many other nations. Nagasaki has remained perhaps Japan's most cosmopolitan city, the influence of the Chinese and Western inhabitants still evident in the architecture, the cuisine and the culture, not to mention industry.

Nagasaki is often referred to as the birthplace of modern shipbuilding in Japan. In 1868, the first ship dock (Kosuge Ship Repair Dock) was built in Nagasaki by the British merchant Thomas Glover and the Satsuma family. Later, an iron foundry across the



Glover House, Thomas Glover's residence



harbor was converted into a shipyard, and when the Mitsubishi Company took it over in 1887 the business grew rapidly.

NK first opened its Nagasaki office in 1919 and has maintained a strong presence ever since. Today, NK occupies a functional three-story building from which staff need not fear being distracted by views of the harbor. The current GM, Mitsuru Umeno's youthful looks and enthusi-





Dejima Island

asm belie his 33 years experience with NK, which has included 3 years in Jeddah and 5 years in Los Angeles. Umeno san leads one of NK's busier domestic offices. With 7 ships currently being built to NK class across three yards, and sometimes more, not to mention regular survey work, the 7 hull and 5 machinery surveyors are constantly busy. Umeno san claims that even he must very occasionally jump to the demands of his principle



(From left) NK Nagasaki GM, Mr. M. Umeno, Machinery Principal Surveyor, Mr. M. Tsukida, Hull Principal Surveyor, Mr. T. Ogami

surveyors if they need an extra experienced hand, but from the gleam in his eye one cannot help but sense that he not so secretly relishes any chance to pull on his steel capped boots and unholster his trusty surveyors hammer at a moments notice.

Umeno san had arranged for us to visit two ships being built to NK class in separate yards. The first of these was a 110,000 gt LNG carrier (LNG Tanker S. No. 2157 for Osaka Gas, NYK, MOL and K LINE) under construction at the Mitsubishi Heavy Industries, Ltd. Nagasaki Shipyard, and the second an 18,000 gt, 1,200 teu Container carrier *UNI POPULAR* under construction at the Evergreen Shipyard for Uniglory Marine Corporation.

The Mitsubishi Heavy Industries Nagasaki Shipyard is located almost

directly opposite the NK office, on the other side of the harbor but only about 15 minutes drive away. The main office building sits impressively atop a hill overlooking the yards, so after a short meeting and safety briefing, as we descended by elevator through many sublevels, emerging into a

long tunnel leading to the dock, I couldn't help feel like I was in a scene from a James Bond movie. The feeling quickly faded as we searched for our allocated bicycles among the hundreds lined up against the wall. Looking across from the other side of the harbor I had failed to grasp the true dimensions of the yard or the ships... I quickly appreciated the hard-found bicycle. For the majority of readers, who I expect have spent half their lives stomping around shipyards and ships, it may have proved a fairly blase experience, but for a true, generally desk bound city slicker like myself, emerging from the tunnel onto the expanse of docks and coming face to face with 110,000 gt of LNG carrier was quite an experience.



Mitsubishi Heavy Industries, Ltd., Nagasaki Shipyard



(from left) NK surveyor, Mr. S. Ohya, Owner's Supervisor, Mr. T. Morinaga, MHI Technical Staff, Mr. K. Imase



LNG Tank as seen from below

Our primary host, the onsite NK surveyor Ohya san introduced us to the shipyard inspector Mr. Imase and the ship owners representative, the determinedly earnest Mr. Morinaga. We, that is to say they, were to survey two items, a No.5 Tank Transition Part, and the fire protection materials in the Engine Room 2nd DK (Lining & Ceiling) S-side Fr. 40-59. Watching the three at work, poking, probing, tapping, peeling and discussing, I began to build a picture of the nature of the complex interrelations that make up this process called ship surveying. A cooperative approach, based on mutual respect between these three vastly experienced surveyors, meant any divergence of views could be rationally and quickly resolved, despite the three perhaps occasionally having different priorities. Of course, my main concern was not with the quality of the welds or lining. I just wanted to be sure to keep up, so I didn't get lost or forgotten in the bowels of the ship, wandering forever in the spaces under and around the five giant spherical tanks, each more than 30m in diameter and seemingly floating above me, looking like Darth Vader's Death Star courtesy of their insulation blocks.

Re-emerging into the daylight, we headed for the bridge to take photos. If the ship had seemed big and impressive from dockside, then looking



Engine Room



Re-checking of some welds

down and along its full structure, it was huge and complex beyond description. It was difficult to believe that it could be so near completion after keel laying just 14 months earlier.

A short bicycle ride to another pre-fabrication area to re-check some welds previously deigned not quite perfect enough, and our morning's work was complete. Perhaps it was the environment, the overalls, the safety boots and harness, I don't know, but I felt strangely productive despite having contributed nothing more than a long string of naive questions to the morning's activities. A quick lunch in the staff dining room, and we headed back to the NK office.

Since we had not had time before our first yard visit, Principal Hull Surveyor, Mr. Ohgami took some time to explain the surveyor support system software, whereby original information entered in head office, for example from original drawings, by the Hull Department, can be incorporated into the routine survey plans. This has proved a great time saver now that all the domestic offices and head office are linked by a WAN (Wide Area Network) and eliminates the potential for errors inherent where data re-entry is required.

With the NK surveyors already on site, we took a taxi out to Chouei Zousen, probably better known to readers as Evergreen Shipyard Corporation. A genuinely warm and friendly welcome by Deputy Manager of the production department's inspection section, Mr. Tadayoshi Mine awaited us as did a very welcome cool drink. As it has been more than 10 years since I had worked in the tropical environment of Papua New Guinea, the heat and humidity of Nagasaki's wet season were beginning to take their toll, and the novelty of changing

into overalls and safety kit was wearing off.

So it was that, with the previously predicted rain finally arriving as intermittent showers, we headed down to the yard. And what a picture it was.

Although originally established in 1943 as the Fukahori Dockyard

of Kawaminami Industry Co. Ltd., the yard became the Evergreen Shipyard in 1997 and has been handsomely refurbished. The yard and fabrication areas are very well organized and it is obvious that the whole operation runs like clockwork. The two ships currently under construction are both being built to NK Class and we were to observe a final propeller fitting survey on the 18,000 gt, 1,200 teu Container ship *UNI POPULAR* being built, naturally enough, for Uniglory Marine Corporation.

As we descended into the drydock, I was fascinated to find that for all the myriad of hi-tech equipment being used on site, that



Slipway Launch Setup

this 18,000 gt of Container ship was seemingly supported at an odd angle on timber chocks and poles. Our ever amiable host, Mine san explained that we were actually quite lucky to see it because in fact few ships are built for traditional slipway launching these days, and this yard was one of only a few left that could accommodate such a launch.

Mine san, then introduced us to the owners supervisor, Uni Glory Line Chief Engineer, Mr. Hin-hsiung Lin. I thought it curious that the owner would have someone supervising what is effectively its "own" yard. But again, as at Mitsubishi Shipyard, watching the interaction between the



Evergreen Shipyard Corporation



(From left) Evergreen Shipyard Technical Staff, Mr. T. Mine, Uniglory Line's Supervisor, Mr. H. Lin, NK Surveyor, Mr. N. Honzawa

NK surveyor, Mr. Honzawa, the yard staff and Mr. Lin, it became clear that this cooperative interaction and analysis of each issue is the key to the highest standards of surveying being met and maintained during ship construction.

Although I had seen, and admired the form, of a real, albeit single, propeller blade at the Sea Japan 2000 trade show earlier this year, I couldn't help but be impressed by the size and gleam of this full new specimen. Having little, well OK, no real interest in the minute detail of discussions on shaft micro alignment, seal integrity and the

like, I smooth-talked Mine san into elevating me via cherry picker to take some better pictures. With good pictures in mind again, Matsui san and I asked our ever obliging host to take us out onto the water in the yard's resident launch, to try for a good shot of the two ships being built side by side. Alas by that stage the weather was well and truly conspiring against us, and we headed ashore wet but wiser for the afternoon's efforts.

We returned to the NK Nagasaki office weary but satisfied with our efforts and keen to avail ourselves of their generous offerings of liquid refreshments. We subsequently retired to a small local izakaya for further liquid refreshments, local delicacies (I use the term generously!!) and a well lubricated debate on the relative merits of various finer points of the Japanese and English languages and with our hosts urging us to return later in the year for Nagasaki's most famous festival called "Kunchi" held every Autumn.

Starting as a celebration of autumn harvests in the late 16th century

"Kunchi" became a shrine festival when Suwa Shrine was founded in 1634. Originally, it was also a time to hunt for hidden Christians after the ban on the religion, and this is symbolized today by the custom of "niwamise" (garden showing) when the presenting neighbourhoods open up their homes to public scrutiny. One of the most famous events of the festival is the "Dragon Dance" which was originally performed on New Year's Day by Chinese residents in Nagasaki. From October 7 to 9, the highlights of the festival, vividly reflecting the diverse history of Nagasaki, occupy three main festival sites and spill into the streets creating an atmosphere of celebration throughout the city. I only hope I *can* make it back to this most interesting of cities.



Kunchi Festival



Final propeller fitting survey

Authors note.

After my first one and a half days in Nagasaki I decided it was such a classically picturesque port city, with such a fascinating history that it deserved to be written about on these merits alone. Not that it should be just known as only the second city in history to be the target of an atomic bomb. However a visit to the Nagasaki Peace Park and Atomic Bomb Museum before returning to Tokyo convinced me that no opportunity should pass without reminding anyone possible of the horror of this event. For the record, at 11:02 AM on August 9, 1945, a single atomic bomb totally and utterly devastated and destroyed about one-third of the city of Nagasaki and killed or injured about 150,000 men, women and children. Lest we forget. The city has recovered miraculously since then and these days shows few scars of this dark chapter in its history. Nagasaki has since devoted itself to the cause of world peace and the abolition of nuclear weapons.

Audit and Evaluation of Ship Safety-Management Systems Using the ISM Code

Introduction.

About two years have passed since the ISM Code (an international safety management code for shipping) came into force on July 1, 1998.

During this two years, ClassNK has obtained authorization to carry out audits from 47 countries, has carried out audits of 427 companies in 24 countries, has issued DOCs to 396 companies, has carried out audits of 3,202 merchant ships, registered in 30 countries, and has also issued SMCs to 2,618 ships,

Generally positive opinions on its effectiveness, include, for example, the Swedish Club (a P&I Club) which reports that the amount of compensation for marine casualties and damage has decreased by about 30% over the past 4 years, as a result of preparations for and implementation of the Code.

To establish whether the safety-management system (SMS) of the ISM Code has taken root as part of an accepted safety culture, ClassNK (Ship Management Assessing Division) tried evaluating its impact by analyzing items of non-conformity in audits of ships and companies, as well as items that could be obtained from other sources over the past year.

It is hoped that this report will improve SMSs and contribute as a reference for everyone developing SMSs.

ISM Code Phase II will come into force from July 1, 2002. In order to

introduce a Management System which conforms to the Code, an early introduction schedule and a careful preparation are indispensable. Readers who intend to apply the ISM Code in the near future are encouraged to establish a system which works effectively by paying attention to the following commentary.

2. The results of and items identified by the audits of companies and ships conducted by the Society.

The results of the audits of companies by the Society for the year beginning January 1999 through December 1999 were as follows.

- The number of Initial Audits was 34.
- The number of Annual Audits was 344.
- The number of Renewal Audits was 4.
- The number of other kinds of audit was 269.

Among these cases, 361 non-conformities and 300 observations were identified at Initial Audit, Renewal and Annual Audits. In the other kinds of Audit, there were 4 non-conformities out of 269 cases.

2-1. The ranking of the non-conformities (NC) by cause.

The following table shows items of non-conformity identified by the audits, in order of frequency, grouped by their requirement according to sections of the ISM code. (See Table 1)

In the company audits, the largest number of Items related to section 12 of the code (Company Verification, Review and Evaluation) while the second largest number related to section 8 of the Code (Emergency Preparedness).

In the ship audits, the number of items relating to section 10 of the Code (Maintenance of the Ship and Equipment) was the greatest while the second largest related to section 6 (Means and Personnel).

2-2. Discussion of the items identified.

An explanation of frequently found items of non-conformity grouped according to sections of the ISM Code follows.

(1) Regarding the regulations and the Code.

Many non-compliances were identified, including, non-compliance with flag state laws, deficiencies in the basic training on survival techniques which is supposed to be given to new crew prior to their first departure, and occupational familiarization training as well as the Watchkeeping standards, etc., that are required by the STCW Convention.

The key reason for non compliance is a failure to adequately document the systems. In other words, it is because attention to correspondence regarding the systems and updating of

Table 1. Items of Non-conformity identified by the audits, in order of frequency

Ranking	Company Audits Initial and Annual Audits	%	Shipboard Audits	%
1	Code 12 Company Verification, Review and Evaluation	22	Code 10 Maintenance of the Ship and Equipment	19
2	Code 8 Emergency Preparedness	18	Code 6 Resources and Personnel	16
3	Code 6 Resources and Personnel	17	Code 1 Definitions, Objectives and Application	15
4	Code 11 Documentation	11	Code 11 Documentation	12
5	Code 10 Maintenance of the Ship and Equipment	10	Code 7 Development of Plans for Shipboard Operations	10

the statutes is neglected in preparing for the audit by the Society.

Since one of the main purposes of the ISM Code is to apply treaties and rules, It is desirable that companies pay better attention to amendments to treaties and rules.

(2) Education, training (Code section 6).

Deficiencies in important documents for directions to be submitted to new personnel before first departure are very common. And, it is also clear that often proper education and training of onshore employees and crew are not given.

The Society considers that the implementation of the safety-management system is largely attained by securing a competent crew. And of course education and training of crew, including shore employees, is important to maintain a capable crew.

(3) Emergency Preparedness (Code section 8).

It is frequently pointed out that no effective program of drills and exercise for shore personnel to respond to emergency cases has been established, and it is also pointed out that joint training of the company staff and the ship crew isn't being carried out.

It should be understood that support by shore staffs as well as preparedness by ship's crew, is a key element of the system when a marine casualty, accident or pollution of the marine environment occurs.

(4) Maintenance of the Ship and Equipment (Code section 10).

In particular, the most frequent deficiencies identified relate to the non-fulfillment of maintenance procedures to improve reliability of important and stand-by machinery.

Also, deficiencies related the records of regular testing of equip-

ment and technical systems and deficiencies and non-fulfillment of execution of the maintenance plan are often identified.

Re-confirmation of whether the present routine maintenance in Engine Space is working effectively or not as a functional system is required.

(5) Verification, Review and Evaluation of the SMS by the company (Code section 12)

Most of the non-conformities are: non-fulfillment of revisions of the SMS, an internal audit which isn't done in accordance with the plan and procedures, and non-fulfillment of the corrective actions identified by the internal audit. This item is the most important element to verify whether SMS is functioning effectively or not and is audited especially strictly at the annual audits after the initial audit.

3. Analysis of information from other sources.

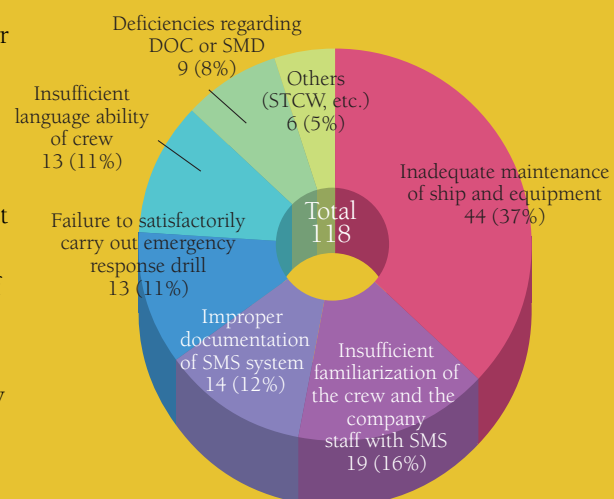
In addition to the Classification Societies, Port States are also carrying out inspections which stress conformity with the ISM Code.

The difference between the two is that Port State Control (PSC) inspections are much more enforcement focussed than audits by the Classification Societies and that Port State Control does not separate inspection of Management Systems from inspections of hardware. For example, when a defect of hardware is obvious at inspection, there is a possibility that Port State will instantly identify such a defect as a Non-conformity (often a Major Non-conformity) of the ISM Code as a basis for Deficiency of the Management System. This tendency is apparent in Figure 1.

Contents of the non-conformity.

- (1) Most non-conformities relating to insufficient maintenance were due to lack of proper maintenance of ship and equipment until the PSC inspection was carried out. When many defects regarding ship equipment are identified at the PSC inspection, there is a tendency to suggest that the SMS itself is not functioning effectively, but this probably merely reflects some inconsistencies of interpretation and implementation of the code at this still-early stage.
- (2) Insufficient familiarization of the master, the crew and the company with the SMS, and the fact that the company does not always do business according to the agreed procedure can be a serious problem. Lack of the recognition of the role of the designated person by the master, which was identified frequently when the ISM Code came into force, still remains a major problem.
- (3) As to "Failure to satisfactorily carry out emergency response drill," there are a lot of cases where crews' unfamiliarity with the emergency response drill is regarded as ineffective practice of SMS.

Figure 1. Classification of non-conformities by factor of ship and equipment



LNG Re-Liquefaction Plant Introduced on an LNG Carrier

However, it seems that in future, even records will not be enough because there have been several cases where the SMS was regarded as deficient when the demonstration of the practice couldn't be done well even when all the records of the drill were prepared.

- (4) PSC usually identifies two different issues, one is that a company provides a SMS document in a language which the crew can't understand and the other one is that crew doesn't have language ability to understand the SMS document which the company prepared. At any rate, the company is responsible for the deficiency.

4. Conclusion.

In both the audits and in PSC over the last year, many non-conformities were reported regarding Maintenance of the Ship and Equipment, Management Resources and Personnel and Company Verification, Review and Evaluation.

This is the same tendency as the results of the last investigation, and we cannot help but point out that business hasn't usually been undertaken in accordance with the system and that review for improvement is not being attempted even if due to deficiencies of the documentation of the system. It seems that there is still a long hard road to be traveled on the road to safety culture.

In the ISM Code, it is important to aim at the continuous improvement of the SMS not only by initial development of the SMS but also by continuous implementation of the SMS, paying attention to feedback and execution of the results.

The gas cargoes carried by liquefied gas carriers, are usually gaseous under normal temperature and atmosphere conditions. Large-scale bulk transportation is possible by liquefaction of the gas substance. There are three ways to liquefy a gas; compression at normal room temperature (=fully pressurized method), cooling and compression (=semi-refrigerated (pressurized) method) and cooling at normal atmospheric pressure (=fully refrigerated method).

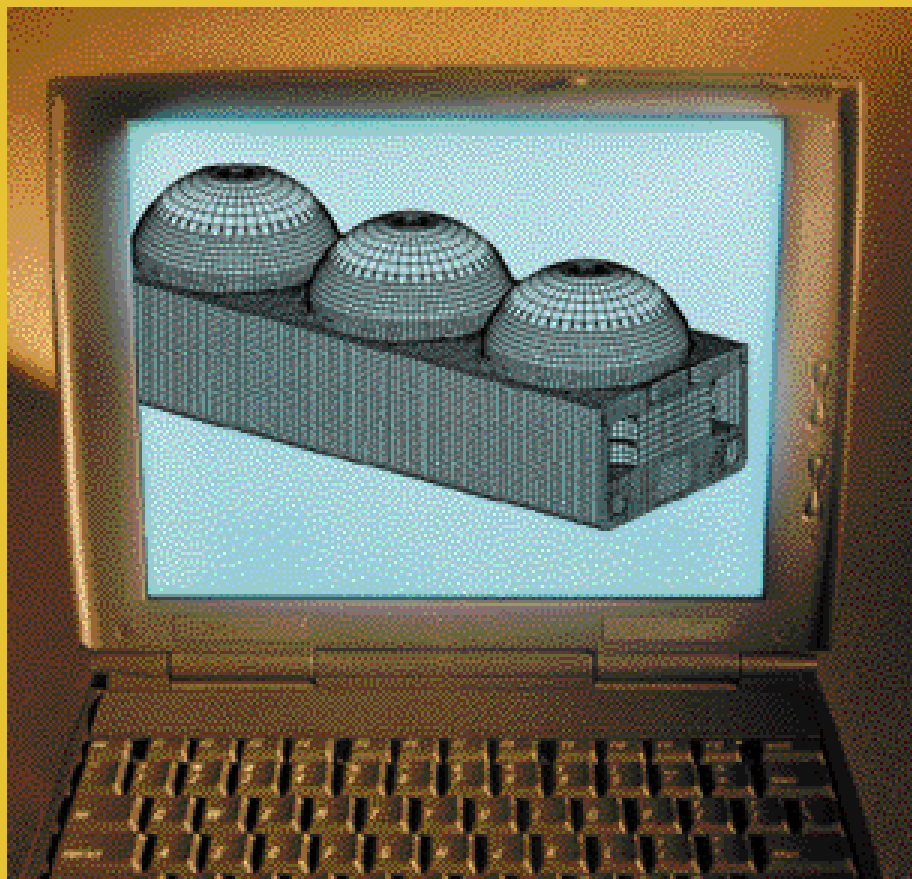
In a fully refrigerated type liquefied gas carrier, cargo is liquefied in accordance with the vapor pressure-temperature curve of the particular substance, by cooling the substances to less than the saturated vapor temperature of that substance in normal atmospheric pressure.

While the saturated vapor temperature of propane, a typical cargo of a fully refrigerated type LPG carrier is -42.1°C , that of methane, the typical cargo of a LNG carrier, is -161.5°C . Fully refrigerated type liquefied gas

carriers load and carry the cargo at such low temperatures. However during the voyage, despite the insulating material surrounding the cargo tank, there is a small rise in temperature of the cargo liquid due to natural heating from the atmosphere and "boiloff gas" occurs. As a result of this boiloff gas, the pressure inside the cargo tank rises.

The designed pressure of the cargo tank of the fully refrigerated type liquefied gas carrier is usually about 0.025MPa, and the "Rules and Guidance for the Survey and Construction of Steel Ships" and the IGC code require that means of temperature/ pressure control be provided to prevent the pressure inside the tank from exceeding the design pressure.

One such means, which cools down the boiloff gas mechanically to control the pressure inside the cargo tank, is called a re-liquefaction plant. Each substance has a temperature (the critical temperature) at which it cannot be liquefied even if it is further



pressurized. Since this temperature is 96.7 degrees for propane, it can be liquefied even at normal temperature by being pressurized to just more than the saturated vapor pressure. However, since that of methane (the usual LNG carrier cargo) is much lower, -82.6 degrees, it cannot be liquefied even if being pressurized, unless cooled down to less than that temperature. Therefore a re-liquefaction plant is usually used as a means of temperature/pressure control device on fully refrigerated type LPG carriers because it is comparatively simple, since seawater can be used as a coolant, because the cargo can be liquefied at normal temperature.

The principle is fundamentally as follows.

1. A high-temperature and high-pressure gas is formed by compressing the boiloff gas with a compressor.
2. The latent heat of the gas is absorbed by the seawater, which acts as a coolant in the condenser, and a high pressure liquid is formed.
3. It is returned into the cargo tank as low-temperature, low-pressure liquid by effecting an adiabatic expansion via an expansion valve.

On the other hand, to re-liquefy methane, for example on an LNG

carrier, a device for refrigeration is necessary because a cryogenic substance must be used as the refrigerant to liquefy the methane.

Generally the economics of actual re-liquefaction plants for LNG carriers have not been favorable, therefore the means of “temperature/pressure control” for the cargo of LNG carriers has been a process whereby the boiloff gas is burned in the main boiler as a fuel for the steam turbine propulsion system, with obvious economic advantages.

In adopting this method, the loss of the cargo cannot be avoided due to the use of the boiloff gas. But, at times when the price of LNG rises for example, the adoption of the LNG re-liquefaction plant can be reconsidered as a more economical method.

The first LNG re-liquefaction plant “ZERO-LOSS®” was announced by Swiss Sulzer Brothers Limited in 1973. This system adopts the “closed Brayton cycle” in which nitrogen is used as the refrigerant. This system has the advantage of being simple, with the least number of components, thus offering the highest reliability and ease of operation. Another advantage of this system is that control of the plant capability can be achieved by changing the volume flow of the nitrogen in the closed refrigeration cycle. Thanks to these advantages,

effective unmanned or automatic operations are possible, even if the amount of boiloff gas varies widely during the operational mode of the ship at the time of fully loaded voyages and ballast voyages.

The flow of the system is shown diagrammatically in the figure below.

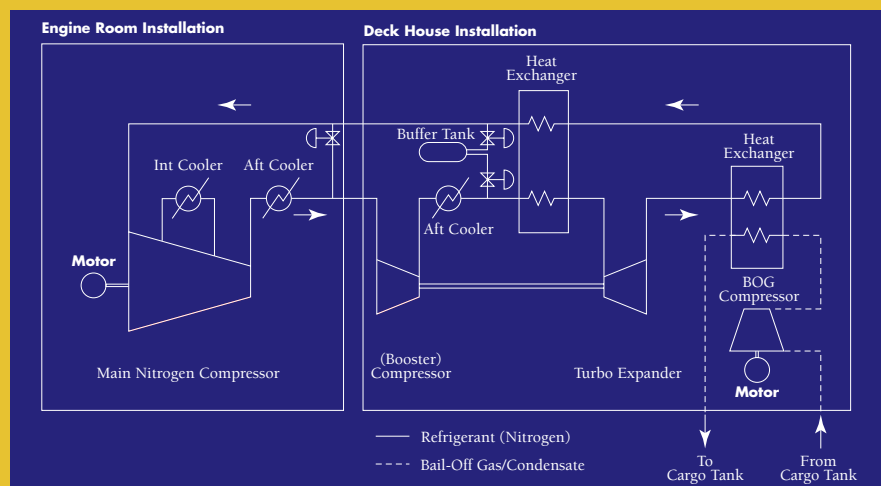
Main machinery and equipment being used for this system is as follows.

- N₂ Compressor: 2-stage radial type
- Turbo Expander/Compressor: Single stage radial type, Connected to each other
- BOG Compressor: Single stage radial type
- Cryogenic Heat Exchanger: Brazed plate fin type
- N₂ Buffer Tank: Cylindrical type

All of this machinery and equipment has been technically proven in cryogenic industries on shore. And the designs have been established based on further actual service. However, the reason why it has not been adopted in ships until now is said to be the fact that it has been uneconomical in relation to the amount of fuel consumption for operation along with the initial cost of these devices.

Currently, the first LNG carrier to install a LNG re-liquefaction plant is being constructed at Mitsubishi Heavy Industries, Ltd. Nagasaki and will enter service from October this year. The plant has been developed jointly by Osaka Gas Co. Ltd., Nippon Yusen Kabushiki Kaisha, Mitsubishi Heavy Industries, Ltd. and Chiyoda Corporation.

Confirmation of the reliability and improved economics over time may also see the complete replacement of the conventional steam turbine with more efficient modern diesel engines on LNG carriers.



Liquefaction Plant Schematic

The Chinese province of Shandong is known as the cradle of the Yangtze (Yellow River) civilization, one of China's four great historical civilizations. It is the birthplace of philosophers and thinkers such as Confucius (the father of Confucianism), and Mencius who was also a famous thinker.

Qingdao City is located almost in the center of the southern coastline of the Shandong Peninsula. With an area of 10,000 square km Qingdao City takes up about 7% of Shandong province, and about 1/3 of the province's population of 6,900,000 people is concentrated in this city area. The people seem to lead a comfortable life because population density is quite low when compared with the big cities such as Beijing and Shanghai.

The calm Western-style brick houses of the present day Qingdao City reflect the strong German influence in the city's history, which changed it from a small fishing village of a previously remote district. The Germans also quickly realized that the water which gushed out from the famous mountain "Laoshang" in the eastern part of the town, was most suitable for beer-making, so the production of beer began very early. Thus it came to be that the world famous Tsing Tao beer was produced.

Also famous for its clean sea and attractive streets, many people come all year round to Qingdao as tourists. Especially in summer, when the population increases greatly as many



tourists from all over China rush to the Qingdao seaside because it isn't as hot as the inland cities, even in summer. It is said that the climate in Qingdao is very easy to live with.

And of course, we mustn't forget Shandong cuisine which is considered typical among the various Chinese cuisines available in Qingdao. High-quality ingredients are abundant with the marine products caught in the nearby seas especially famous. A meal is always begun with the drinking of Qingdao beer and wine, and is generally finished with abundant fruit as the dessert. In any case, everyone eats

well, and then drinks well, and enjoys their meal.

At present, the city is actively promoting further tourism and is preparing the appropriate infrastructure with the construction of high rise buildings and so on.



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Qingdao

On the other hand, Qingdao City also has its flip side as a significant industrial city. In particular, the textile industry has developed to rival Shanghai and Tianjin. Qingdao port is a port with quite a history, being built in 1892. It is one of the more important Chinese ports, in line with Shanghai, Tianjin, Dalian, and so on as a gateway to the continent. Many kinds of industries have developed in Qingdao because of its good geographical location. There are 13 piers and 71 quays in the port, which can also accommodate a ULCC in the oil berth. The container quay handled more than 1,500,000 teu last year, making it the second busiest in China.

The NK Qingdao office covers almost the whole area of the Shandong province. Sometimes travel in excess of 500km at a time is required but this distance is often covered as a pleasant train journey enjoying the scenery of the farm villages.

Typically, afloat surveys are done in Qingdao Port, Hungdao, Yantai, Weihai, Rizhao, and Lian Yun Gang,



(From left) NK Qingdao GM, Mr. Isao Takano, Secretary, Ms. Zhu Mei, Surveyor, Mr. X. W. Chen,

among others, while new shipbuilding and class maintenance surveys are undertaken at shipyards in Qingdao, Hungdao, Yantai and Weihai. Anchor chain inspections take place in Zibo & Jimo City, Boiler inspections in Jiaozhou City and Material inspections in Jinan City, while Life Boat inspections are done in Qingdao.

When many inspections are concentrated on the same day, a regional support system involving other NK offices in the neighboring areas has been established, in order to ensure that the inspection service which is most suitable for the client's schedule, is met.

It is expected that the ships travelling to and from China will increase further as the amount of trade will increase when China joins the WTO. This increase in the load movement is expected to not only impact shipping companies and shipyards, but also many other industrial developments, so we expect to deal with a variety of new enterprises and clients. We are looking forward to being able to meet many more people from now on.

Each NK office in China, including the Qingdao office, must prepare for the corresponding increase in inspections expected. We must strive to continue to provide the service which has so far kept our customers so satisfied.

On a personal note, I am very pleased and grateful that everything has gone smoothly since I arrived at my new post here in Qingdao, thanks to the wonderful support of the NK Qingdao team, and our clients.

Durban Office

The Port of Durban, which has 57 berths, is the busiest port on the African continent and is the largest in terms of container capacity. During 1999, 3,473 ocean going vessels of 131 million gross tons visited the port, of which an average of 110 vessels per month were container. Durban's container terminal is one of the largest of its type in the southern hemisphere with container movements exceeding 80,000 per month.

Being conveniently placed on the primary North and South Atlantic trade routes to Indian Ocean and Far Eastern ports, Durban is a favorite call for vessels taking bunkers and also changing crew personnel.

With two floating docks and one graving dock, which can be divided into two separate independently floodable compartments, Durban is also a favorite call for routine and casualty ship repair. The larger of the two floating docks, owned and operated by Elgin Brown & Hamer (Pty) Ltd, has a lifting capacity of 8,500 tons and a floor length of 140m. The largest vessel to occupy the graving dock is a panamax sized container ship with a length of 265m and beam of 32.5m

Richards Bay, some 90nm up the coast from Durban is Africa's largest port in terms of bulk cargoes exported. The coal terminal at Richards Bay can handle five capesize bulkers at one time with an average loading time of 48 hours for a capesized vessel.

ClassNK's new Durban Office, which opened during September 1999, is very active in the ports of

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Durban and Richards Bay with occasional visits to Kenyan, Mozambiquan, Madagascan and Mauritius ports.

For those who have held managerial positions in such world capitals as Tokyo, London and Hong Kong, South Africa comes as a shock to their “fast-lane” business mentality. The relaxed attitudes in South African business are at first extremely frustrating, and then, with the passage of time, become amusing. Equally frustrating are the challenges of dealing with a public sector where local and state government organizations struggle with their own bureaucratic regimes and are inexperienced in the high paced demands of international business.

South Africa is a Third World country with much potential, the opportunity to substantially develop tourism being one of the country’s greatest assets. Regrettably a spiraling crime rate, which for a variety of reasons nobody seems able to control, deters would-be tourists from visiting the region. Instability in the neighbouring southern African states is also deterring tourism and international investment in South Africa, particularly when, at times, the international media hint at overspills of instability into South Africa.

Within a two-hour drive from the city of Durban, people can visit several game parks and view at close range most of southern Africa’s wild animals in their natural surroundings.

South Africa is a nation of sport lovers. Every morning at 6 am you will see countless joggers, walkers, and cyclists all training for local,

national and international events. The favorite sport is rugby football, with the South Africans at second place behind the New Zealanders in the world rankings.

General Manager of ClassNK’s Durban Office, Alan Perry, who was previously based in ClassNK’s London Office, has quickly become used to the problems associated with living in South Africa, such as having to live within a razor-wire topped, walled complex with steel bars on the windows and doors of his house, and only talks of the advantages of living in South Africa, such as the beautiful climate nine months a year when he can enjoy driving his MGB Roadster which arrived in Durban from the U.K. shortly after he did, and the breathtaking scenery which he enjoys from the air when indulging in another of his passions, private flying.

Perry was proud of his appointment to set up and manage ClassNK’s new Office in Durban, especially in the Society’s centenary year, in a building shared by other industry giants such as Lloyd’s Register of Shipping and P & O Nedlloyd, and which enjoys a magnificent view of Durban harbor. The coming years will be interesting ones as the new South Africa emerges as a regional economic power from its tormented past and as an example to the rest of Africa of how ethnic differences can be overcome and how harmonious coexistence is the true way forward.

Within the spirit of the new South Africa, ClassNK will also play its part by assisting the economic future of the marine-related industries in Durban.

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NK Durban GM, Mr. A.F. Perry and Secretary, Mrs. Arthi Singh

MEGA-FLOAT Update

Regular readers of the *ClassNK Magazine* will no doubt be keen to be updated on one of the more unusual projects that NK contributes its expertise to, the MEGA-FLOAT research project.

First reported on in the 1996 issue of *ClassNK Magazine* (issue No. 48), research has consisted of two phases: Phase I, spanning three years from 1995 through 1998, and Phase II, which began in 1998. The main aim of the Phase I research was to demonstrate the reliability of large-scale floating structures through the development of a 300m long floating steel structure test model. The Phase II test model structure is to be used to conduct a number of demonstration tests and research for a planned period of three years. All the pieces of the Phase II model, classed with the Society the previous September were brought together for final welding in August 1999, in the waters offshore from the Yokosuka area in Tokyo Bay. The 1,000m long structure builds upon the results obtained from the Phase I model. This article presents a brief update on the Phase II research and the activities on the MEGA-FLOAT structure.

Of the many uses envisioned for the MEGA-FLOAT structure, such as being used as a floating base for container yards for amusement and sports facilities, and as a disaster relief base, amongst others, that of providing a reliable base for airport facilities is the most demanding and difficult to achieve. The Phase II model has thus been constructed in order to carry out many tests related to airport functions and to demonstrate the feasibility of these and other functions. At a size of 1,000m x 60m (with one portion 120m in width) x 3m, this model structure is significantly larger than the Phase I model (300m x 60m x 2m). A floating airport measuring 5km x 2km or 1,000 hectares in size (roughly the equivalent of 700 soccer fields) is envisioned as the final structure.

The Phase II research will include;

1. Development of facilities capable of accommodating wave motions and tides,

2. Development of airport function simulation programs,
3. Demonstration tests of landing instrument and equipment systems,
4. Take-off and landing experiments.

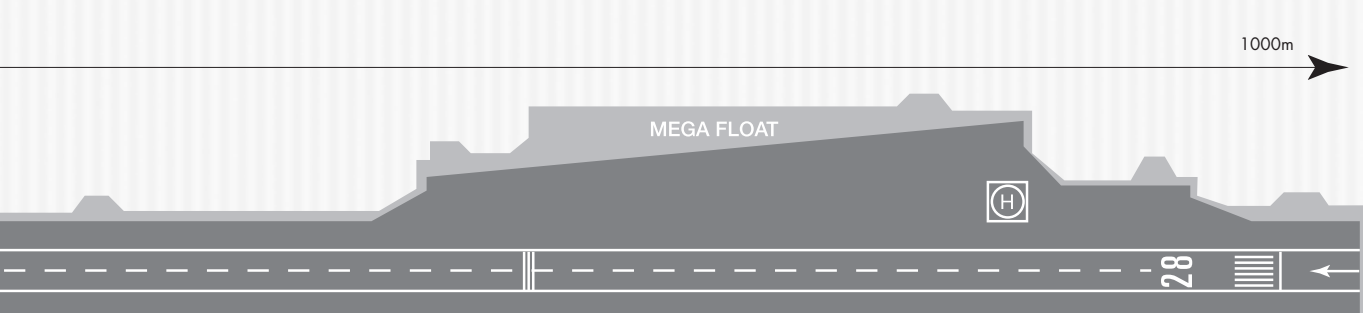
With much of the research on the first three completed, it was the fourth of these, the take off and landing experiments, that staff of NK were recently invited to observe. On a bright sunny summer day we were ferried out to see firsthand the outstanding success that this project has achieved. While the basic science and technology of taking off from and landing aircraft on floating objects at sea, i.e. naval aircraft carriers, has been established for over 50 years, our





host Mr. Michimasa Yamada, GM of the MEGA-FLOAT Marketing and Planning Dept., explained that the much larger scale and higher safety requirements for commercial public aviation, had presented a range of new challenges for the MEGA-FLOAT research team. As we watched the plane successfully take off, touch and go, and land several times from different directions, it was clear that most if not all of these challenges had been met by the MEGA-FLOAT research team. The team was particularly happy with the results,

given that the MEGA-FLOAT had just 3 days earlier experienced its first typhoon. The team had looked forward to that event with uncharacteristic enthusiasm, as it represented a first real test for the mooring and structural systems in a worst-case scenario. Needless to say, the MEGA-FLOAT met all expectations, and the planned take off and landing rest were able to proceed on schedule. The MEGA-FLOAT project is clearly on track and we look forward to following its progress in the future.



Mr. Masataka Hidaka, Vice President of Class NK, Takes Over as IACS Chairman for 2000/2001

The International Association of Classification Societies (IACS) held its 41st Council meeting on the 31st of May and 1st of June 2000 at the head office of Germanischer Lloyd in Hamburg, and Mr. Masataka Hidaka, Vice-President of ClassNK, was elected as Chairman of IACS for a one-year term, effective from July 1, 2000.

This is the third time ClassNK has served in this capacity (the first occasion was in 1971 and the second in 1988). Hisayasu Jin, a former Principal Technical Officer of IACS, and a principal surveyor at ClassNK, was also appointed as Chairman of the General Policy Group (GPG). The Council meetings will be held in December 2000 and in May 2001, and two GPG meetings will be held in October 2000 and March 2001.

Mr. Hidaka said in his statement as new Chairman of IACS on July 3 that, although IACS has worked hard and successfully to set higher standards for safety, it must relentlessly pursue and achieve ever higher standards and compliance by ships. And he declared that the agenda for IACS over the coming year will be led by the need for an enhanced class survey



Masataka Hidaka
Executive Vice President

regime, greater transparency in class data and increased uniformity in IACS' technical standards.

Class NK takes the Chair of IACS during a challenging period of transition, when the future structure, role and goals of IACS are being strictly scrutinized in the wake of the losses of the *Erika*, the *Leader L* and the *Treasure*. Although the classification system remains sound, accusations of bad performance by a classification society could affect IACS' confidence. In this situation, the role and duty of the Chairman is to greater strengthen IACS' position in the maritime industry and ensure its central role as the shipping industry's unique source of deep technical knowledge and expertise, and as its guardian of technical standards.

The Construction of the New NK Information Center

The new NK Information Center (provisional name) is to be built next to the NK Research Center (in Chiba) and will serve as NK's information warehouse and communications hub. As such, it will also be the heart (or brain) of the NK Globalware System, which will benefit all. Construction commenced May 29 and is expected to be completed by the end of June 2001.

The center has been specifically designed to withstand the worst natural disasters, incorporating the latest most sophisticated base isolation system to minimize the impact of major earthquakes. It will be totally self sufficient in such an emergency, with independent power generation capacity, water supply, etc., allowing NK to continue the provision of essential information and services to clients.

A substantial four story facility of around 5,500m², it will initially take about 100 of the current head office staff. However it is also being designed to accommodate and serve if necessary, as an alternative head office, in the case of a disaster affecting the existing head office.



Artist's impression

Technical Services Relating to the Safe Operational Management of Ships

Several major ship chartering companies are endeavoring to improve the quality of ship audits to meet their clients' demands for better quality transportation services. Their goal is to achieve safer navigation of ships under their control by developing their own safe navigation management systems similar to the ISM Code and the ISO 9000 series.

The system being developed and implemented adapts the concept of the Plan-Do-Check-Action cycle for assurance. A range of items regarding safe navigation, and preservation of the marine environment are decided upon for a shipowner or management company, as the independent charterer's standard. These requirements (of the charterer) are then executed in accordance with an agreement (contract, memo) with the shipowner or the management company.

The implementation is verified through company audits and ship audits in accordance with a standardized procedure. If items are identified as requiring improvement, a "requirement

for corrective action" is submitted to the shipowner and or the ship management company.

To support such progressive safe operational management of ships, the Society began a new technical service, performing parts of the above-mentioned ship audits (the "check phase of the Plan-Do-Check-Action cycle"), maximizing the experience it has accumulated performing ship surveys and ISM audits. In other words, in accordance with the scheme developed by the charterer, the Society auditor, accredited by the charterer, attends the ship and carries out the audit according to the checklist, and reports the result to the client.

The effect of the results of audits by the Society together with the company's audit results in the Plan-Do-Check-Action cycle maximizes the quality assurance improvement. Accordingly, it contributes to the prevention of delays in operation of the ship and decreases in the accident rate.

As a part of its technical services, the Society will continue to work with clients, to develop and provide new types of services, such as these customized ship audit services, to improve the safe operational management of ships.



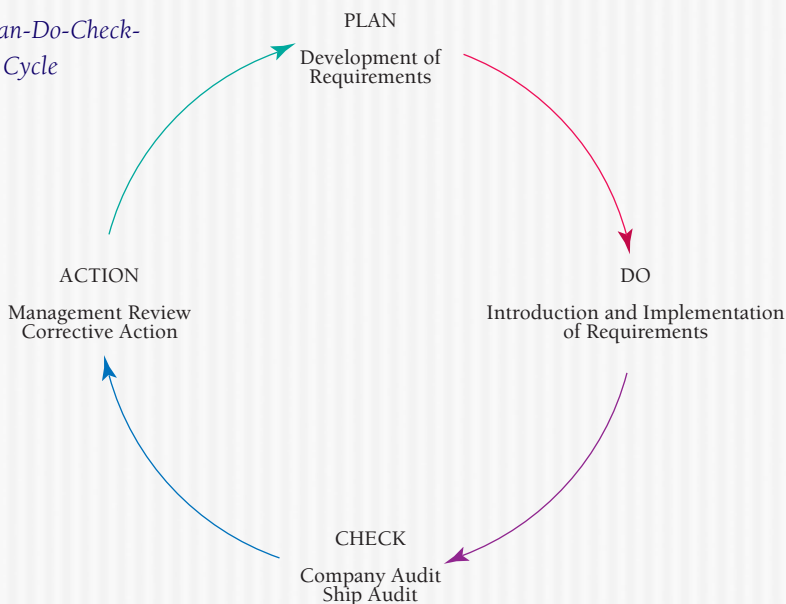
Asahi Tanker Co., Ltd., the first coastal tanker service in Japan to receive ISO 14001 certification

An Introduction to NK's Assessment and Registration Services for Environmental Management Systems

As the international standard for environmental management systems (ISO 14001) came into force in September 1996, the Environment group within the NK Quality Assurance Division (Environmental NK) had to quickly come to terms with the enactment of the rules for assessment and registration of environmental management systems (EMS), developing the quality system for these new assessment and registration services, and the training of auditors. The rules for assessment and registration were finalized in December 1997, and a registration certificate was issued to a company for the first time in February, 1998.

By July 2000, 12 companies including, for the first time, a Japanese shipping company, had achieved

The Plan-Do-Check-Action Cycle



registration of their environmental management systems.

Also, in June 2000, a certificate of accreditation was issued by the Japan Accreditation Board for Conformity Assessment, to the Society, regarding its registration and audit services for ISO 14001 environmental management systems.

Awareness of the importance of environmental protection is increasing worldwide, and the number of organizations that want to be registered for the environment management system is increasing rapidly. The number of ISO 14001 certifications in Japan is already 3,700 as at April, 2000, and this is expected to increase rapidly.

Environmental NK offers assessment and registration services for ISO 14001 anytime, and works hard to help develop a system that most suits the client's needs.

NK Rotterdam Office Commences Conformity Assessment/Certification under European Council Directive 96/98 EC on Marine Equipment

Most countries around the world tend to put more emphasis on the export of manufactured industrial products to foreign countries than their domestic consumption. As one consequence of this, many inconveniences due to differences in standards and requirements among various countries have become obvious.

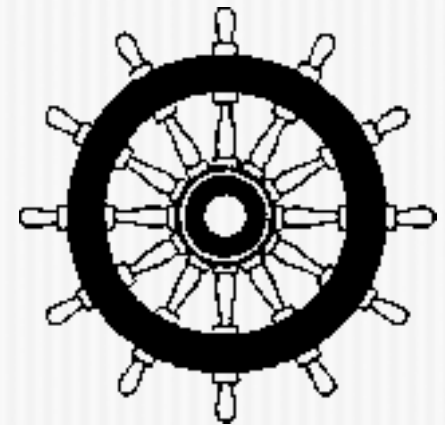
To solve those problems, in order to improve product circulation and to promote safety and environmental protection, the European Union, (which promotes unification in various fields such as currency), in attempting the unification of technology of products and test standards, announces EC Directives, which are adopted as domestic law by member nations.

The EC Directive in relation to ships is called Council Directive 96/98 on Marine Equipment (MED) and became effective after January 1999. Recently, you may have seen marine equipment displaying a "wheel mark" (see fig. below right). This mark indicates that the equipment was manufactured and certified in accordance with the new approval system for marine equipment, as per MED. This MED establishes conformity assessment/certification systems regarding marine equipment related to life-saving appliances, fire fighting equipment, fire protection structures, navigation, radio and marine-pollution prevention equipment, which are installed on ships registered in the 17 European countries which make up the EU member states, plus Norway and Iceland.

While International Conventions such as SOLAS and MARPOL are adopted as they are, as the rule or the standard for the certification, it has been characteristic that the quality guarantee system based on Type examination is widely adopted as the Conformity Assessment procedure for marine equipment.

Now, the Conformity Assessment procedure must be carried out by an assessment body called a Notified Body. NK Rotterdam has been recognized as an experienced and knowledgeable body to undertake such tasks by the Government of the Netherlands, which is a member state of EU and has been designated as a Notified Body. NK Rotterdam has begun carrying out the conformity assessment procedures related to the MED.

For more information, please feel free to contact NK Rotterdam (Tel. +31-10-4137071, Fax. +31-10-4138530), the Material and Equipment Department (Tel. +81-3-5226-2020, Fax +81-3-5226-2019) or other local survey offices who will process your application or inquiry.



Official Marking for MED

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