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- Session Ⅰ Best Practices and Perspectives of the Integrated Ocean Governance Plan
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  - Session Ⅱ-1 Greenship Technology
  - Session Ⅱ-2 Asia Initiative in Marine Finance Market
  - Session Ⅱ-3 Deep Sea Offshore Plants and Seabed
- Session Ⅲ Factoring High Oil Prices into Logistics Industry Risk Management
- Session Ⅳ Emerging Issues for Global Seafood Industry
- Session Ⅴ Climate Change and Future for Marine Environment and Biotechnology

Special Session

Special Session Ⅰ Diverse Industrial Models of Marine

- Seaweed Pulp
- Marine Biodiesel
- Blue Bio 2016

Special Session Ⅱ Vision and Prospects of the Design in Marine Industries

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- Special Event Ⅰ Korea - China Marine Economist Roundtable
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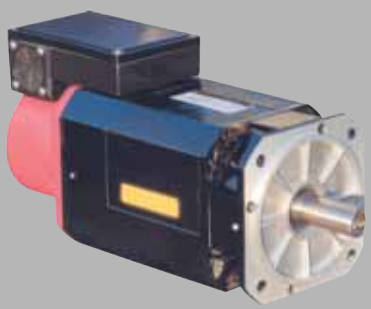

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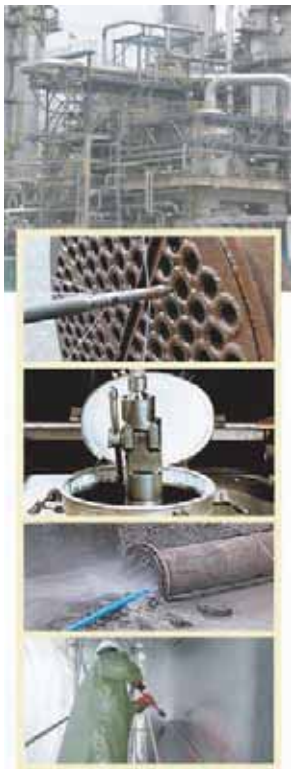

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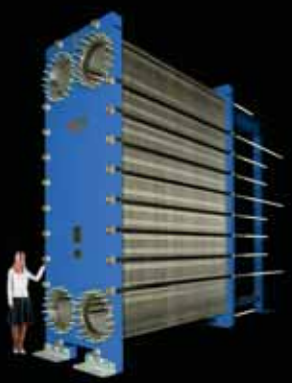

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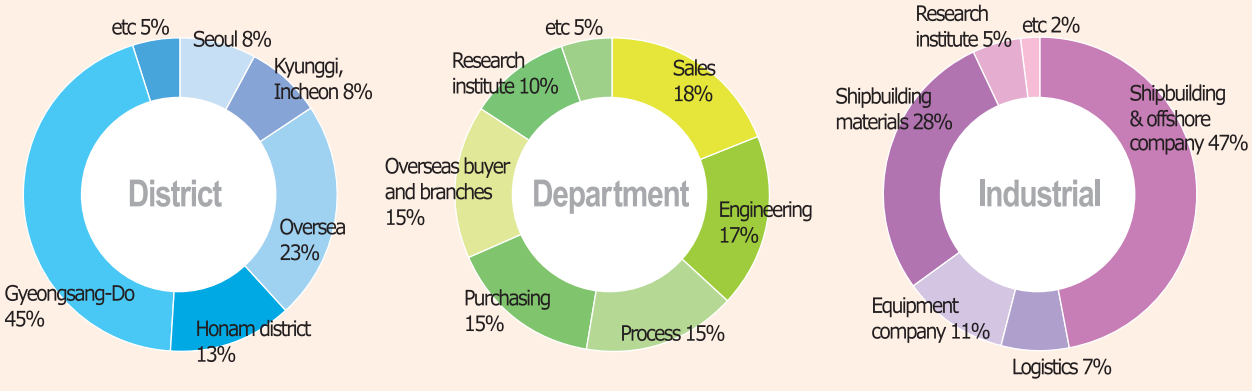

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Goh Jae-ho, new President of DSME, stresses substance and communication

Daewoo Shipbuilding & Marine Engineering (DSME) held a ceremony to mark the inauguration of new President Goh Jae-ho at its Okpo Shipyard on April 4. During the inauguration ceremony, he emphasized the substance and communication in the business process.

Goh Jae-ho, who was appointed as new CEO of DSME, said, "We will be at the forefront of leading the change amid stability with an emphasis on substance to build up international competitiveness. For that, I will spend more time on listening to the opinions of employees at Okpo Shipyard on Geoje Island."

In addition, he said that he would provide the best support to ensure that the Daewoo Heavy Industry Academy offer a wide range of in-depth courses and make good on the graduates' dream of climbing the corporate ladder to become a CEO, and do his utmost to create the best value in fulfilling corporate responsibilities to society.

Along with that, he plans to impart fresh momentum into the effort to develop technical manpower in an attempt to tide over current difficulties in the aftermath of global financial crisis. Also, he announced 4 basic directions, such as the substance/stability for DSME's major business, selection/concentration for growth engine, trust, enthusiasm and cultural harmony.

DSME President Goh Jae-ho(right) is shaking hands with the official of ship owner at the site.

Particularly, he announced that the company would be reorganized into several units, such as the technology, production, business, finance, growth engine, business innovation, etc., to increase the specialization, maximize results, and promote responsibility-based management system that assigns authority and responsibility to major organizations handling overall affairs.

He mentioned in his inauguration address, "DSME will be transformed into a company which its employees are proud of, attracts young talent, and maximizes the shareholder value."

DSME plans to turn its Daewoo Heavy Industry Academy - which trains high school graduates to develop them into expert in heavy industries over the long-term - into an in-house university in order to offer an opportunity for employees with a high school diploma to earn university degrees.

AVEVA's Marine Technology & Service Centre develops new product with leading Asian shipbuilders to increase design and production efficiency

AVEVA announced AVEVA Pipe Supports - Marine 12.1 on April 4, an entirely new specialised product within the AVEVA Marine portfolio, is now available. Designed to meet the unique requirements of the shipbuilding industry, it was developed in collaboration with leading Asian shipbuilders at AVEVA's Marine Technology & Service Centre (MTSC) based in Busan, Korea. AVEVA Pipe Supports - Marine increases design and production efficiency through the precise definition and management of pipe supports, saving costs and compressing project schedules.

"AVEVA Pipe Supports - Marine offers a highly tuned user interface, improved design consistency, accurate materials information and reduced production time compared to other non-specialised tools," comments Stephane Neuveglise, Head of Business Management - Marine Systems, AVEVA. "Users benefit from greater flexibility and control, while shipyards benefit from reduced production time and costs. This new product is a good example of how we are working to make shipbuilding altogether more efficient and cost effective".

"Pipe Supports - Marine draws on the experience of an already established solution in use by hundreds of our plant customers and combines the insight and experience of the shipbuilding industry",

said Dave Wheeldon, Chief Technology Officer, AVEVA. “It has been created with direct involvement from leading names in the Marine industry. This collaborative approach is an important part of AVEVA’s strategy to develop game-changing solutions for our customers”.

AVEVA Pipe Supports - Marine makes available tools to create pipe support details in the AVEVA Marine 3D model and then automatically create pipe support manufacturing drawings for each pipe support.

DHSC held a naming ceremony for Samjohn Dream

DHSC (DaeHan Shipbuilding Co., Ltd) held a naming ceremony for HN1051, a 207,000-ton bulk carrier ordered from the Greece-based Golden Flame Shipping S.A., at its No. 1 Quay Wall on March 27.

The ceremony was attended by about 50 related officials, including Lee Byeong-mo, President of DHSC, executives of the company, Christos J Samonas, Chairman of John Samonas & Sons, John C. Samonas, the Fleet Manager, and others.

On the naming ceremony, Doreen Samonas, the wife of Christos J Samonas, Chairman of John Samonas & Sons, served as godmother to the vessel which she christened as ‘Samjohn Dream’, wishing it a safe voyage. This newbuild measures 300m in length, 50m in width, 25.1m in height and can sail at a maximum speed of 15.4 knots (28.5km/h).

This vessel is one of the two 207,000-ton class bulk carriers ordered from the same ship owner in November in 2010. Construction of the vessels began in June and September, respectively, last year, and HN1051 was completed first after approximately 9 months. The remaining 1 unit is currently under construction at DHSC’s No. 1 Dock and scheduled for delivery in May.

Lee Byeong-mo, President of DHSC, said, “The trust of the ship owner in all aspects of our shipbuilding processes, including the quality and safety, was vital to the successful completion of this vessel’s construction. We will make our best effort for the remaining works to ensure that we deliver the vessel with perfect quality.”

Christos J Samonas, Chairman of John Samonas & Sons, remarked, “We are thankful to DHSC that built the highest quality vessel without a single incident, and will build a close partnership with DHSC based on mutual trust.”

Major officials of both companies are posing for photo during the naming ceremony of HN1051.

Intergraph Supports the ISO 15926 Standard with the Release of SmartPlant® P&ID ISO 15926 Export Utility

Intergraph released its SmartPlant® P&ID ISO 15926 Export Utility, a commercially available solution to support interfaces based on the ISO-based data exchange. This release further demonstrates Intergraph’s commitment to open interfaces and standards.

SmartPlant® P&ID ISO 15926 Export Utility offers data exchange benefits between the process design schematics and the 3D physical design for engineering companies, as well as facility owners. This allows piping and instrumentation diagrams (P&IDs) to be exported in the ISO 15926 format, which means data as well as graphical content can be exchanged with other ISO-compliant plant design and information management solutions. Intergraph worked with longtime customers to develop an explicit value proposition and technical requirements used to guide the development of the SmartPlant® P&ID ISO 15926 Export Utility.

“The release of the SmartPlant® P&ID ISO 15926 Export Utility is another step that demonstrates Intergraph’s continued commitment to satisfy client demand for openness and interoperability,” said Patrick Holcomb, Intergraph Process, Power & Marine’s executive vice president of global

business development and marketing.

Holcomb cites the SmartPlant® P&ID ISO 15926 Export Utility as another in a long line of Intergraph efforts to support open data exchange between its industry-leading solutions, and other plant design solutions developed by other technology providers. This new capability will be further discussed during the Fiatech™ Annual Technology Conference & Showcase in Miami.

Intergraph is an active, longstanding member of Fiatech, an Austin, Texas-based not-for-profit international consortium working together to lead global development and adoption of innovative practices and technologies to realize the highest business value through a capital asset's life cycle. Recent Fiatech initiatives have helped accelerate the delivery of interoperable tools, systems, work approaches and processes, including an open source exchange of information through ISO 15926.

Holcomb, who represents Intergraph on Fiatech's board of advisers, said, "Intergraph and its SmartPlant® Enterprise integrated solutions is a longtime supporter of industry standards. This support dates back to the ISO 15926 origins in the 1990s. Since then, we continue to contribute to valuable standards and develop interfaces that support compliance and satisfy client demand."

SmartPlant® P&ID is the No. 1 asset-centric, rule-driven P&ID solution in the global market and has created more than 500,000 P&IDs for plants from around the world. It helps users to develop and manage their facilities using SP P&IDs with a focus on the plant asset rather than the documentation representation. This accurately reflects the as-built plant for enhanced safety, quality, efficiency and productivity.

Close ties between DNV and KOGAS in LNG research and development

DNV has signed a MOU with Korea Gas Corporation (KOGAS), South Korea's state-run gas corporation, to cooperate on research & development in LNG sector on April 12. While this is the second MOU with KOGAS after its first MOU on 2010 to cooperate on EHSQ issues, DNV is the first international risk management organization in Korea to cooperate with Korea Gas Corporation with regards to research and development projects in LNG sector.

Based on the MOU signed, DNV and KOGAS will co-organize conferences and cooperate on R&D projects throughout the entire LNG value chain from up-stream to down-stream including gas reservoir exploration, natural gas production, liquefaction, transportation, storage, re-gasification, and supply.

"DNV has maintained good relationship with KOGAS providing several SHE risk management services including EHSQ evaluation and safety culture assessment. We are happy to expand our cooperation to the research area and further our long-term partnership with KOGAS. Based on our expertise in LNG industry, we anticipate contributing to KOGAS's acquisition of innovative technology and strengthening of its position in the global market," said Jon Rysst, Regional Manager for DNV Korea and Japan.

DNV & KOGAS signed a MOU to collaborate in LNG research and development.

As a sole LNG provider in Korea, KOGAS is continuously expanding its investment in foreign resource development project and acquisition of non-conventional gas such as shale gas to obtain stable energy source. Furthermore, KOGAS is more focused on the mid-downstream of LNG business which focuses on a return on investment based on LNG demands and stable income generation through technical service.

While continuously providing SHE risk management services for KOGAS to strengthen its mid-downstream operation, DNV will further its cooperation with KOGAS for this national LNG provider to acquire advanced technical competence and create long-term values in the global LNG market.

HHIC-Phil's Subic Shipyard signed a deal for the maintenance and repair of U.S. Navy vessels

Hanjin Heavy Industries and Construction (HHIC) is launching a new strategic business to surmount the difficulties facing the shipbuilding industry in the wake of the global financial crisis. HHIC announced that HHIC-Phil's Subic Shipyard entered into a Master Collaboration Agreement (MCA) with AMSEC, an affiliate of Huntington Ingalls Industries, the largest warship builder of the United States, on April 18.

Under the MCA, HHIC-Phil's Subic Shipyard will provide a wide range of services such as the maintenance, repair, logistical support, etc., for ships of various nationalities, including the ships owned by the U.S. Navy and the U.S. government, by leveraging the cutting-edge technology and expertise that it has amassed through many years of work in related fields.

This MCA was sealed as the Pacific region has recently emerged as key strategic area for many countries, including the United States, and shipping lines, and the U.S. Navy plans to increase its presence and activities in the western Pacific region in the next several decades.

Thus, HHIC-Phil's Subic Shipyard, located at the heart of the western Pacific region - which offers a geographical advantage - is equipped with the world's leading shipbuilding technology and repair capability and recognized as the optimal shipyard capable of offering the best services while meeting the growing demand for logistical support service (MRL support service) in the Pacific region.

Having signed the MCA, HIC anticipates that the new business of Subic Shipyard will create new revenue streams and stimulate the expansion of MRL support service and thereby create more opportunities.

HHIC-Phil's Subic Shipyard, completed in 2009, was built on 800,000 pyong of land in Subic Bay and is equipped with the world's largest dock measuring 550m in length and 135m in width, 4km-long quay wall facilities, 4 goliath cranes and automation equipment.

HMD built its 600th vessel in 14 years

HMD (Hyundai Mipo Dockyard) reached 600 ship milestone in 14 years after it launched the newbuilding business. HMD announced that it accomplished this monumental landmark with the delivery of 'Sky Hope', a 1,000TEU container carrier, to CK LINE, the ship owner, on March 19.

HMD achieved this milestone of 600 ship delivery in 14 years after it delivered 'RAMFORM', its first ship, in 1997. The naming ceremony held on the same day was attended by Choi Won-gil, President of HMD, Kim Ji-soo, President of CK LINE, including the related officials of the ship owner and classification society, who congratulated the launch of new vessel and wish it a safe voyage.

HMD's shipbuilding volumes have sharply increased over years; 1 unit in 1997, 4 units in 1998, 8 units in 1999, 20 units in 2001, 46 units in 2005, 60 units in 2006, 70 units in 2008, and 80 units in 2011.

HMD held a naming ceremony for 2 units of 1,000TEU containerships on March 19, which was attended by about 50 related officials from the ship owner and classification society, including HMD President Choi Won-gil (third from the left in the first row) and CK LINE President Kim Ji-soo (seventh from the left in the first row).

Based on type of vessels, HHMD delivered 378 product carriers, 89 containerships, 60 bulk carriers, 19 LPG carriers, 28 pure car carriers, and 26 special purpose vessels such as drillship.

An official from the ship owner said that this momentum of growth will be maintained amid the growing diversification of portfolio to make inroads into the PSV (Platform Supply Vessel) sector this year despite sluggish shipbuilding market.

Thus far, a total of 25 vessels built by HMD were selected as the Best Ship of Year over the last 11 consecutive years - including 11 product carriers, 6 containerships, 2 LPG carriers, Con-Ro vessels, special multi-purpose vessels (TEFC), etc., - since the shipbuilder's submarine fiber-optic cable laying vessel was selected as the best ship for 2001, thereby cementing its status as the builder of premium quality vessels.

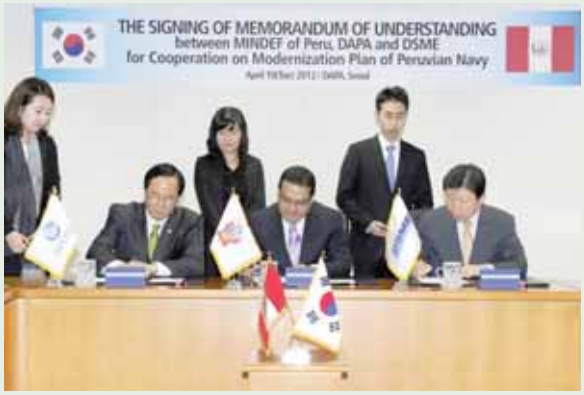
HMD set a delivery target of 80 vessels for this year and a new order target of USD 3.2 billion, approximately 60% up from 2011.

DSME signed a MOU for the joint production of warship for Peruvian Navy

Daewoo Shipbuilding & Marine Engineering (DSME) is making foray into the defense market in Latin America following its entry into the same market in Asia. Goh Jae-ho, CEO of DSME, signed a memorandum of understanding (MOU) with the Peruvian Defense Minister and the commissioner of Defense Acquisition Program Admin-istration (DAPA) in the DAPA building on April 10 for the joint production of warship for Peruvian Navy.

Under the MOU, both parties will cooperate on the technology and production for the joint production of warships to be ordered by the Peruvian government. The Peruvian government is moving to award large-scale warship contract, such as submarine depot management, multirole logistics support vessel, etc., including the new build submarines.

Having signed this MOU, DSME took one step closer towards winning the large-scale contract to build warships for the Peruvian Navy. So far, Korean government and DSME have accelerated their drive to win the warship contract from the Peruvian government through the working group comprised of the government, public and private sectors such as the Ministry of Defense, the Ministry of Knowledge Economy, the Ministry of Foreign Affairs and Trade, Defense Acquisition Program Administration, Korea Defense Industry Trade Support center, Navy, etc.



DSME signed a MOU in the DAPA building, located at Yongsan District in Seoul, for the joint production of warship for Peruvian Navy.

Goh Jae-ho, CEO of DSME, mentioned, "Having signed this MOU, DSME has become the most preferred bidder for the project to build warships for the Peruvian Navy. Once the final agreement is signed, DSME will accomplish the splendid feat of making inroads into the defense market in the Central and Latin America, going beyond Asia and Europe."

DSME, which won a submarine contract from Indonesia in December last year and a logistics support vessel contract from U.K. in February this year, is close to winning the warship contract from Peruvian government and emerging as a major player in the global defense market.

Korea Exim Bank promotes the growth of shipbuilding and marine equipment industries based on coexistence and cooperation

Korea Exim Bank announced that it entered into an agreement with 3 companies - Hyundai Heavy Industries (HHI), Hyundai Mipo Dockyard (HMD), Hyundai Samho Heavy Industries (HSHI) - for the operation of 'large and small-to-medium business coexistence & cooperation program' at Westin Chosun Hotel in Seoul on March 30.

Kim Yong-hwan, President of Korea Exim Bank, and three presidents from Hyundai Heavy Industry Group are posing for photo after signing an agreement for the operation of large and small-to-medium business coexistence & cooperation program at Westin Chosun Hotel in Seoul on March 30.

This coexistence & cooperation program revolves around several themes; 'partnership in overseas business' for small and medium-sized firms making foray into foreign markets together with large companies, 'sustainable growth with SME (small and medium enterprises)' which are equipped with leading technologies, and 'seed of hope' for the disadvantaged in the society.

The signing ceremony was attended by Kim Yong-hwan, President of Korea Exim Bank, Lee Jae-sung, President of HHI, Choi Won-gil, President of HMD, and Oh Byeong-wook, President of HSHI, who expressed their firm intention for pursuing the co-growth of large companies and SMEs.

The shipbuilding industry ranked first among all Korea's export last year for the first time and has been the key driver of the nation's export growth for a long time so far.

However, the local content rate in domestic shipbuilding and marine equipment industry remains below 64%, which is far lower compared to the local content rate of approximately 90% in automotive sector. Particularly, the local content rate in the high value-added offshore plant sector is no more than 20%.

This agreement entered into between Korea Exim Bank and HHI aims to raise the local content in ships and marine equipment and help expand the technological capabilities of small and medium-sized companies.

Kim Yong-hwan, President of Korea Exim Bank, said right after the signing ceremony, "For sustainable growth, the co-growth of large companies and small and medium-sized companies is not a matter of choice but it is actually a must. I hope that this agreement will lay a foundation for the culture of co-growth to take root in whole industries."

Lee Jae-sung, President of HHI, said, "I am thankful to Korea Exim Bank for making effort to help build up competitiveness of vendors in the shipbuilding and marine equipment sectors. Large companies will be actively involved as strategic partners of vendors to create healthy and sound business environment."

RINA plays key role in world's first marine CNG project

RINA has been appointed by Indonesia's electricity utility PT PLN (Persero) to help develop the world's first marine Compressed Natural Gas (CNG) project on 19 March. The project, which is expected to deliver the first gas in 2013, is to transport between 3 and 6 thousand standard cubic feet (mscf) per day of CNG from the Indonesian island of Gresik to another Indonesian island, Lombok, where it will feed the Peaking power plant.

RINA has already delivered the feasibility study, and is now developing the Front End Engineering Design (FEED). This will be followed by support during tendering, and the provision of project management support during the Engineering Procurement and Construction (EPC) phase. Tendering will open in May 2012 and a number of different technologies are being considered.

This is a pilot project which will allow the use of cheaper natural gas in place of liquid fuel for power production. If the pilot project succeeds, the marine CNG technology will be applied to other power plants across the country with similar or larger capacity. PLN has mapped out potential utilisation of CNG in Indonesia. CNG will come from low-capacity gas wells, marginal gas wells, gas flare and surplus of gas supply as a result of a fluctuating gas absorption pattern.

RINA will advise on the most appropriate type of vehicle, logistical pattern, design of the compression and decompression terminals, and documents for EPC tender for construction of the marine CNG facilities. RINA has developed rules for the classification of CNG ships, which are based on new technological guidelines and which take into account experience gained so far in the field.

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Futuristic green ships are unveiled

Eco-friendliness and energy efficiency are the key issues facing the global shipbuilding market. The shipbuilding industry has strived for many years to control the marine pollution from ships as the EEDI (Energy Efficiency Design Index) and EEOI (Energy Efficiency Operational Indicator) will be adopted next year.
The underlying aspect of green ship is the reduction of CO_2 emissions and pollutants from the vessels at sea. The existing vessels, as well as new vessels, are subject to the environmental regulations. The fundamental solution is the technology for replacing the fuels used to power existing ships. Although hybrid or fuel cell technology have already been commercialized in the automotive sector, the technical barrier still remains before hybrid or full cell vessels become commercially viable.
The shipbuilding industry has adopted related technologies to build new green ships, such as coating materials, ship model design, engine and propulsion system, global positioning system, etc. The green ships which incorporate a variety of eco-friendly technologies are being unveiled.

Green, a paradigm shift

International Maritime Organization (IMO) is currently playing a leading role in regulating the greenhouse gas (GHG) emissions from ships amid increased emphasis on eco-friendliness worldwide. The IMO regulations require a reduction in NOx emissions from ships by 80% by 2016 and CO_2 emissions from ships by 30% by 2025. In addition, the IMO regulation requires all ships to be equipped with the ballast water

treatment system from next year.

According to the industry, IMO Marine Environment Protection Committee (MEPC) met in London, U.K., last year and adopted the amendments to MARPOL Annex VI Regulations for the 'International Convention for the Prevention of Marine Pollution from Ship (MARPOL)' in relation to the regulation of carbon emissions from international shipping. All vessels in excess of 400 ton dead weight, built after January 1, 2013, are required to be designed, constructed, and operated in accordance with the CO_2 emission standard by type of ship and tonnage if the aforesaid amendments become effective. As a result, EEDI (Energy Efficiency Design Index) became mandatory for new vessels, and existing ships are required to operate in line with EEOI (Energy Efficiency Operational Indicator).

EEDI and EEOI, which stalled over the objection of China and developing countries so far, are expected to come into force after 2013. In addition, IMO requires all ships built before January 1, 2013, to retain the SEEMP (Ship Energy Efficiency Management Plan), which incorporates the objectives of greenhouse gas emissions and energy-saving, on board.

IMO will enforce the CO_2 emission standard by phase, granting a period of grace for ships. IMO Marine Environment Protection Committee reached an agreement that ships should meet emission standards adopted in the amendments for 2 years from January 1, 2013 to the end of 2014, and reduce the carbon emissions by 10% below the IMO emission limits between 2015 and 2019 and additional 10% below the IMO limits below between 2020 and 2024 and onwards.

▲'STX DOVE', a 6,700-ton pure car carrier of STX Pan Ocean, is equipped with solar panel that can produce up to 24kw on the upper side of the deck. STX DOVE was fitted with solar panel in Korea early March and came into Ulsan port at the dawn of April carrying the cars which were loaded onto it in Latin America.

Air pollutants from ships

- ***Nitrogen oxides***
  - Tier II and III
  - Formation of various kinds of SCR
  - Cheap and long-lasting Catalyst
- ***Sulphur oxides***
  - Low sulphur fuel oil
  - DeSOx system - Scrubber, Cyclone and etc
- ***Carbon dioxides***
  - Energy saving device
  - New generation model
- ***PM***
  - PM reduction devices
  - High quality bunker and/or better maintenance
- ***VOC***
  - Onboard VOC control system
  - Shore VOC control system

Table 1. NOx Emission Control - MARPOL Annex VI Reg.13

RPM	Tier I(Paragraph 3) 2000.1.1 ≤ K/L	Tier II (Paragraph 4) 2011.1.1 ≤K/L	Tier III (Paragraph 5.1.1) 2016.1.1 ≤ K/L
n < 130 rpm	17.0 g/kWh	17.0 g/kWh	3.4 g/kWh
130 ≤ n 130 < 2000 rpm	45.0 x $n^{(-0.2)}$ g/kWh	45.0 x $n^{(-0.2)}$ g/kWh	9.0 x $n^{(-0.2)}$ g/kWh
2000 rpm ≤ n	9.8 g/kWh	9.8 g/kWh	2.0 g/kWh

20% 80%

Tier III

The emission standard set forth in the Paragraph 5.1.1 is applied to the NOx emission control areas of the sea. For the areas of the sea outside the NOx emission control areas, the provisions specified in the Paragraph 4 will be applied.

(Source: Korean Register Green And Industrial Technology Center)

Advent of environment-friendly offshore era

The growing trend toward green ship is irreversible. R&D projects related to green ship in the shipbuilding industry have been carried out in multifaceted fashion. European countries and Japan are current leaders in the green ship technology. EU began to have interest in green ship from late 1990s and researched into 'zero emission ship' that can accommodate 100 passengers. Meanwhile, Japan has pushed ahead with 'Super Ecoship Project', a new-concept ship powered by the fuel cell as main power and uses solar and wind energy at the same time.

The ultimate purpose of shipbuilders with regard to green ship is to construct eco-friendly vessels fitted with engine that do not emit SOx, NOx, etc., the major contributor to the environmental pollution. For the existing vessels, the focus of research was placed on installing the emission reduction system onboard.

Domestic shipbuilding heavyweights have accelerated their drive to develop green ship technology. Samsung Heavy Industries (SHI) is currently conducting R&D project related to the technology that enables the use of natural gas as auxiliary power, along with the waste heat recovery and low temperature combustion technology to minimize the consumption of fuel. Hyundai Heavy Industries (HHI) obtained certification for its ballast water treatment system from IMO, which increases the energy efficiency and reduces fuel consumption. HHI has successfully installed this system on board ultra large crude carrier. Meanwhile, Daewoo Shipbuilding & Marine Engineering (DSME) recently unveiled the high pressure natural gas fuel supply system, an environment-friendly technology enabling the reduction in the emissions of greenhouse gases, such as CO_2, NOx, etc., by over 95%.

Korean government has increased its support for the development of green ship technology. Last year, the Ministry of Knowledge Economy (MKE) announced a mid and long-term strategy that aims to help build up competitiveness of domestic companies in shipbuilding and offshore sectors. The government estimates that the green ship market would be worth a combined KRW 200 trillion by 2015, including direct and indirect markets. Accordingly, the government plans to inject KRW 300 billion into the development of green ship for the next decade.

Meanwhile, Korean Register of Shipping (KR), Korea Marine Equipment Research Institute (KMERI), North Jeolla Provincial Government, Gunsan Municipal Government, Gunsan University, etc., plan to establish the Green Ship Certification & Standardization Support Center with an investment of KRW 30 billion by 2015. The Green Ship Certification & Standardization Support Center to be established in Gunsan University will play a leading role in fostering the relat-

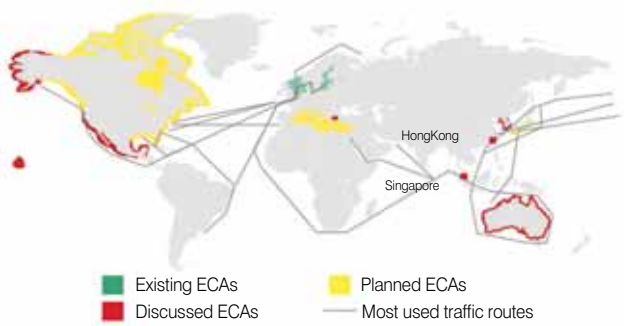

Figure 1. Emission Control Areas (ECAs) for IMO Tier III (Source: Rolls-Royce)

Figure 2. IMO agreement to reduce atmospheric pollution from ships over the next 5 years - the reduction in SOx shown - 2016 IMO Tier III comes into force. (Source: Rolls-Royce)

Figure 3. A total of 240 solar panels, 25m wide and 11m long, installed on the deck of STX Pan Ocean's 'STX DOVE', a pure car carrier with the carrying capacity of 6,700 cars. These solar panels can produce up to 24kw of electric power and generate 5% of the electricity necessary for the ship's operation.

ed industries and promoting the R&D projects related to marine equipment compliant with the IMO's carbon emission standard.

Photovoltaic energy for auxiliary power supply

STX Shipbuilding & Offshore (STSOS) has injected fresh momentum into the effort to build environment-friendly vessel. Through that, STXOS plans to maintain competitive edge over Chinese rivals based on technological competitiveness while actively coping with a variety of environmental regulations that have become more rigorous than ever worldwide.

In 2009, STXOS unveiled the environment-friendly STX GD (Green Dream Project) ECO-Ship which dramatically reduces the emissions and saves the fuel cost by over 50%. Moreover, STXOS recently presented a pure car carrier equipped with solar panel to produce some portion of the energy necessary for the operations. In the first place, the STX GD ECO-Ship adopted the triple blade propeller to enhance the efficiency of propulsion and the energy-saving auxiliary blade system that improves the flow at the stern, thereby maximizing the basic specification and increasing the energy efficiency.

In particular, the STX GD ECO-Ship incorporated the advanced eco-friendly technologies, such as WHRS (Waste Heat Recovery System) which recovers hot waste gas from the engine to convert thermal energy into electric energy.

STX GD ECO-Ship, fitted with eco-friendly engine, reduces carbon monoxide emissions by 45% and increases fuel efficiency by 40%, compared to the existing ships that use bunker C oil as main fuel. Additionally, wind turbine generator or photovoltaic generator can be installed on the deck to use the renewable energy to power the vessel.

Furthermore, 'STX DOVE', a pure care carrier of STX Pan Ocean with the carrying capacity of 6,700 cars, is equipped with the photovoltaic power system to produce the electricity for auxiliary power supply. According to STX, STX Solar developed the photovoltaic power system and STX Marine Service

Figure 4. 'MSC BERYL', a 13,000TEU-class supersize containership of STXOS, which obtained the EEDI certification from GL.

undertook the installation and provided technical advice.

Solar power and wind power technology are vital for building green ships. Although photovoltaic power systems were installed on board cruise ships for illuminating the cabin, etc., STX DOVE is the first ocean-going vessel nationwide to be fitted with the photovoltaic power systems.

The 25m wide and 11m long photovoltaic power module, which consists of 240 solar panels, is mounted on STX DOVE and can produce up to 24kW of electricity. It represents 5% of electricity necessary for the ship's operation such as the engine control, ventilation, lighting, etc. STX Pan Ocean plans to change the module to increase the power output to 60kW by the end of this year and to 120kW by 2013, so that approximately 30% of electricity can be generated from the voltaic power system.

An official from STX said that the companies with leading eco-friendly technology would become the dominant players the shipbuilding and shipping industries as the green energy boom was sweeping through the offshore sector. He added that STX's technology for vessels powered by photovoltaic energy would be applied to other vessels after close examination of various operational aspects, as well as fuel-saving effects.

Last month, STX Offshore & Shipbuilding (STXOS) became the world's first shipbuilder to obtain EEDI certification from GL and successfully delivered 'MSC BERYL', a 13,000TEU ultra large containership. This containership incorporates the cutting-edge green ship technology and reduces CO_2 emissions by nearly 20%. Furthermore, this vessel uses the electric power supplied from onshore electrical grid when it is being anchored in the harbor, and features AMP (Alternative Maritime Power) that enables the reduction in the exhaust gas emissions from the ship's engine during the production of electric power. In light of that, STX is expected to leverage STX Europe's advanced technology in the construction of cruise ships and vessels powered by LNG, the environment-friendly fuel, and thereby attain stronger competitiveness than other shipyards in the construction of eco-friendly vessels.

Eco-friendly engine, the key to success

Domestic shipbuilding heavyweights have completed or are developing eco-friendly ship technologies that can reduce emissions of pollutants, such as waste heat recovery system, LNG-powered propulsion system, etc. Hyundai Heavy Industries (HHI) has been at the forefront of developing eco-friendly vessels, including the green engine, ballast water treatment system, electricity-powered LNG carriers, etc., since 2008. 'HiMSEN H35G', a LNG-powered engine developed by HHI in 2010, incorporates the cutting-edge Lean Burn technology that ensures the highest efficiency with minimal fuel. Particularly, HiMSEN H35G reduced CO_2 emissions by over 20% and NOx emissions by over 97%, compared to existing diesel engines.

Recently, HHI successfully completed the inclination type approval test for its HiMSEN engine, which was conducted with an inclination of 25 degrees, in the presence of the officials from Det Norske Veritas, the Norwegian classification society. HHI proved the durability and operability of its HiMSEN engine in the test conducted with an inclination of 25 degrees to reproduce the inclination condition of rough sea environment, unlike the ordinary test usually performed at a horizontal angle for ships and onshore power generator engines, and thereby demonstrated the viability of the engine

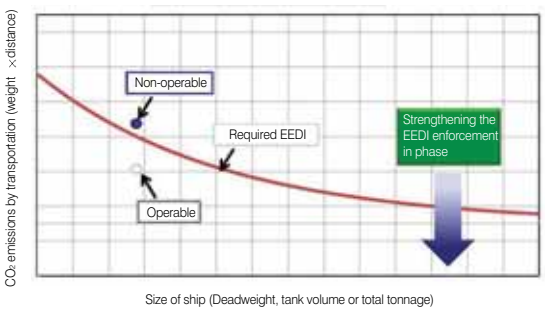

Figure 5. Concept of IMO EEDI regulation (Source: Korean Register Green And Industrial Technology Center)

Figure 6. 'HiBallastp', developed independently by HHI last year, filters out various aquatic organisms larger than 50 μm from the seawater inside the ship's ballast tank and sterilizes them through electrolysis.

Figure 8. The hybrid vessel built by DSME. This vessel, equipped with dual fuel engine, has a maximum carrying capacity of 162,400m^3 of LNG.

Figure 7. German Schulte's 7000TEU container ship equipped with HHI's 'EcoBallast'.

in the offshore plant market.

The engines for offshore facilities, such as drillship, are required to meet stricter quality standards than those for general merchant vessels. Hence, the engines manufactured by MDT of Germany, Wartsila of Filand, Caterpillar of the U.S., have been used for offshore facilities. Meanwhile, HHI's HiMSEN is used for the propulsion of ship, auxiliary power supply and onshore power generation and have been exported to about 40 countries worldwide.

HHI developed the electrolysis HiBallast System last year, following its development of EcoBallast which sterilizes the seawater using ultraviolet rays. HHI's HiBallast System, developed with its independent technology, filters out various aquatic microorganisms larger than 50 μm from the seawater flowing into the ship's ballast bank and sterilizing them through electrolysis. This system can sterilize 500 to 8000m^3 of seawater per hour.

IMO requires all ships to be equipped with the ballast water treatment system from 2012. The industry estimates that the market for ballast water treatment system would be worth approximately KRW 15 trillion by 2016.

LNG, the key pillar of eco-friendly strategy

Daewoo Shipbuilding & Marine Engineering (DSME) has developed and incorporated a variety of eco-friendly parts and technologies into ships, along with the fuel supply system that dramatically reduced emissions of various greenhouse gases, thereby establishing a leading position in the green ship market.

Last year, DSME completed the development of LNG-powered systems in collaboration with MAN Diesel & Turbo, a world-leading marine engine maker. This propulsion system is a high pressure fuel gas supply system (HP-FGS) that supplies the highly pressurized natural gas fuel to the next-generation gas injection engine (ME-GI:MAN Electronic Gas-Injection Engine), and uses LNG as main power supply instead of existing bunker C oil. This system reduces CO_2 by 23%, NOx by 80%, and Sox by over 95%, compared to the diesel engine of the same output.

This ME-GI engine, which can be fitted to very large vessels, adopts high-output and high-efficiency direct propulsion system and can supply the gas using only about 5% of power compared to the existing engines.

Along with that, DSME has unveiled a wide range of solutions, including PSS (Pre-Swirl Stator), a fuel-saving system built on the green ship technology, VOC (Volatile Organic Compound) emission reduction system, WHRS (Waste Heat

Figure 10. Changes in the source of power for ships & expected scenario for implementation.

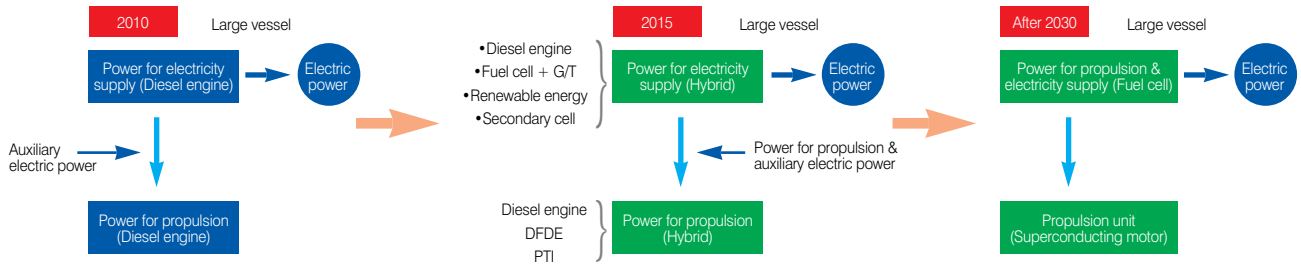

Figure 9. High pressure fuel gas supply system (HP-FGS) of DSME.

Recovery System) which recycles the heat of exhaust gas from marine engine.

PSS technology helps ensure uniform flow of water entering the propeller at the stern with the blades being fixed in front of the ship's propeller. This leads to the reduction of fuel consumption by 3 to 5%, increase in the speed of vessel, and decrease in the emission of pollutants. These technologies will be applied to the very large crude carrier project awarded early this year from Kuwait's state-owned KOTC (Kuwait Oil Tankers Company). DSME plans to incorporate these eco-friendly technologies to nearly all vessels that it will build in the period ahead, such as LNG carriers, containerships, very large crude carriers and others, and has mapped out the strategy to secure competitive edge with a focus on the development of new eco-friendly technologies.

Energy management roadmap

Samsung Heavy industries (SHI) completed its energy management roadmap with an objective of reducing the greenhouse gas emissions by 20% by 2020. Additionally, SHI established a strategy to inject USD 500 billion into the development of eco-friendly vessel technology and register 1,000 patents in related fields by 2015. SHI estimated that the total carbon monoxide emissions from an 115,000-ton oil tanker would stand at approximately 1.17 million tons during the 25-year operation period from its deployment to decommissioning, and the CO_2 emissions produced during the vessel's operation would account for 98%.

SHI plans to press ahead with the development of high-efficiency eco-friendly technology that can reduce CO_2 emissions from the vessels' operations and enhance the operational efficiency. Particularly, SHI will develop various new technologies to increase the energy efficiency, such as the optimized ship model design that minimizes fuel consumption, waste heat recovery system, low temperature combustion, etc.

The efforts to reduce greenhouse gas emission from ships are expected to continue. Although the technologies, such as natural gas engine, solar panel mast, hull coating, etc., have yet to be commercialized, many different fuel-saving technologies which can enhance the energy efficiency of ships have been discussed. The final goal may be using the solar, wind, electric energy, etc., as the main power. However, hybrid or LNG engines which are expected to be commercially viable in the near future are considered the most convincing option.

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ABB hit a record high of USD 40 billion

ABB hit a record high of USD 40 billion amid fast growth in the Americas and Asia. Among these, ABB Korea continues on its fast growth path, making record high sales of KRW 500 billion in 2011. ABB plans to strategically make inroads into the 12 sectors with great potentials for growth.

ABB Korea President and CEO, Han yun-sok Country Manager

ABB Korea held the event to announce the business performance and strategy of ABB group and ABB Korea on March 30. Han Yun-sok, President and CEO country manager said, "Sales rose 17% year-on-year to USD 40 billion due to balanced growth. Especially with improved productivity, we registered USD 500 billion in sales, up approximately 40% from the previous year, and fueled the growth in Asia region. This is a very encouraging result. We will not save our efforts for the growth and domestic industrial development."

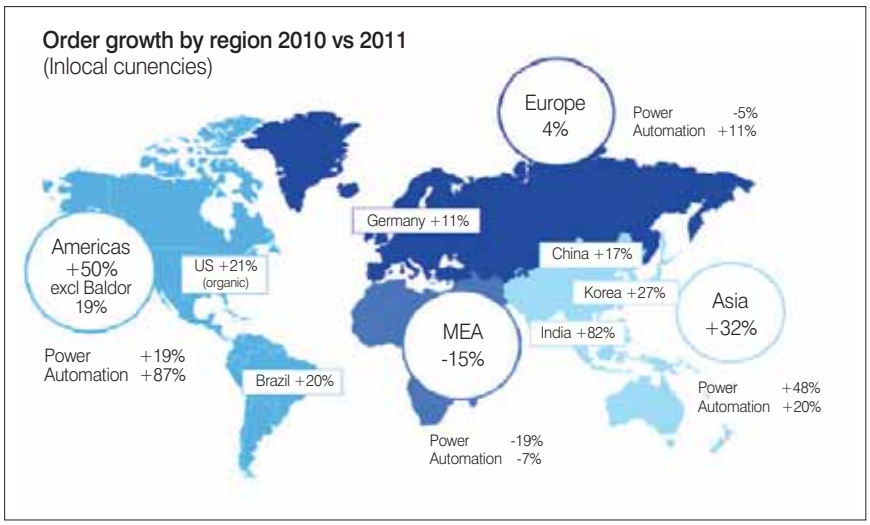
Last year's remarkable growth of ABB, according to analysts, is attributed to its increased market share by Baldor's acquisition and at the same time due to skyrocketing demand. In the business sector, industrial automation division, which Baldor company belongs to, grew by 63% to USD 9.57 billion in yearly revenue and also registered 32% growth in order intake from Asia region. The company has stable structure through a variety of portfolio and shows balanced growth of sales in Europe, Middle East, Africa, Asia, and US, not confined to a particular region.

Concentration and selection, Sales target of KRW 1 trillion by 2015

It is estimated that the world population will reach approximately 9 billion by 2050. So the demand in resources like water, metal, mineral, and etc. will soar. The rapid economic growth of developing countries such as China, India, and Vietnam will fuel the demand for resources. Environmental problem caused by global warming has become a global issue with drastic effects on overall areas of industries.

According to these changes, the company selected 12 potentially major sectors with great prospect for growth based on the strength in electric power, automation portfolio, technology leadership, powerful organizational capability to achieve objectives, extensive experience, solid financial structure, global operations.

- *Renewable energy*
- *Energy efficiency*
- *Oil and gas*
- *Smart grids*
- *DC technology and expanding application areas*
- *Software*
- *Service*



- Data Center
- Industrial automation
- Power electronics
- Mechanical power
- Geographic market penetration

Along with this, the company selected Industry Segment Initiatives that all business departments commonly head for and the industry which must be focused on among the whole business of the Group. The sector, which has no much business at present but has growth potential, was included.

ABB Group aims to achieve a two-fold growth by the year of 2015 while ABB Korea set the target of KRW 1 trillion in sales in Korea by then. For that, the group set up major growth sectors and People strategy.

For 2015 ABB strategy, top 5 priorities are listed as followings.

1. Sharpening Competitiveness
2. Full understanding of the future trends in modern society
3. Active promotion of major business
4. Moderate M&A based on principle
5. Development of untapped areas

To achieve a two-fold growth by 2015, ABB seeks to tap into new markets through M&A and vigorously expand newly growing area. For that, the company plans to aggressively strengthen service and software business by increasing the budget of R&D by 4% by 2015. Especially, the sales from the service and software sectors will account for 16 to 25% of the company's total sales. ABB has been already providing high-end products to customers with strengthened service within the delivery date, as well as putting consistent efforts on cost optimization, to strengthen its business in the software sector, since 2011.

ABB Korea also set up the strategy not only for business success but for its employers. During the aforesaid event, Min, Young-ok, Director of ABB Korea, explained about global talent nurturing program which arranges the right man in the right place to increase work efficiency and complements the self-development and evaluation system. ABB Korea has the program that 10% of its employers have overseas work experience as a part of 'People strategy' and has already been providing English learning courses to its employers and their families.

First appointments for XpressLink dealers network

The leading provider of global mobile satellite communications services, Inmarsat announced the first appointments for its global network of XpressLink dealers on 23 April. Twelve of the world's most-respected maritime communications specialists have been approved to sell XpressLink, providing access to shipping fleets worldwide through sales teams based in North America, Europe, Middle East and Asia.

Inmarsat issued an invitation to distribution partners, service providers and system integrators in early March to confirm interest in becoming an XpressLink dealer, with a positive response from more than 80 per cent. Negotiations with the majority of applicants are now at an advanced stage. The initial 12 dealers that have completed the rigorous selection process are: Anchor Marine Equipment & Repair Company, AND Group, Arskom Marine, DH-INTERCOM, Elcome, Hellenic Radio Services, Navarino, Tile Marine etc.

"We are excited by this endorsement of the XpressLink service as a gateway to Global Xpress," said Frank Coles, President, Inmarsat Maritime. "These 12 companies are at the forefront of delivering high-quality and cost-effective solutions to shipping fleets. They will not support a service unless they know it offers demonstrable value to their customers - value that is future-proofed with the transition path to Global Xpress. Several of the dealers we have announced today have already closed deals, and we expect more soon."

XpressLink offers a fully-integrated Ku-band and L-band solution for a fixed monthly cost. A complete solution managed by Inmarsat, it delivers a compelling combination of broadband speed, a reliable and high-quality service, and global coverage. XpressLink supports always-on data speeds of 768kbps, with a committed information rate of 192kbps, when the VSAT service is active.

RS has opened a Design and Newbuilding Support Centre in the Republic of Korea

Design and Newbuilding Support Centre was established in line with the RS' strategy to expand its global operation. RS will also focus on providing better services within the region, like supporting the project jointly implemented with STX Offshore & Shipbuilding (STXOS), as well as strengthen the cooperation with Korean shipyards.

The Centre has been established in line with the Russian Maritime Register of Shipping (RS) strategic global expansion plans. It will facilitate further development of RS services in the region.

The main objectives of the newly established office are to foster closer contacts with clients and partners within one time zone; to provide technical support to RS surveyors involved in newbuilding projects at Korean yards, to render the full range of RS services in newbuilding for Korean market, including design review, surveys of ships during construction, certification of marine equipment, to liaise and hold joint seminars with representatives of the Korean maritime industry.

The first project of the new Centre is supervision during construction of two LNG carriers for JSC "Sovcomflot" under the recent agreement with STX Offshore & Shipbuilding shipyard. Other projects are in the pipeline.

The official opening ceremony and evening reception took place on 7 March 2012 in Busan. The ceremony was attended by senior maritime executives, including Nikolai Grigoriev, Director of Global Shipping & Logistics of Gazprom Global LNG; Viktor Rokhlin, advisor of JSC "Sovcomflot" Chief Executive Officer; Hwanag Byung Hyun, Senior Executive Vice President STX; Chullyun Kim Executive Vice President Samsung Heavy Industries; Executive Vice President Daewoo Shipbuilding and Marine Engineering Yong-Seop Han, Executive Director Hyundai Heavy Industires G. J. Ha; Senior Manager Hyundai Mipo Dockyard C. H. Song; President of SPP Shipbuilding Kwak Han Jung, Sales Director Hanjin Heavy Industries and Construction Jy Kim; President of Sungdong Shipbuilding & Marine Engineering Byun Moon Sung; Executive Director Sungdong Shipbuilding & Marine Engineering B.I. Gu; and Andrey Osmakov, Consul-General of

<go to page 40>

Russian Maritime Register of Shipping held a launching ceremony for the Design and Newbuilding Support Centre on the 25th floor of Samsung Life Insurance building located at Beomcheon-dong, Busanjin-gu, Busan, to expand cooperation with Korean shipyards.

Portfolio with a focus on eco-friendliness and energy efficiency drives the sales growth

Siemens Industry Sector presented a blueprint for its future growth strategy. Siemens is expected to push ahead with its strategy to expand its market share based on its leading portfolio with a focus on energy efficiency and eco-friendliness.

Siemens presented a wide spectrum of products and solutions for the integrated industrial automation under the theme of 'Ultimate Reliability, Maximum Value' during the Automation World 2012 held in COEX, Seoul, from April 3 to 6. Particularly, Siemens showcased its specialized and integrated automation solutions and products that are environment-friendly, energy-saving, and increase safety.

Kim Jong-gab, President & Chairman of Siemens Korea, said, "We strive to make significant contribution to the advancement of Korea's key sectors such as the infrastructure & cities, energy, healthcare, etc. We aim to achieve a two-fold increase in sales by 2016 and push ahead with our strategic plans to develop excellent manpower and strengthen the corporate brand."

Siemens announced its mid and long-term strategies to achieve steady sales growth. For that, Siemens plans to strengthen its position in the innovative sectors and emerging markets and increase the market share based on eco-friendly portfolio. In addition, Siemens will strategically push ahead with the business and services tailored to the needs of customers.

In particular Siemens aims to achieve steady revenue growth based on a wide-ranging eco-friendly portfolio. Last year, Siemens registered EUR 29.9 billion in that market, which accounts for 40% of its total sales.

Siemens plans to achieve EUR 40 billion based on this portfolio by 2014. This eco-friendly technology is divided largely into three types. The first type is the renewable energy technology related to the wind power, electric power network, steam turbines for photovoltaic power plants. The second type is the eco-friendly technology for water treatment, air pollution removal, etc. The third type is the high efficiency products and solutions that increase energy efficiency.

Energy efficiency and data security solution

Siemens unveiled new products, including 'SIMATIC HMI Comfort Panels' and

Siemens booth (left) during the Automation World 2012. The innovative automation solutions of Siemens captivated the visitors (right).

'PCS7 V8.0' that provide about 70 new functions and enhanced performance, during the Automation World 2012.

'SIMATIC HMI Comfort Panels' integrate various functions and all models can be mounted vertically, thus increasing the space utilization in the plant, and therefore can be used for the design of special machinery.

PCS7 V8.0 supports various innovation functions, in addition to the proven performance such as the flexibility, expandability, security integration, batch automation, energy management and others. Through these innovation functions, customers can improve the system efficiency throughout entire life cycle. As the process becomes more complex, the requirement for the robustness and functionality of HMI device also becomes complex. The state-of-art SIMATIC HMI Comfort Panels integrate various functions to meet these requirements and are high performance HMI devices featuring high quality aluminum front side casings.

- 4~ 22 inch Comfort Panel
- Brightness adjustment
- LED backlight
- High resolution wide screen display
- No frame and excellent visual effect

Eun Min-soo, Vice-President of Siemens Industry Sector, said, "Siemens provides comprehensive range of one-stop services ranging from the entire industrial plant control system and individual parts of switchgear cabinets to variable speed drives and high efficiency motors. Considering that the energy efficiency improvement and data security have become the prerequisite for long-term competitiveness of manufacturers, we will keep innovating the related product lines of Siemens."

<continue page 38>

the Russian Federation in Busan.

Grigoriev of Gazprom Global LNG remarked, "Gazprom's and other Russian companies' need for cost-effective and environmentally-friendly tanker fleet for trade and export operations and the need for offshore units and vessels for the exploitation and production of natural resources on the Russian shelf, call for a new approach based on innovation, best scientific achievements and best practices of the world's shipbuilding sector. RS maintains close contacts with almost all the maritime industry stakeholders, both Russian and foreign: shipyards, shipowners, research institutes and international organisations. Thanks to its unique practical experience and position, RS can and should become a 'bridge', coordinating Russian and foreign partners' joint efforts for innovation in shipbuilding."

Rokhlin of Sovcomflot said, "Sovcomflot highly appreciates the level of interaction with RS and looks forward to expanding the scope of our cooperation".

"Our clients' ambitious fleet construction plans have prompted us to expand our global presence, especially within the major shipbuilding centres, - emphasized RS CEO Mikhail Ayvazov. The first RS office in the Republic of Korea was established back in 1996 with the main focus on ships in operation. Since 2005 RS has continuously been involved in various newbuilding projects in Korea and has acquired substantial experience of cooperation with the major Korean shipyards.

The high-tech marine projects involving RS participation in Korea range from Arctic shuttle tankers to state-of-the-art drilling units. These projects have enabled us to establish good relationships with the local maritime industry."

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The Offshore Plant Equipment Test & Certification Center was launched to promote the localization of equipment

A center dedicated to the test and certification of domestic offshore plant equipment was launched. Located on Geoje Island in Gyeongsangnam-do, the Offshore Plant Equipment Test & Certification Center is expected to play a key role in strategically supporting the advancement of domestic small and medium companies into foreign markets while promoting the localization of equipments in offshore plant industries which has recently shown rapid growth.

The opening ceremony of "Offshore Plant Equipment Test & Certification Center" was held on March 30 with over 100 industry-academy major officials including the Vice-Minister of Knowledge Economy, Yoon, Sang-jik and the Governor of Gyeongsangnam-do, Kim, Doo-gwan, at Geoje-si, Gyeongsangam-do. The ground breaking ceremony took place on April, 2010 and the center was completed on March of this year with the purpose of fostering the offshore plant equipment and the certification Industries. The center was promoted as part of 'South-eastern offshore plant global hub' with KRW 15 billion investment for the construction and launched inside Korea Marine Equipment Research Institute.

The prevailing opinion is that the explosive growth in demand has already started while the 3 domestic shipbuilding giants are expected to account for 60% of the whole sales. The Offshore Plant Equipment Test & Certification Center will help build up competitiveness of local products and strengthen the cost competiveness by establishing the test/certification infrastructure and R&D facilities.

Accordingly, the Offshore Plant Equipment Test & Certification Center will play a pivotal role in acquisition of the KOLAS (Korea Laboratory Accreditation Scheme) certification and creation of the database related to the offshore plant equipment test & certification technology, and support the test and certification of offshore plant equipment. This center can also carry out the evaluation of performance and test/certification for equipments including compressor, pump, valve, and plumbing.

Particularly, the Offshore Plant Equipment Test & Certification Center is equipped with the world's first facilities testing LNG FPSO Multi Purpose Dynamic Simulator, Fuel Gas Compressor Package Test Facility and Asia's largest Non-line Tensioner Cylinder Package. Besides, it also has about 12 kinds of different facilities testing the offshore plant equipment, including the Seawater Lift Pump Test Facility, Jet-fire Test Rig

At the same time, the Offshore Plant Equipment Test & Certification Center, when linked to the southeastern R&D belt

The opening ceremony was attended by about 100 officials, including Yoon, Sang-jik, Vice-Minister of Knowledge Economy, and, Kim, Doo-gwan, the Governor of Gyeongsangnam-do, Park, Yoon-so, chief director of Korea Marine Equipment Association, Kim, Ki-jeong, President of Korea Marine Equipment Research Institute and others from Offshore plant equipment companies.

The signboard hanging ceremony for the Offshore Plant Equipment Test & Certification Center

Fuel gas compressor package test facility

Table 1. Equipment of Offshore Plant Equipment Test & Certification Center

Equipment	Description	Number of Items
Extremely low temperature environment testing facility	Extremely low temperature compressed airflow Extremely low temperature valves	2
Fuel gas compressor package test facility	Performance test equipment for compressor package	1
Multi-purpose complex tower	Seawater Lift Pump Package Test	1
	Anchoring Winch Package Test	1
	NL-Tensioner Cylinder Package Test	1
Jet-fire test facility	Pipe protection material Wall plate protection materials	2
Dynamic Test Rig	Welding structure Equipments for extremely low temperature Outfitting materials	3
Multi Purpose Dynamic Simulator (MPDS)	Topside process design, research/application of dynamic behavior Education on LNG FPSO topside process concept & training on the operation, training, and application of HAZOP analysis	1
ICP Spectrometer	Equipments for analysis of mechanical parts and materials of vessel and offshore plant	1
3D Printer	Equipment producing 3 dimensional model and parts based on designed 3D data	1
DAQ System	Measurement of environmental and physical stress from offshore plant mechanical parts	1
Fire propagation equipment	Interior materials	1
Equipment of measuring smoke and Toxicity	Interior materials	1
Cone Calorimeter	Interior materials	1
Total		18

Equipment testing the smoke density

such as Pusan Offshore Plant Equipment R&D Center and Hadong Offshore Plant Institute for Explosion Fire Test, will make significant contribution to the improvement of offshore plant equipment technology.

Yoon, Sang-jik, Vice-Minister of Knowledge Economy said, "Offshore plant market will expand fast, worth approximately USD 500 billion by 2030. The Offshore Plant Equipment Test & Certification Center will increase the reliability of domestic offshore plant equipment and provide a link of co-growth to the offshore plant shipyards and equipment manufacturers."

The Ministry of Knowledge Economy plans to help the Offshore Plant Equipment Test & Certification Center secure technology and manpower necessary to move beyond the test and evaluation phase and begin to provide the certification service independently at the soonest, develop and strengthen the international certification brand that can compete with existing overseas companies.

And also, the Offshore Plant Equipment Test & Certification Center will provide training on the technology through the current testing equipment and LNG FPSO Multi Purpose Dynamic Simulator, which can be practically applied in the offshore plant equipment manufacturing sites or shipyards.

Major business of the Offshore Plant Equipment Test & Certification Center

- *Establishment of offshore plant equipment test/certification and performance validation facilities: Seawater Pump Test Facility, Fuel Gas Compressor Test Facility, Extreme Low temperature Environment Test Facility*
- *Establishment of offshore plant equipment test/certification facility: Simulator(OTS), Design Analytical Equipment(3D Printer, ICP Spectrometer, DAQ System, Dynamic Test Rig), Safety-Related Equipment*
- *Establishment of offshore plant equipment test/certification supporting system (KOLAS certification, etc)*
- *Establishment of database related to the offshore plant equipment test/certification technology, and provision of support*

An insight into the global offshore industry

A global event, which provides an insight into the future of offshore industry and humanity, is slated to open at Busan Exhibition and Convention Centre (BEXCO) in early June. Particularly, this event coincides with the 2012 Yeosu International Expo, offering many different things to watch, and provides a unique platform to exchange knowledge in the global offshore sector.

The '6th World Ocean Forum 2012', which is organized by the Ministry of Land, Transport and Maritime Affairs (LMTMA), Busan Metropolitan Government, and Korea Association Marine Industry (MAMI), will be held at the Busan Exhibition and Convention Centre (BEXCO) for 3 days from June 4 to 6 under the banner of 'Blue Frontiership & Ocean Governance'.

This World Ocean Forum is expected to draw about 3,000 domestic and overseas scholars and experts in offshore sector and provides a unique platform to explore the potentials of future offshore industry which is closely related to the survival of humanity and discuss the global issues based on the new trends of 5 major industries in the offshore field (shipbuilding & offshore plant, logistics, fisheries, marine environment, new offshore industries).

This forum consists of 5 regular sessions and 3 special sessions, and touches on the most sensitive issues facing the offshore industry, such as the integrated offshore governance, offshore plant, logistics industry in the era of ultra high oil prices, fishery problem in global era, climate change, environment, etc.

The key note speech will be delivered by Peter Herzig, Director of IFM-GEOMAR in Germany, who is also chairman of POGO(Partnership for Observation of the Global Oceans), and Baek Jin-hyeon who currently serves as President of the Graduate School of International Studies, Seoul National University, and judge of International Tribunal for the Law of the Sea (ITLOS). The special speech will be delivered by Tony Haymet, Director of U.S. Scripps Institution of Oceanography.

Session I
- *Best Practices and Perspectives of the Integrated Ocean Governance Plan*

Session II
- *Global Pioneer Strategy of Greenship & Offshore Plant Industries*

Session III
- *Factoring High Oil Prices into Logistics Industry Risk Management*

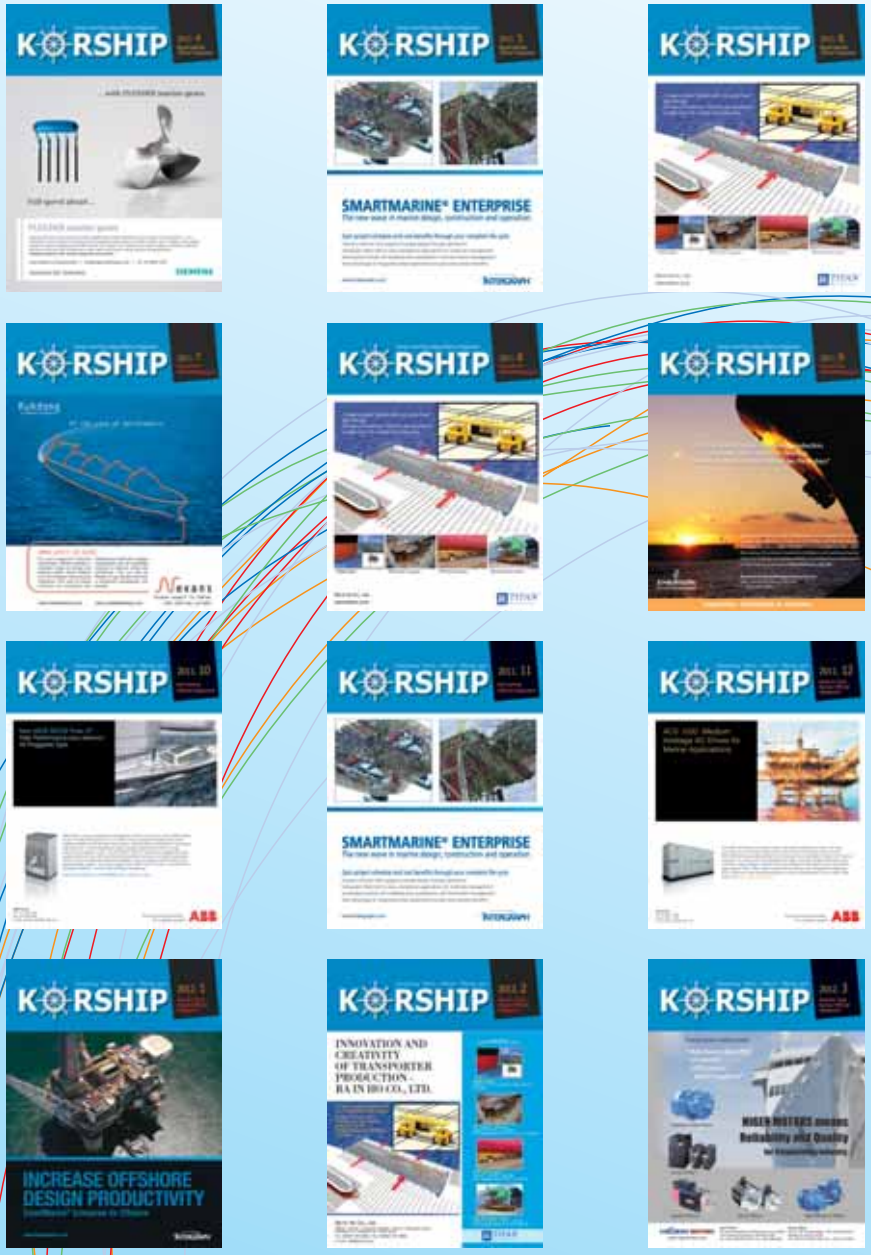
Session IV
- *Emerging Issues for Global Seafood Industry*

Session V
- *Climate Change and Future for Marine Environment and Biotechnology*

Special Session
- *Diverse Industrial Models of Marine Bioresource*

The special session will introduce the industrial models in the ocean bio field which has been thrust into limelight and present ancillary events such as Korea-China offshore economic expert roundtable, offshore journalist forum, etc. Particularly, Offshore Bio Industrial Exhibition, held in parallel with this World Ocean Forum, will revolve around the theme, 'New Value Creation, Future of Offshore Bio Industry'. The participating companies will present their research results in the booths arranged separately.

According to the Forum Organizing Committee, this Forum is expected to serve as a platform to discuss the global issues base on the new trends of 5 major industries in the offshore field. Specifically, this Forum will present the model of international event that highlights the characteristics of ocean city and provide opportunities to experience the impressive Korean culture and connect with the international experts in offshore industry.



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Mass appeal

Buffalo Marine tells how the use of precision metering technology can help to manage expectations and eliminate disputes.

Emerson Process Management Korea

On 26 August 2009, Buffalo Marine Service s M/V San Joaquin pushing the T/B Buffalo 401K pumped 1,500 metric tonnes (mt) 500 centistoke (cst) bunker fuel to the M/V Maersk Wyoming. To the casual observer, there was nothing extraordinary about this particular bunker job; however, upon closer inspection, both vessels were monitoring the mass flow of bunkers via mass flow Coriolis meters. After seven hours of pumping, the Captain of the M/V San Joaquin printed out a fuel ticket for the 1514.39 mt that had been pumped by the T/B Buffalo 401K. Meanwhile, the M/V Maersk Wyoming s Chief Engineer compared the meter ticket against the reading on his vessel s mass flow meter and acknowledged that he had received 1515 mt - a 0.05% difference.

The transparent nature of this operation reinforced the value of the recently-installed mass flow meter and FuelTrax system aboard the T/B Buffalo 401K. The real time temperature and density readings recorded by FuelTrax validated that the volume was not inadvertently boosted by entrained air. More importantly, the measurement of the fuel in mass ensured that the bunker fuel's characteristics - such as density - did not create an unreliable or questionable volume. This 'certainty of measurement' allayed any concerns over the barge owner 'skimming' fuel for its own benefit or the supplier providing a lesser quality of product.

Mass flow meters in conjunction with FuelTrax are by no means a panacea. Yet, the employment of such a system has already substantially reduced delivery disputes and

shortage claims. In essence, it clearly represents Buffalo Marine's commitment to employing proven technology for the benefit of its customer base.

Over the last two decades, Buffalo Marine has recognised that it is imperative to accurately measure and document bunker deliveries. Thus, before the advent of reliable and robust mechanical measurement devices, bunker crews were constantly reminded to properly gauge tanks, re-gauge and re-gauge yet again so that there was no doubt as to the amount of bunker fuel aboard the tank barge. Despite this fastidious approach to documenting the number of barrels on hand or the amount of barrels transferred from the bunker barge, it was not uncommon for personnel to question the accuracy of the gauge readings or even demand to personally gauge the bunker barge tanks. In other instances, gauge readings taken by the crews aboard the vessels in receipt of bunkers were even wary of their own readings due to the possibility of significant air entrainment during the course of the loading.

As Buffalo Marine's President and CEO Pat Studdert recalled: 'We knew there had to be a better way to convince our customers that what was ordered, was delivered.' That sentiment drove Studdert to evaluate the metering capabilities of Buffalo Marine's blending tank barge - the Buffalo Star. This particular barge, equipped with a kinematic static mixture, was designed to provide precision blended fuel products from a combination of its IFO 380 centistoke (cst), cutter stock and marine gas oil tanks. The brains of the blending operation consisted of Emerson's Micro Motion Coriolis meter and e-blend control system.

Studdert recounted: 'Given the success of the mass flow meter system aboard the Buffalo Star, it stood to reason that a similar system could be installed on our newer bunker barges.' Yet, the infrastructure costs and regulatory requirements associated with non-self propelled tank barges led Buffalo Marine to consider mechanical meters.

'The relatively complex nature of the Buffalo Star's piping systems and mandate that the power and control systems associated with the meters must be self-contained and intrinsically safe were a bit daunting,' commented Studdert. Eventually, in order to avoid extensive shipyard refitting and design modifications to accommodate a control booth and separate power source, mechanical meters (i.e., positive displacement) were placed on all new construction bunker barges in 1997. The meters also required a robust air eliminator system and were temperature compensated to enhance the system's accuracy.

Like any new system that is subjected to the rigours of the maritime environment, the strainers, air eliminators and actual meter required routine maintenance. This was of utmost importance with respect to the calibration of the metering system since hard landings or any other 'shocks' suffered by the tank barge could easily knock the tumblers out of alignment.

> 'Buffalo Marine Service quickly reaped the benefit from this investment as short-delivery claims ceased to exist when bunkers were delivered from a metered barge'

As Studdert noted: 'The additional maintenance measures and calibration schedule was well worth it. Our bunker crews possessed a tool that produced a meter ticket that documented what had been delivered to the ship.' More importantly, the relatively simple nature of the system made it easy for the personnel aboard the vessel receiving bunkers to grasp how the meter operated and recognise that it was nearly impossible for air entrainment to artificially boost the barrels delivered. This went a long way in allaying any concerns over short deliveries.

Buffalo Marine Service quickly reaped the benefit from this investment as short-delivery claims ceased to exist when bunkers were delivered from a metered barge. However, Studdert was not quite convinced that the mechanical meters were an optimal solution. After all, the Buffalo Star's mass flow meters continued to perform in a flawless fashion without large demands in maintenance and routine calibration. His instincts proved to be correct when a team comprised of Emerson and Nautical Control Systems approached Buffalo Marine about the prospect of installing a mass flow meter on a bunker barge.

What caught Studdert's eye was the fact that the computer monitoring system was installed in the pushboat's wheelhouse. Thus, there was no need for a separate control room and accompanying power supply on the tank barge. This reduced the amount of additional equipment on the bunker barge and permitted wheelhouse personnel to monitor the

mass flow of bunkers as if they were located on the bunker barge with the tankerman.

The key to the system was the umbilical cord that connected the FuelTrax meter on the barge to an independent port on the pushboat. The cord, in turn, provided power from the pushboat's generator to the meter. All of this was synched up to a FuelTrax control system which included a separate interactive computer screen for the benefit of personnel monitoring the evolution from the wheelhouse.

Studdert knew he had a 'winner' of a system when the Captains informed him that the mass volume data depicted on the FuelTrax wheelhouse monitor permitted them to better gauge the bunker discharge process. 'Previous concerns over the tankermen properly using the mechanical meter on the tank barge were eliminated. Additionally, bunker tankermen had greater confidence that the digital readings depicted by the FuelTrax system were more precise and less vulnerable to inaccuracies that were related to mechanical meters.' In short, tankermen soon realised that their verification gaugings at the end of the bunker job were always in line with the data from the mass flow meter.

> 'Mass is mass is mass. Unless you change the laws of physics, the amount recorded by the Coriolis meter is what we pumped to the customer'

Consequently, when personnel from the ship that had just received bunkers were presented with a mass flow meter printout from wheelhouse personnel, it was quickly understood that the meter had taken into account the properties of the fuel delivered (i.e. temperature, density). Therefore, the accuracy of the data was sacrosanct. As one veteran Buffalo Marine Captain put it: 'Mass is mass is mass. Unless you change the laws of physics, the amount recorded by the Coriolis meter is what we pumped to the customer!'

Buffalo Marine personnel were also quite impressed with FuelTrax' Bunker Trax menu. During any portion of the bunker transfer process, pushboat personnel, dispatchers at the main office or any authorised person equipped with a laptop and internet connection could log into the system and access the particulars of any given bunker job. The impact of this data was profound as it enabled personnel to monitor pumping performance, temperature trend lines and density consistency throughout the course of the bunkering evolution.

Studdert recalled a recent bunker job where the ship's Chief Engineer was convinced that it was impossible for the barge to have pumped at a nearly 500 mt/ hour rate.

'Our Captain patiently explained to him that the rate was consistent with the pump's rating,' recounted Studdert. 'The Chief Engineer countered that the fuel temperature was too low for that as he was convinced that the fuel was no more than 110° F. At this juncture, the Captain pulled up the temperature graph as well as the bunker density chart to drive home to the Chief Engineer that the entire process was transparent and our pumps performed as advertised.

'Once the Chief was presented with this data, he studied it carefully, asked if all of the tow's jobs were this thoroughly documented and then proceeded to sign the bunker delivery receipt without any further comment.'

This type of experience certainly validates Buffalo Marine's commitment to install mass flow meters and the FuelTrax system on its fleet of bunker barges.

'Perhaps our biggest problem is that the demand for FuelTrax-equipped bunker tows exceeds our supply,' commented Studdert. 'However, we have stressed to our customer base and regional suppliers that while the bunker barges with mechanical meters lack the FuelTrax data history, these meters still provide accurate delivery information.'

As he continues to outfit his fleet of pushboats with FuelTrax systems, Studdert is convinced of the importance of bunker delivery transparency and believes that mass flow meters represent the future of the bunker business.

'All too often, the bad habits and shenanigans that are perpetrated by a few are imparted to the bunker community as a whole - regardless of the port,' said Studdert. 'If I can convince our most sceptical customers that they are in possession of every barrel they ordered with a FuelTrax printout from a Coriolis meter, then I save time, money and, most importantly, positively bolster our profession's reputation.'

Authors

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Future technology (10): Wind energy - Offshore and Onshore in different directions

Wind energy started onshore, and the turbines currently used offshore are modifications of the onshore versions. In the next decade, the technology trends onshore and offshore are expected to become significantly different. Whilst the size of onshore turbines will remain in the 3 MW range, offshore turbines will increase to 10 MW. Onshore turbines will probably be tailored for each specific location/terrain, while offshore turbines will be installed further from shore, requiring new solutions with respect to access and maintenance.

DNV

Introduction

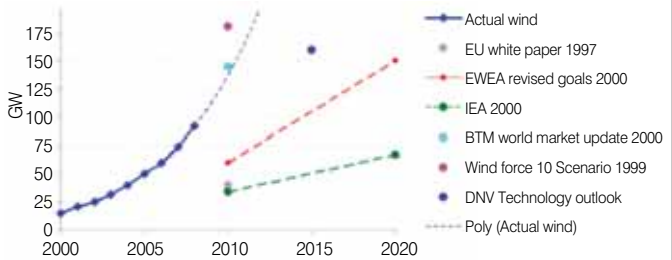
Wind energy, as it is known today, started onshore. Turbine capacity is typically in the range of 2.3~3 MW, limited by the size (width, height, and length) that can be transported by truck. Onshore applications have probably reached their maximum size, and future turbines will not be significantly larger. They will, however, be smarter, and may be tailored for each specific location. Today's offshore turbines are basically slightly modified onshore versions.

Towards 2020, two different trends will emerge in offshore wind power. Turbines will increase in size, with 10 MW turbines probably in operation by 2020, and they will be installed further from shore. For example, the average distance from shore for wind farms installed in Europe in 2009 was 12.8 km, while the Dogger Bank wind farm is located 125.195 km from shore. In USA and China, wind farms located far from shore will probably be in operation by 2020.

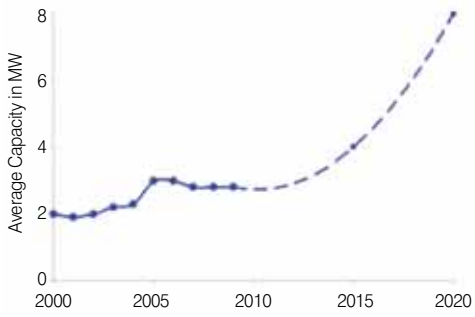
Smart blade design

Wind turbines use blades that can be twisted (pitched) to suit the wind speed and to maintain the desired output. The pitch action requires feedback from a controller and activation by actuators. Faster responses could be obtained if the blade itself were to twist when the loads on it increase. By designing the turbine blades with some degree of sweep (like a curved sword), this can be possible.

Another solution is to orient the carbon fibres in the blade so that it twists slightly whenever it is bent. It is also possible to



Wind energy capacities - Most studies underestimated the growth of the wind industry. (Source: DNV)



Average size of offshore wind turbines - Offshore turbines are expected to grow in size. (Source: EWEA and DNV)

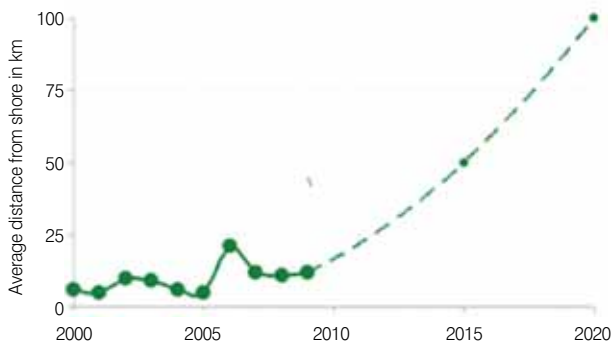
design “smart blades” with active controls, i.e. blades that change their aerodynamic properties according to the measured loads.
More sophisticated blade designs are anticipated within the next ten years. The challenge will be to prove that new designs, with limited field history, function satisfactorily over the operating life of the installation. Key aspects will be robustness and fatigue strength.

Advanced control systems

Optimum control is key to smooth and safe running of a wind turbine. The control system has to know when to start, to stop, and to yaw, and how much to pitch the blades to maximize energy output and to minimize loads.
The latest control systems can measure the loads in each of the blades, and are used to smooth out loads due to turbulent winds. The same measurements can be used to calculate fatigue effects and can shut down the turbine if damage is critical. The data can also allow the operating strategy to alter to maximize energy capture.
Operating individual wind turbines in wind farms with different operating rules requires smart sensor technology and complex control algorithms. Improved data transfer capabilities and decision support systems will enable centrally located control centres to optimize the operations of the wind farms.

Direct drive

Most turbines use a gearbox to increase the rotor speed of the electric generator. Gearboxes are prone to failure and increase the weight of the turbine.
A number of manufacturers have replaced the gearbox with a single, large-diameter generator which, combined with a converter, can be connected to the grid. This approach is not without its own challenges, and both the cost and weight of this option currently exceed the more conventional design with a gearbox. However, this approach is very promising, particularly if permanent magnets become cheaper and more powerful, lighter materials are introduced, and converters become more versatile.
Direct drive options will become cost-competitive towards 2020, and are likely to become the dominant drive type for all sizes of wind turbines.



Distance from shore - Developments like Dogger Bank will require new solutions to operation and maintenance. (Source: EWEA and DNV)

New fixed and floating offshore foundations

At present, offshore wind turbines are limited to shallow water (20-30 m water depth), and most use a single, tubular, monopile foundation. For deeper waters, various “jacket” structures that comprise several footings and are similar to (but smaller than) offshore oil and gas installations, will be developed. Optimised platform types and better understanding of loads and foundation design, will increase the viable water depths to about 50 m.
Towards the end of the next decade, floating platforms will be used for wind turbines, enabling them to operate in almost unlimited water depths and where winds are best. Prototypes are being tested and several concepts are on the drawing board. One challenge of moving onto floaters is the need for complex dynamic cables to enable connection to the grid.

Novel installation methods

As floating wind turbines require deep waters for the connecting /mating of the nacelle to the support structure, using floaters will require new installation methods.
However, several areas with high potential for floating offshore wind, i.e. US and Asia, only have shallow water close to shore, and therefore either the mating operation will have to occur at site, requiring complex and costly offshore operations, or a completely different way of installing the turbines must be developed.
One new concept is to transport fully assembled turbines horizontally, on a barge, from the fabrication yard to the offshore site. Once at site, the barge tilts 90 degrees through a ballasting operation, to release the turbine in a vertical position. Provided that challenges related to up-ending and release of turbines are resolved, horizontal installation of complete turbines will be commercially available by 2020.

A Neutral XML schema for basic design stage interface to class societies (1)

Intergraph (Korea) Corporation

SUMMARY

The use of 3D models is now commonplace among engineering design firms and shipyards. Technology advances have made the richness of these models more than adequate for the purposes of developing cost and schedule data early in the design cycle and tendering an offer to an owner/operator with a known level of risk.

The typical next step of the process is gaining confidence that the design will meet the safety and strength standards of the classing regulatory agency, most of whom now rely on first-principles-based analyses.

While the traditional means of conveying the design between these cooperating organizations is paper or digital drawings, the review and approval process can be significantly expedited if mechanisms exist to share the design model with the regulatory agency. Since the two organizations rarely use the same underlying modeling systems, some form of data exchange must take place.

Various approaches have been used in the past from industry standards to direct translators. The author has been involved with the development of modeling systems and tools that cover the spectrum of the ship design lifecycle, including hullform development and analysis, 3D, multi-discipline, concurrent basic design, detailed design, planning, and production design.

These systems can support the development of a single model that can be used throughout the entire process through a gradual refinement of detail as the design progresses from the early to the late stages of the lifecycle.

A neutral XML-based schema has been developed and utilized for the exchange of the early design information between these systems and tools developed by some regulatory agencies. This paper will present the schema and discuss ways to extend and/or enhance it to meet the needs of a broader audience in efforts to develop a de facto industry standard exchange mechanism.

NOMENCLATURE

AP	Application Protocol
CIS/2	CIMsteel Integration Standard Release 2
DIME	Data Interface Management Engine
ISO	International Standards Organization
LR	Lloyd's Register Group
SM3D	SmartMarine® 3D
STEP	Standard for the Exchange of Product Data
XML	Extensible Mark-up Language

1. INTRODUCITON

Beginning in the late 1980's and extending over the next two decades, there was extensive worldwide interest in the development of a robust ISO STEP-based (ISO 10303) product model exchange mechanism for shipbuilding data.

A number of projects, both in the United States and Europe, funded by the US Navy, the European Union, and the National Shipbuilding Research Program (NSRP) and cost-shared by organizations within the shipbuilding industry developed the data models for these standards and prototyped implementation among a wide range of stakeholders including classification societies, shipbuilders, and application software vendors.

While these efforts contributed significantly to the advancement of the industry towards its goal, they ultimately fell short of gaining worldwide acceptance. This left a void that needed to be filled and resulted in a continuation of the development of "point-to-point" solutions based on a variety of ad hoc application programming interfaces (API's) and XML-based interfaces.

While these have been effective in terms of achieving the end result, they have not been cost-effective from an industry perspective as the number of interfaces grows at a combinatorial rate as the numbers of applications increase (Figure 1). Thus, they haven't served to advance the industry toward a "neutral" schema that could serve a broader audience and

reduce the number of "point-to-point" solutions with which a shipbuilder or software vendor would have to manage.

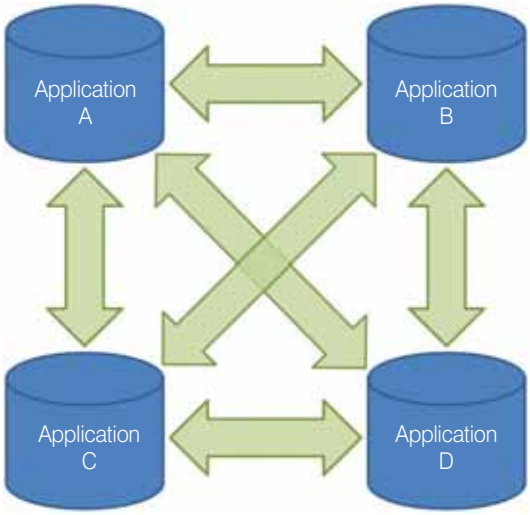


Figure 1. Point-to-Point Interface Schematic

To this end, a neutral XML schema was developed based on the work done for the STEP Standards under the shipbuilding Application Protocols [Reference 1] as well as that done for the Structural Steel Industry - known as CIMsteel Integration Standards Release 2 (CIS/2) [Reference 2].

The scope of the interface is the exchange of structural data between the native modeling application, third-party applications, and end-user custom interfaces to business systems, production systems, analysis tools, and legacy applications. Since the formats of these external systems vary widely and there are no implemented and universally adopted product modeling standards in this area, Intergraph developed a "neutral" XML format that can serve this purpose.

By providing a neutral schema, the intent is to offer a cost effective path forward for any customer or 3rd-party application provider to interface with SmartMarine® 3D (SM3D) and to avoid the need to develop specific interfaces between various applications on an ad hoc basis (Figure 2).

The objective of this interface is to provide an exchange of geometric and property data about structural business objects such that they can be mapped from one application schema to another. The connotation of the double-ended green arrows in Figures 1 and 2 denote that these are envisioned as two-way translators - one from the application to the neutral schema and another from the neutral schema to the application.

In reality, effective exchange can be accomplished between two cooperating partners if one "exports" the data and the other "imports" it. Obviously, in this scenario, there is no feedback loop. The interface between SM3D and LR's RulesCalc using its DIME toolkit is, in fact, a directed one-way interface. A application vendor need only develop and maintain one interface to the neutral schema and is unaffected by the number of applications in use within the industry.

Even though this schema is quite rich in terms of the information model, it is not the complete schema of the objects within SM3D - hence the term "neutral". This means that the mechanism cannot be used to support direct round-tripping of data into and out of the native modeling application without some loss of fidelity. Additional data coupled with pre- and/or post-processing within the translator software is necessary to avoid the loss of information. With this additional data and the proper mapping, it would be possible to re-create the objects so that they behave similarly to native objects within the system. This issue is expanded on in section 5 of the document.

The following sections will provide background and the details of the neutral schema. The author will present some proposals for extensions to the schema that would facilitate approval and configuration management and will conclude with details of a case study of the commercial implementation of the schema and its real-world use in an academic environment.

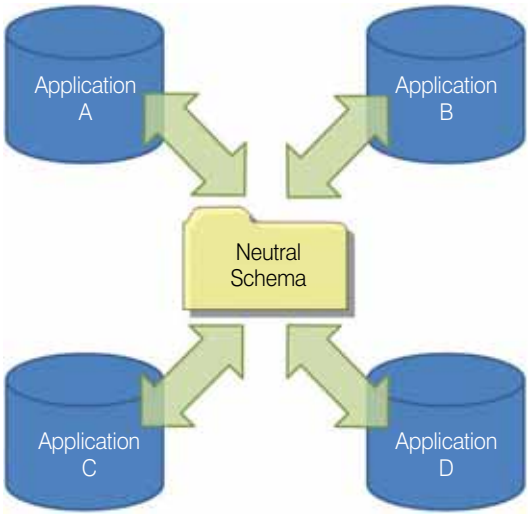


Figure 2. Neutral Schema Interface Schematic

2. BACKGROUND

The STEP standardization effort described in the Introduction had the backing of a broad spectrum of industry participants (both commercial and military), was well funded, and developed many prototypes that served to feed the development of the standard and prove the feasibility of the technology. Unfortunately, it failed to result in commercially available, off-the-shelf (COTS) translator products that industry participants could adopt into their business practices.

In the case of the US Navy, additional funding was directed towards the development of translators based on the underlying STEP Application Reference Models (ARM) using an XML format [References 3 and 4]. This approach tailored the scope of the exchange toward the modeling tools and use cases specific to key naval projects underway at the time. There was almost no uptake of this approach on the commercial side of the industry. What the approach did do, however, is set the stage for XML as a viable mechanism for data exchange.

On the commercial side, the application vendors had no other option but to revert back to "point-to-point" solutions based on market demand. As XML became more widely adopted, vendors found that many applications produced some form of output in this format.

The development of a data exchange interface then became an issue of taking what data existed and doing the best they could to use it. In some cases it was possible to "enhance" the schema to improve the interface but in many cases it was simply a matter of using what was available. This process repeated itself every time the vendor had to develop an interface to another system.

Unlike the shipbuilding industry, the "steel" construction industry - who started their STEP AP development at the same time as the shipbuilding participants - did produce a viable industry exchange mechanism. While not an official STEP AP, CIS/2 has gained wide acceptance by application vendors thus enabling organizations working in this area to exchange data with one another for the purposes of performing analysis and for transitioning from design to detailing and fabrication.

While the above approaches were all based on trying to address the exchange needs through standards efforts, there is another technology path available - that of developing and promoting "open architectures". SM3D is such a system and was developed on Microsoft's COM technology and a commercial Relational Database engine (MS SQL).

The underlying data model is exposed and delivered to every customer so that it can be used to develop a custom command, interface, or application directly to the SM3D database. Examples of this from Samsung Heavy Industries are numerous [Reference 5]. It can be used to develop custom commands or to read and/or write directly to the database.

A number of customers developed very powerful and sophisticated applications and tools for exchange and analysis using SM3D. While these were successful, they proved to be complex and required more expertise on the development side-the customer side - and they took longer to implement. This experience led to the development of a better 3D API for SM3D and to the design and implementation of the XML-neutral schema.

3. WORKFLOWS

A number of common workflows exist where an interface would be beneficial in reducing engineering design man-hours and shortening the design timeframe.

Some of these are:

1. early design to analysis tools;
2. early design to cost estimating (ERP) tools;
3. and, early design from design agent to shipyard.

The first of these - exchange with analysis tools - covers a broad spectrum ranging from hullform development and fairing, hydrostatics, computational fluid dynamics, finite element meshing and analysis, hydrostatics, intact and damaged stability, longitudinal strength, and weight and center of gravity.

4. SCHEMA

The schema has been broken down into seven subsets corresponding to functional groupings of the data elements. These categories are: Schema (general); Axis System; Catalog; Compartments; Definitions; Geometry; and Plate Geometry.

It will not be possible to cover all the details of the schema in this paper. What will be provided is a high-level description of some of the key elements (objects) such that the reader gets a feel for the richness of the schema and can gain some idea of how it would map to their own application domain.

4.1 AXES SYSTEM SCHEMA

A coordinate system is one of the most straightforward objects in the schema and is intended to capture the definition of one or more "framing" grid systems. The ship is assumed to be defined in a "global" co-ordinate system, however, the schema supports any number of additional co-ordinate systems - both cartesian (i.e. parallel to one of the coordinate system's orthogonal axes), radial, and cylindrical. Each cartesian and radial reference represents an infinite planar surface while each cylindrical reference represents an infinite cylindrical surface.

The individual elements of the reference grids are uniquely named, identified and located and they can be grouped together to form meaningful subsets (e.g. "X reference planes", "Y reference planes", etc.). Lastly, a transformation matrix is supported to define the origin and orientation of the "local" coordinate system with respect to the global coordinate system.

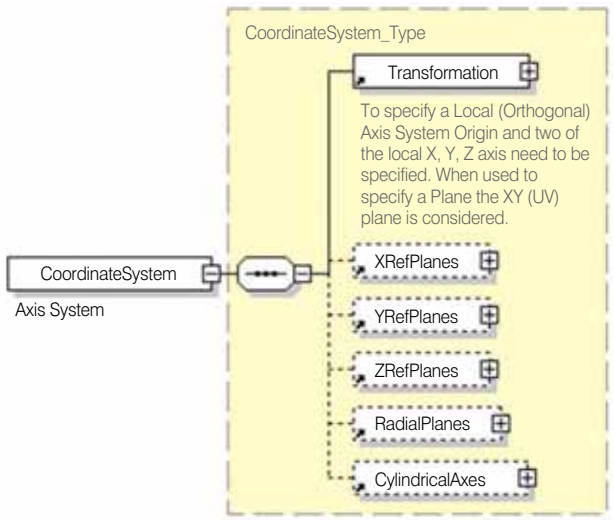


Figure 3. "Coordinate System" High Level Schema

One of the main purposes of these objects is to support the ability to define structural objects whose position, surface definition, and orientation are based on the framing system. Should the definition of the framing system object change, the related structural object will also update - keeping the design model intact.

Table 1 lists the elements (objects) of this schema subset, as well as the complex data types.

Table 1. "Axes System" High Level Schema

Elements	Complex types
CoordinateSystem	CoordinateSystem_Type
CylindricalAxes	CylindricalAxes_Type
RadialCylinder	RadialCylinder_Type
RadialPlanes	RefID_Type
RefID	RefPlane_Type
RefPlane	RefPlaneGroup_Type
RefPlaneGroup	RefPlanes_Type
XRefPlanes	
YRefPlanes	
ZRefPlanes	

4.2 CATALOG SCHEMA

The catalog sub-schema targets the definition of materials, thicknesses, and profile section sizes. It is rare that two different applications would have the same format for this type of data and so additional pre- and post-processing is performed to accommodate the "mapping" of data during the translation. A Microsoft Excel file is provided that serves as a template for creating the mapping file.

The role of the schema is to comprehensively define the properties for the various objects while the role of the mapping file is to define the rules for setting the data on import when a particular occurrence of a material, size, or section is processed from the target data set.

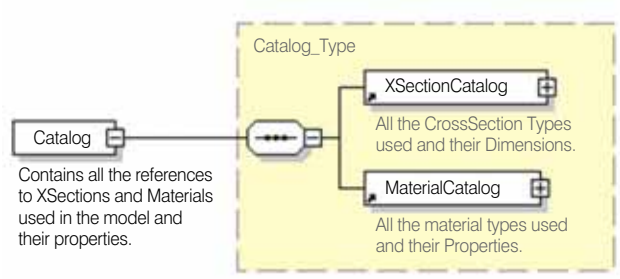


Figure 4. "Catalog" High Level Schema

The majority of objects in this schema are devoted to the definition of the various cross-section shapes typical in shipbuilding. In addition to the standard shapes (e.g. angle, flat bar, bulb flat, T-bar, I-bar, channel, round, half-round, and rectangular), the schema provides for a "custom section" that is completely user defined. For each section type, the definition includes parameters for each of the key "dimensional aspects" of the section. Table 2 lists the elements (objects) of this schema subset, as well as the simple and complex data types.

Table 2. "Catalog" High Level Schema

Elements	Complex types
Angle	Angle_Type
BulbFlat	BulbFlat_Type
Catalog	Catalog_Type
Channel	Channel_Type
CornerR	CustomXSection_Type
CustomXSection	Flange_Type
FilletR	FlatBar_Type
Flange1	HalfRound_Type
Flange2	IBar_Type
FlatBar	Material_Type
HalfRound	MaterialCatalog_Type
IBar	Parameter_Type
Material	Rectangular_Type
MaterialCatalog	Round_Type
MaterialRef	RoundTube_Type
Parameter	TBar_Type
Rectangular	Web_Type
Round	XSectionFamily_Type
RoundTube	
Slope	**Simple types**
TBar	
TopCornerRadius	XSectionType_enum
Web	
XSectionCatalog	

< to be continued >

AUTHORS' BIOGRAPHIES

Michael Polini holds the current position of SmartMarine® 3D Product Manager at Intergraph Corporation and is based in Hampton, Virginia, USA. He is responsible for defining the scope and requirements of the product and co-ordinates the activities of the Product Center (Development, Support, and Certification), Business Development, Sales and Marketing, and Product Management. He was heavily involved with the development of the STEP Shipbuilding Application Protocols - especially AP215, AP216, and AP218. He has both a B.S.E. and M.S.E. in Naval Architecture and Marine Engineering from the University of Michigan.

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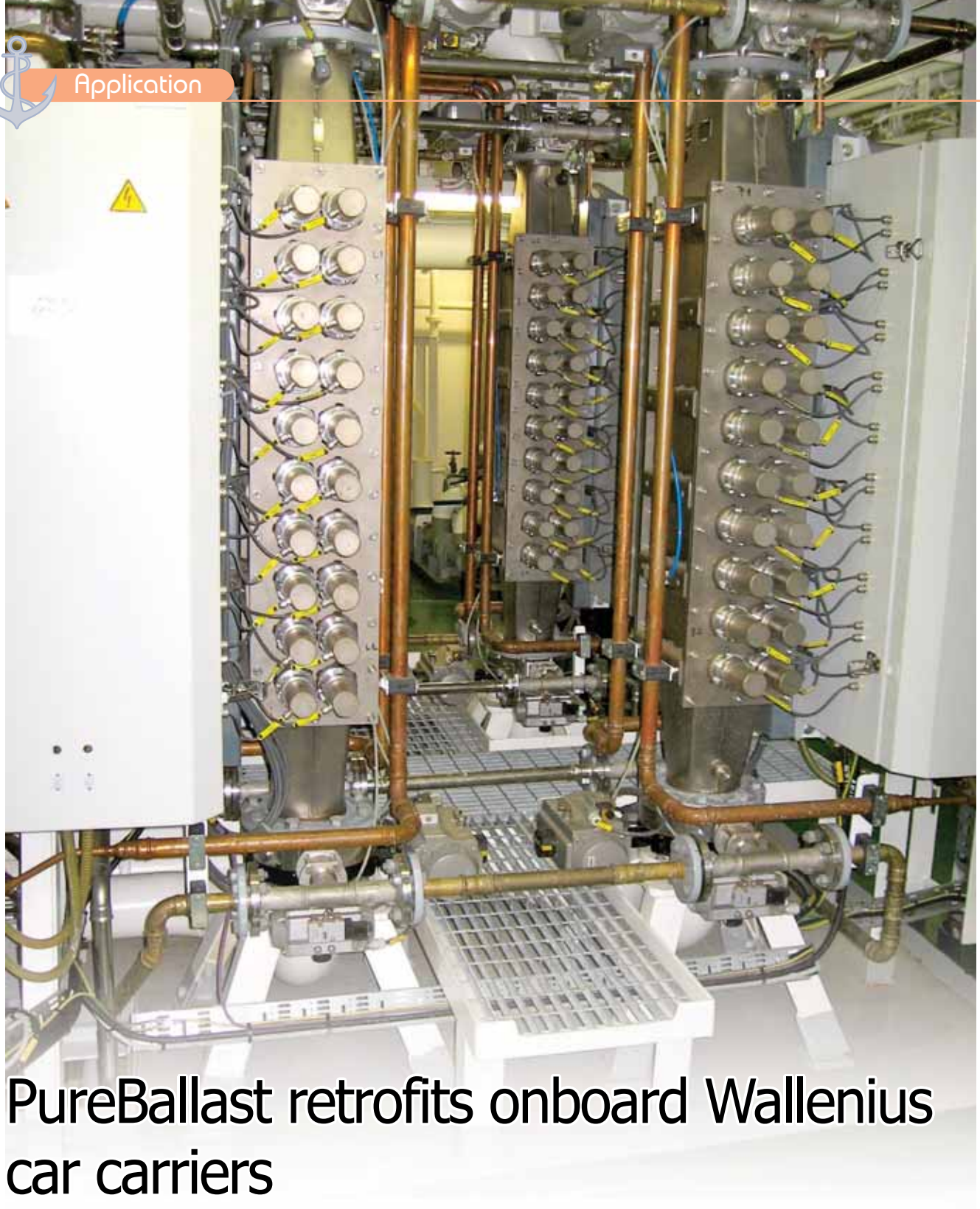

PureBallast retrofits onboard Wallenius car carriers

The year 2016 - the projected deadline for ships with ballast capacity in excess of 5000 cubic metres to comply with the IMO Ballast Water Convention - may seem to be light years away.
But for the family-owned Swedish shipping and logistics company Wallenius Lines, that time is now. Wallenius Lines began to retrofit its global fleet of PCTC and Ro-Ro vessels in 2008 - years ahead of schedule.

Alfa Laval Korea

No wait-and-see strategy

The estimated number of ships that will require retrofitting of their ballast water treatment systems varies widely. However, one thing remains certain: the task at hand is huge and time is short. Known for its high environmental profile, Wallenius Lines is blazing new trails with regard to environmental policy that protects the world's oceans from the threats posed by transporting potentially invasive species.

In 2003, Wallenius installed a full-scale PureBallast prototype onboard its car carrier M/V Don Quijote to test the ballast water treatment system. PureBallast is a fully automated and highly effective chemical-free system for cleansing ballast water on board. It purifies the water via a combination of filtration and advanced oxidation technology (AOT). Both methods are safe for the crew and environment.

After PureBallast became the world's first IMO-approved chemical-free ballast water treatment system, Wallenius has installed PureBallast on all new buildings. In 2008, the shipping and logistics company began retrofitting its existing fleet with PureBallast, starting with the M/V Fedora and M/V Fidelio, two of its large car and truck carriers.

Five-stage retrofit strategy

Why retrofit now?

In the coming years, the critical mass of retrofits may limit the supply of ballast water treatment systems as well as access to qualified retrofit workers. Wallenius Lines believes that retrofitting its ships with PureBallast now will give the company a competitive advantage later when other companies are scrambling to comply with IMO regulations.

"It's important for ship owners to determine which vessels to begin retrofitting and then plan and execute a strategy," says Ulf Granlund, who at the time was Wallenius' environmental specialist in charge of retrofitting the large car truck carriers.

According to Granlund, ship owners should carefully evaluate which system to install based on these criteria:

- *Purchase and installation costs*
- *Space and power requirements*
- *Low-pressure drop over the ballast water treatment system*
- *Training costs for the crew to operate the system*
- *Ease of accessibility to system components for operation and maintenance*
- *Manufacturer guarantees*
- *Global coverage regarding spare parts and service engineers*

"Global availability of spare parts and service is of paramount importance," says Granlund. "Once the convention is ratified, it will be enforced by port state control officers in the same way as oily water separators and therefore must always be in good working condition."

With demand in 2008 at an all-time high, Wallenius required retrofitting of the two car carriers without taking them out of service. The vessels operated 24/7 with virtually no idling time. With no off-hire for the ships, it was important to plan carefully and retrofit in stages using a riding crew of pipe workers, welders and electricians. Installation took place over the course of nine months whenever the ships were in Europe.

"It is, of course, in a ship owner's best interests to retrofit vessels with the minimal modifications to the existing equipment and physical structure of ship as well as with minimal disruption to ship operation," continues Granlund.

"The riding crew boarded and worked on the Wallenius vessels whenever the ships were sailing in European waters," recounts Granlund. "Then the crew disembarked at the last EU port and returned to their regular places of employment until the vessels called at an EU port again and retrofit work resumed."

While installation with a riding crew had obvious advantages of avoiding downtime, it also posed challenges, including transportation of personnel and equipment and securing cabin space on board, which requires additional planning and logistics.

• Stage 1: Preliminary design and engineering

Initial preparation work took place during each ship's scheduled sailing list. This included: an onboard inspection and survey; review of original drawings, piping and instrumentation diagrams; and identification of interfaces and integration with existing control systems. Based on the vessel type and functional requirements, the engineering team determined how to install a system capable of processing 1000 m^3/h. The team also considered other factors that affect installation, such as available space and remote operation.

Electrical and piping requirements also play a major role in retrofitting. Electrical preparations included installation of electrical supply, preparation of automation cables to control system, preparation of remote interface and/or remote panels as well as verification of electrical load balance (or, if required, calculation of a new load balance), and verification of pump capacity (head). Piping preparations included inlet/outlet SW and LT system and discharge connection from the filter. The PureBallast system has a bypass, which enables electronic logging of ballast water activities, and Alfa Laval recommends not adding any other bypasses to the system.

• Stage 2: Selection and purchase of the treatment system

Wallenius selected a PureBallast 1000 with a capacity suitable for the operational needs of the vessel.

The 3500 x 2300 mm installation footprint is based on a side-by-side configuration of the four AOT units and includes access and service area.

• Stage 3: Connect the treatment system to the piping

All pipe work and supports were connected during the this phase. Based on the initial preparation work, most piping and supports required to install PureBallast were pre-fabricated by third-party supplier selected by Wallenius. The AOT units were transported to Helsingborg, Sweden, where the third-party supplier crafted most of the piping and supports. Some pieces, however, required construction on board in order to ensure reduced tensions in the pipe system.

• Stage 4: Conduct electrical cabling and control panel work

During this phase, the riding crew worked on cabling for the electrical cabinets. No additional auxiliary generators onboard were required. Remote control panels were installed to start, stop and monitor PureBallast from any location onboard. The control equipment is positioned at the same location on board both ships, which made installation and operation easier for the crew that work on both vessels.

• Stage 5: Commission the system and train the crew

Commissioning the PureBallast system and training the crew to safely operate and maintain the system occurred during the ships' fourth visits to Europe. The PureBallast system was then put into service.

Moving ahead

Installing and commissioning PureBallast onboard the M/V Fedora and M/V Fidelio provided Wallenius with valuable insights into the challenges of ballast water treatment system retrofitting. Wallenius has continued to retrofit its fleet, with the M/V Faust and the M/V Otello next in line. Insights from the first installations have contributed to savings both in time and costs.

Retrofit partners

Due to the critical mass of retrofits in the near future, Alfa Laval is now establishing strategic partnerships with companies and training personnel who can assist with design, installation and commissioning of PureBallast systems.

To date, a total of 200 PureBallast systems ranging in capacity from 250 to 2500 m^3/h are in service, or have been ordered. Of these, approximately 10 percent are retrofit systems. In addition to large car and truck carriers, PureBallast has been installed on naval ships, container vessels, bulk carriers, LPG tankers, bitumen tankers, icebreakers, offshore supply vessel and RoRo vessels.

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Excavating the seabed

A sophisticated motor control system supplied by Vacon is central to the operation of the revolutionary UT-1 submersible ultra-trencher, which was built by underwater engineering specialist SMD and is owned and operated by CTC Marine.

Vacon Korea

The UT-1, the world's most powerful jetting remote operated vehicle (ROV), uses hydraulic jets to cut trenches in the sea bed to allow the rapid and cost-effective installation of, for example, flexible flow lines and cables. The Vacon drive system, which uses active front-end (AFE) technology in a common DC bus configuration with modular inverters, controls the pumps that power the trenching jets.

Versatility, proven reliability and low level of harmonics

The engineers at SMD chose Vacon AC drive systems for this prestigious project because of their versatility and their proven reliability in marine applications. In addition, the intrinsically low level of harmonics associated with AFE drives was an important benefit as the UT-1 derives its supplies from a shipboard generator.

The jetting pump drive system developed by Vacon and SMD for CTC Marine's UT-1 submersible comprises four drive panels, each equipped with a 750 A LCL filter and a 750 A AFE module to provide power for the common DC bus. The bus supplies four 460 A INU inverter modules, which deliver their output via sine filters to transformers which step up the voltage to the 3.3 kV needed by the two 375 kW medium voltage pump motors.

All of the key items for this system, except the transformers, were selected from Vacon's extensive range of standard products.

Compact construction and easy integration important benefits

Despite their high current ratings, the power modules used in the UT-1 jetting pump drive system feature very compact construction, an important benefit given the very restricted space available to accommodate them on the ROV. All the modules are also air-cooled, thereby eliminating the additional complexity that would have been involved in implementing a liquid-cooled solution.

Monitoring and supervisory control of the AFE modules and the INU inverter modules are provided via a common fieldbus system, making the drives easy to integrate with the other systems on board the UT-1.

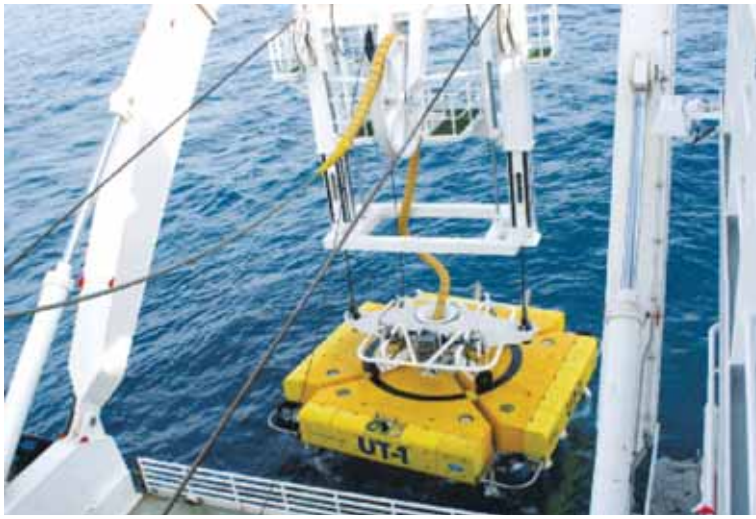
Ultra-trencher with a variety of roles

Permanently installed on the multi-role subsea construction vessel Volantis, the UT-1 ultra-trencher ROV is currently being

used in a variety of roles to service the offshore oil and gas, life-of-field seismic, telecommunications, e-field, power and renewables market sectors.
The innovative design of the UT-1 permits deployment and offers unparalleled flexibility in even the most severe weather conditions. However, in spite of the huge demands operating in these conditions places on its onboard systems, it is delivering exceptional levels of availability, an achievement to which the Vacon drive system has made no small contribution.

Boosting DC link voltage by up to 35% above nominal

The Vacon AFE units used in this project are regenerative modules that have been specifically developed for common DC bus applications. In addition to their excellent harmonic performance, these modules can also boost the DC link voltage by up to 35% above nominal. The INU inverter units are also bidirectional, and are available with integral DC supply systems in ratings up to 75 kW. Higher ratings, such as those featured in this in project, are exclusively for use with external DC supply systems.



CTC Marine

Headquartered in Darlington, UK, CTC Marine Projects (CTC) is a leading provider of subsea, installation, cable lay and trenching services for the international offshore construction industry. CTC operates some of the world's largest fleet of high technology marine trenching and burial equipment, which is supported by a fleet of DP2 multi-role construction vessels, flexible installation and shallow water spreads.

Vacon NXP Common DC Bus products -Providing ultimate flexibility

Vacon offers a comprehensive range of Common DC bus drive products comprising front-end units, inverter units and brake chopper units in the entire power range and voltages from 380 V to 690 V. The drive components are built on proven Vacon NX technology and provide the ideal energy sharing solution for a multitude of power systems.
Vacon Common DC bus components are used in a multitude of combinations across a wide spectrum of high-power process industries from the pulp & paper, steel, metal & mining and marine cranes to smaller machines and production lines, which also demand cost-effective solutions.

Flexible configuration, customized solutions

Common DC bus components can be used in a multitude of combinations. In a typical DC bus configuration, the drives that are generating can transfer the energy directly to the drives in motoring mode. Common DC bus drive systems have different kinds of front-end units to meet the requirements of the electricity network and the process where the drives are used. The front-end units convert a mains AC voltage and current into a DC voltage and current. The power is transferred from the mains to a common DC bus and, in certain cases, vice versa. With the right configura-

tion, the drive system can achieve optimal performance and significant energy savings can be made when braking energy is utilized to its full potential.

Active front-end (AFE)

The AFE unit is a bidirectional (regenerative) power converter for the front-end of a common DC bus drive line- up. An external LCL filter is used at the input. This unit is suitable in applications where low mains harmonics are required. AFE is able to boost DC link voltage (default +10%) higher than nominal DC link voltage (1,35xUn). AFE needs an external pre-charging circuit. However, AFE does not need any external grid side measurements to operate. AFE units can operate in parallel to provide increased power and/or redundancy without any drive to drive communication between the units. AFE units can also be connected to the same field bus with inverters, and controlled and monitored via field bus.

Non-regenerative front-end (NFE)

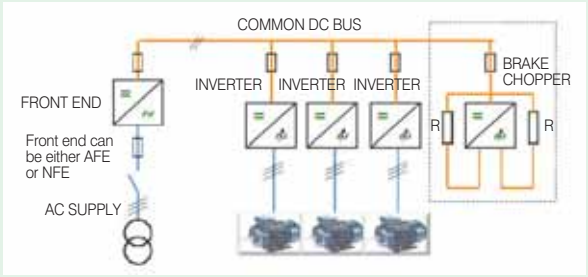
The NFE unit is an unidirectional (motoring) power converter for the front-end of a common DC bus drive line-up. The NFE is a device that operates as a diode bridge using diode/thyristor components. A dedicated external choke is used at the input. The NFE unit has the capacity to charge a common DC bus, thus no external pre-charging is needed. This unit is suitable as a rectifying device when a normal level of harmonics is accepted and no regeneration to the mains is required. NFE units can be paralleled to increase power without any drive to drive communication between the units.

Inverter unit (INU)

The INU (Inverter unit) is a bidirectional DC-fed power inverter for the supply and control of AC motors. The INU is supplied from a common DC bus drive line-up. A charging circuit is needed in case the connection possibility to a live DC bus is required. The DC side charging circuit is integrated for powers up to 75 kW (FR4-FR8) and externally located for higher power ratings (FI9-FI14).

Brake chopper unit (BCU)

The BCU (Brake chopper unit) is a unidirectional power



converter for the supply of excessive energy from a common DC bus drive line-up to resistors where the energy is dissipated as heat. External resistors are needed. By using two brake resistors, the braking power of the brake chopper is doubled.

Key benefits

- *Same software tool, same control option boards allowing the maximum utilization of NXP features over a wide power range.*
- *No additional modules are required. Option boards are compact and easy to install at any time.*
- *Optimized drive system configurations enabling minimized overall investment cost. Excessive braking energy can be fed back to network saving energy costs.*
- *Optimized module design reduces need for additional engineering and saves in cabinet space reducing overall costs.*

Technical highlights

- *Full power (0.55 to 2.2 MW) and voltage (380 to 690 V) range for both induction and permanent magnet motors.*
- *Five built-in expansion slots for additional I/O, fieldbus and functional safety boards.*
- *Low harmonic regenerative front-end. Cost effective non-regenerative front-end.*
- *Compact drive modules and easy integration to cabinets.*

Typical applications

- Continuous web systems
- Metal lines eg. roller table systems
- Winders & unwinders
- Crane systems eg. main hoists, gantry & trolley drives
- Centrifuges
- Winches
- Conveyors
- Excavators

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DSME won its first order of this year to build 2 units 160,000m^3 LNG carriers

Daewoo Shipbuilding & Marine Engineering (DSME) signed a contract with Angelicoussis Group in Athens, Greece, on April 12 to build 2 units of 160,000m^3 LNG carriers.

These vessels will be built at DSME's Okpo Shipyard on Geoje Island and delivered to the ship owner by mid 2015. After delivery, they will be operated by Maran Gas Maritime Inc., a subsidiary of Angelicoussis Group in the LNG sector.

The signing ceremony was attended by Goh Jae-ho, President of DSME, and Seong Man-ho, chief of labor union, who promised the ship owner a successful completion of the project on harmony between the management and labor. Seong Man-ho, chief of labor union, expressed his intention to the ship owner in the signing ceremony that he would ensure harmony and cooperation between the labor and management to build the best vessels in terms of delivery, quality, safety, etc.

Angelicoussis Group is the Greece's largest shipping company that currently owns about 100 vessels, and has awarded orders for the construction of about 60 vessels, including 12 LNG carriers and 13 very large crude carriers, since it placed its first order with DSME in 1994 and is maintaining close relationship with DSME.

Goh Jae-ho, President of DSME, mentioned, "The concerted effort of the management and labor in both production and sales activities has further increased the trust of ship owner in DSME. I will act as a bridge between the site workers and overseas ship owners."

Goh Jae-ho(right), President of DSME, Seong Man-ho(middle), chief of labor union, and John Angelicoussis(left), Chairman of Angelicoussis Group, are posing for photo after signing the contract in Athens, Greece.

STX OSV received orders for 2 offshore specialized vessels

STX OSV secured an order worth approximately KRW 130 billion from DOF for an offshore subsea construction vessel and anther order worth KRW 100 billion from the Norway-based Island Offshore for an offshore subsea support vessel on March 19.

The offshore subsea construction vessel will measure 121m in length, 22m in width and be equipped with a 250-ton crane and 2 remotely operated vehicles (ROVs). This vessel can accommodate about 100 crews. The hull of the vessel will be built at STX OSV Tulcea shipyard in Romania and towed to STX OSV Søviknes shipyard in Norway for the remaining works. The vessel is scheduled for delivery by the second quarter of 2013. Particularly, this newbuilding will feature the new moon pool design - which was recently developed through joint research with DOF and Marintek - to ensure safer operations in various climates and environments.

The offshore subsea support vessel that features the UT 737 CD design of Rolls-Royce will measure 96m in length and 21m in width and be equipped with an 125-ton offshore crane and a remotely operated vehicle (ROV). This newbuilding can accommodate about 60 crews and is scheduled for delivery by the first quarter of 2014. The hull of the vessel will be built at STX OSV Braila shipyard in Romania and towed to STX OSV Brevik shipyard in Norway for the remaining works.

Offshore Subsea Construction Vessel of STX OSV

These orders that STX OSV won on the same day are valued at approximately USD 230 billion in all. Offshore supply vessel collectively refers to the offshore plant support vessels that support the oilfield exploration and exploitation, and is divided into several types: PSV(Platform Supply Vessels) that transports overall equipment and manpower, etc., to the oilfield exploitation platform, AHTS (Anchor Handling Tug Supply vessels) that carries and anchors the oilfield exploitation platform, and OSCV (Advanced Offshore Subsea Construction Vessels) commonly known as offshore subsea construction vessel.
An official from STX said, "These consecutive orders for high value-added vessels were awarded to us in recognition for our excellent shipbuilding technology and expertise. We will step up effort to win more orders as the offshore plant market is expected to show strong performance also this year.


Offshore Subsea Support Vessel of STX OSV

Rolls-Royce to power two Littoral Combat Ships for the U.S. NAVY

Rolls-Royce has secured a contract to supply power and propulsion systems for the two latest vessels in the U.S. Navy's Littoral Combat Ship (LCS) programme.
Designed to operate in combat zones close to the shore (littoral waters), each LCS will be equipped with two Rolls-Royce MT30 gas turbines powering four large Mk1 waterjets. This will enable the vessels to reach speeds in excess of 40 knots.
This latest order is for ships named Little Rock and Sioux City, and follows previous orders for the Milwaukee and the Detroit, which are both under construction. Rolls-Royce already powers two Lockheed Martin Littoral Combat Ships, the USS Freedom, which was deployed two years early and the Fort Worth, which is due to complete trials later this spring.
Andrew Marsh, Rolls-Royce, President - Naval said, "This order builds on the success of the Rolls-Royce powered Littoral Combat Ships to date and we're delighted that we will also power the Little Rock and the Sioux City. We have worked closely with Lockheed Martin, the U.S. Navy and other partners during the LCS programme, using our extensive experience to further develop these highly advanced ships. The combination of the MT30 gas turbine and our latest waterjet technology will ensure these ships are at the cutting edge of global naval capability."
The MT30 is derived from Rolls-Royce aero engine technology and builds on over 45 million hours of operating experience. At 36 megawatts, it is the world's most powerful marine gas turbine and has the highest power density - a key factor in naval propulsion where delivering a high power output in a compact space is essential. The MT30 has also been selected for the U.S. Navy's DDG-1000 Zumwalt class destroyer programme as well as the UK Royal Navy's new Queen Elizabeth class aircraft carriers.
The waterjets are among the largest produced by Rolls-Royce and can pump water at a combined rate of 25,000 gallons per second - enough to fill an Olympic style swimming pool in 25 seconds.
In addition to gas turbines and waterjets, a significant range of Rolls-Royce equipment is specified in the Lockheed Martin design, including shaftlines, bearings and propulsion system software.

SHI obtained an order worth USD 645 million for 1 drillship

Samsung Heavy Industries (SHI) received an order from the London-based drilling rig operator Ensco plc for the construction of 1 drillship.

This drillship, named 'ENSCO DS-8', is priced at USD 645 million and will be built at Geoje shipyard and delivered to the ship owner by the third quarter of 2014. This contract includes an option for 2 additional vessels, which raises the expectation for additional orders.

This drillship that will feature 'DP2' design has the drilling depth capacity of up to 40,000 feet at a water depth of up to 12,000 feet and will be fitted with the state-of-art equipment such as retractable thruster and dynamic positioning system, etc. Ensco has awarded orders for a total of 6 drillships to SHI since it placed an order for a drillship named 'ENSCO DS-3' in 2007, and has maintained a strong relationship with SHI.

Along with that, SHI recently secured an order from an European ship owner for a drillship, which brings SHI's total drillship orders so far this year to 5 units.

Nexans wins over 50 million Euro contract to supply high-voltage power cable

Nexans has won a contract worth more than 50 million Euro to supply a total of 57 km of high-voltage subsea power export cables to Northwind NV in the North Sea on April 10. The project comprises 14 km of cable to connect Belwind Phase 2 to the Northwind wind farm (formerly known as Eldepasco), together with a further 43 km of cable that will transfer a total of 381 MW produced by both wind farms to the onshore grid connection at Zeebrugge.

In addition to the design, type-testing and supply of the XLPE subsea cables, Nexans will also supply mechanical and electrical accessories. This includes the onshore transition joints to connect the subsea cables to the land cables, the accessories for the two platforms, comprising hang-off and GIS (gas insulated switchgear) terminations, and four repair joints.

The Northwind wind farm will comprise 72 wind turbines, summing up to a total of 216 MW installed capacity. The power will be delivered to the Belgian electricity network at the ELIA HV connection station in Zeebrugge. The 14 km section of 245 kV cable connecting Belwind Phase 2 to Northwind will consist of three copper cores, each with a cross-section of 400 mm^2.

The majority of the 43 km, 245 kV connection from Northwind to Zeebrugge will comprise of three 1000 mm^2 copper cores. However, there is a length of the route where the cable has to traverse a sea channel subjected to regular dredging, requiring it to be buried down to 9 metres in the seabed for protection. In order to maintain the electrical performance of the cable along this channel, the copper cross-section will be increased to 1200 mm^2 on a 4 km section. This section of cable will have an outer diameter of 265 mm and will weigh 130 kg per meter.

The subsea cables will be manufactured at Nexans' specialized facility in Halden, Norway. They will also include two FO48 fiber optic elements, manufactured in the Nexans Rognan plant, to enable data communications, control and monitoring for the power transmission system.

"Following the success of our cable contract for Belwind Phase 1, we are delighted to have been awarded the contract to supply high-voltage power cable for Northwind offshore wind farms," says Dirk Steinbrink, Executive Vice President High Voltage & Underwater Cables Business Group of Nexans. "This success is the result of Nexans' proven technical expertise and our excellent long-term relationship with customers in the offshore wind industry."

STX OSV secured an order from a Norway-based shipping company for 2 offshore subsea construction vessels

STX OSV clinched an additional order for 2 specialized offshore vessels, giving a fresh impetus to its effort to win new orders.

STX OSV announced on April 13 that it won an order from the Norway-based Siem Offshore for the construction of 2 offshore subsea construction vessels (OSCVs).

This OSCV will measure 121m in length, 22m in width, and feature 'OSCV 11', the new design developed independently by STX OSV. Additionally, this vessel will be equipped with a 250-ton crane necessary for the subsea construction works. The hull of the vessel will be built at Tulcea shipyard in Romania and will be towed to the Brattvaag shipyard in Norway for the remaining works. The newbuilding is scheduled for delivery by the second half of 2013.

STX OSV has won orders for a total of 6 specialized offshore vessels so far this year. It secured the consecutive orders for 4 specialized offshore vessels in April alone, injecting new momentum to its effort to achieve strong order intake. STX OSV was awarded these consecutive orders in recognition for its excellent shipbuilding expertise and technological competitiveness.

Siem Offshore, the ship owner, is a Noway-based shipping company that operates 44 specialized offshore vessels, including the 5 units that will be built by STX OSV. An official from STX said, "The market for specialized offshore vessels will further expand amid the strong performance of the offshore plant market. STX OSV will step up effort to win more orders."

STX OSV secures contract for one AHTS for Iceman AS.

STX OSV one of the major global designers and shipbuilders of offshore and specialized vessels, ispleased to announce that it has secured a new contract for the design and construction of one Anchor Handling Tug Supply vessel (AHTS) for Iceman AS.

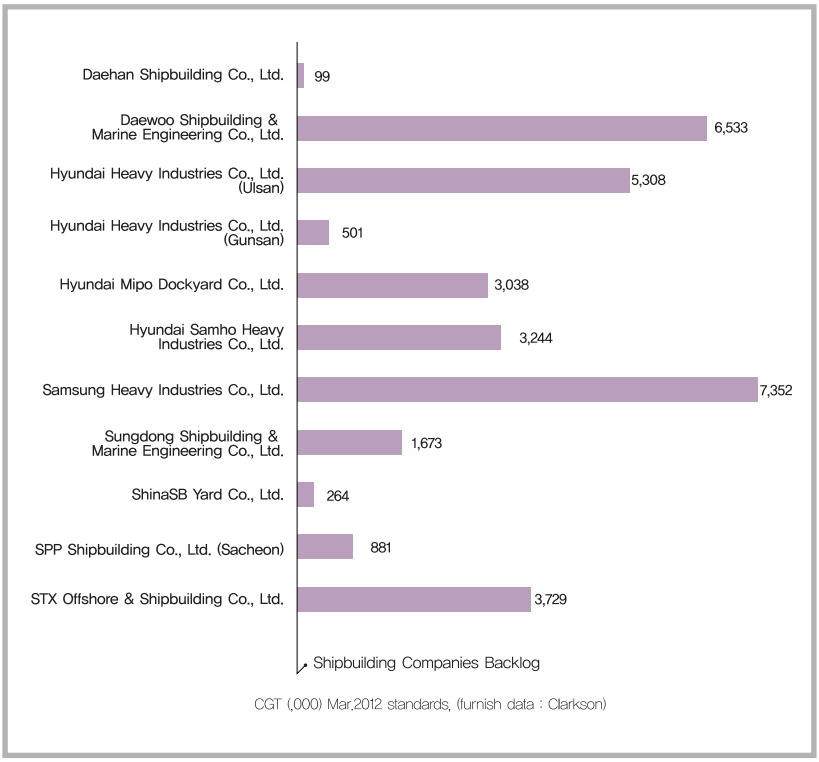
The vessel is developed and designed by STX OSV. It will be of AH 12 design, highly equipped for multi role operations in harsh and arctic areas, with wide beamand built according to ice class. The overall length of the vessel will be 94 meters with a beam of 24 meters.

Delivery is scheduled from STX OSV in Norway mid-2013. The hull of the vessel will be delivered from STX OSV in Romania.

Iceman AS is an investment company under establishment by Pareto Project Finance AS, supported and subscribed for by a group of Norwegian and international investors.

Anchor Handling Tug Supply vessel of STX OSV

Domestic shipyards saw declines in new orders for commercial ships in the first half of 2012 due to the rising freight rates amid sustained high oil prices and reduction in ship financing worldwide. Fortunately, major domestic shipyards have continuously won new orders for FPSO, offshore oil/gas production offshore platform, product/chemical tankers, the high value-added products, showing stronger performance than expected in terms of new order intake. 3 domestic shipbuilding giants are winning large-scale contracts one after another in the offshore plant sector. In addition, offshore energy exploitation activities will gather momentum with new projects worldwide from the second half of this year, which is expected to lead to increased competition among domestic shipyards.



According to the Clarkson data, domestic shipyards have secured a significant portion of the world's orders and maintain world's leading position.

Here, we take a close look at the performance of major domestic shipyards, such as Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME), Samsung Heavy Industries (SHI), STX Offshore & Shipbuilding (STXOS), etc., in terms of order backlog.

Photo: Hyundai Mipo Dockyard Co., Ltd.

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Offshore plant orders awarded to domestic shipyards in 2011-2012

Date		Type	Number of vessel	Amount	Ship owner	Delivery	Shipyard
2011	January	Drillship	1 vessel (including 1 optional vessel)	KRW 590 billion	Diamond Offshore Drilling Limited, U.S.A	Mid 2013	Hyundai Heavy Industries
		Offshore Plant	-	USD 900 million	RasGas, Qatar	Late 2013	Hyundai Heavy Industries
		Drillship	2 vessels (including 2 optional vessels)	KRW 1 trillion 140 billion	Noble Drilling, U.S.A	On a staggered basis until late September 2013	Hyundai Heavy Industries
		Deepwater drillship	1 vessel	-	Atwood Oceanics, U.S.A	Second half of 2013 Marine Engineering	Daewoo Shipbuilding &
	February	Offshore facility carrier FPSO for the North Sea	1 vessel -	KRW 265 billion USD 1.2 billion	Dockwise, Netherlands BP (British Petroleum), U.K	October 2012 Early 2015	Hyundai Heavy Industries Hyundai Heavy Industries
		Platform Supply Vessel	1 vessel	-	-	2012	STX OSV
		Fisheries Research Vessel	1 vessel	EUR 35 million	Ministry of Fisheries and Marine Resources, Republic of Namibia	Early 2012	STX Finland
	March	Offshore Platform (North Sea Drilling & Production platform, Quarters & Utilities platform)	1 unit each	USD 600 million	BP (British Petroleum), U.K	Late 2014	Hyundai Heavy Industries
		Deepwater drillship	2 vessel (including 2 optional vessels)	KRW 1 trillion 200 billion	Aker Drilling, Norway	Second half of 2013	Daewoo Shipbuilding & Marine Engineering
		Drillship	2 vessels	USD 1.1 billion	Ship owner, U.S.A	-	Samsung Heavy Industries
		Platform Supply Vessel	1 vessel	-	Norsea Group AS, Norway	June 2012	STX OSV
		Platform Supply Vessel	1 vessel	-	-	2012	STX OSV
	April	Drillship	1 (including 1 optional vessel)	-	Fred Olsen Energy, Norway	August 2013	Hyundai Heavy Industries
		Drillship	2 vessels	USD 1.12 billion	Maersk, Denmark	-	Samsung Heavy Industries
		Drillship	1 vessel	USD 680 million	Ocean Rig, Greece	October 2013	Samsung Heavy Industries
		Shuttle Tanker	2 (including 2 optional vessels)	USD 200 million	European Navigation, Greece	2013	STX Offshore & Shipbuilding
	May	Drillship	2 (including 1 optional vessel)	USD 1.12 billion	Rowan, U.S.A	Second half of 2013	Hyundai Heavy Industries
		Deepwater drillship	1 (including 1 optional vessel)	-	Vantage Drilling, U.S.A	Late May, 2013	Daewoo Shipbuilding & Marine Engineering
		Offshore Platform (Top side of offshore platform)	-	USD 414 million	Statoil, Norway	-	Samsung Heavy Industries
		FPSO	1 vessel	USD 636 million	Teekay Petrojarl, Norway	Mid 2013	Samsung Heavy Industries
		Platform Supply Vessel	2 vessels	Around KRW 120 billion	Farstad Shipping, Norway	First half of 2013	STX OSV
		FSO	1 unit	-	PTSC, Vietnam	Early 2013	Sungdong Shipbuilding & Marine Engineering
		LNG-FPSO	1 unit	USD 3.026 billion	Royal Dutch Shell, U.S.A	2016	Samsung Heavy Industries
	June	Platform Supply Vessel	2 vessels	Around KRW 150 billion	Island Offshore, Norway	First quarter, third quarter of 2013	STX OSV
		LNG-FSRU	2 units (including 2 optional vessels)	USD 500 million	Höegh LNG, Norway	Second half of 2013, first half of 2014	Hyundai Heavy Industries
		Multifunctional Deep Water Anchor Handling, Offshore Service Vessels	2 vessels	KRW 240 billion	Farstad Shipping, Norway	From the second quarter of 2013	STX OSV
		Drillship	1 vessel	USD 680 million	Ocean Rig, Greece	November 2013	Samsung Heavy Industries

2011	July	Drillship	2 vessels	USD 1.1225 billion	Maersk, Denmark	July 2014	Samsung Heavy Industries
	August	LNG-FSRU (Floating Storage and Regasification Unit)	1 vessel	USD 280 million	Excelerate Energy, U.S.A	First quarter of 2014	Daewoo Shipbuilding & Marine Engineering
	September	Semi-submersible Rig	2 units	USD 1.1 billion	Songa Offshore, Norway	Second hallf of 2014	Daewoo Shipbuilding & Marine Engineering
		Well Intervention Vessel	2 vessels	USD 420 million	Eide Marine Services AS, Norway	2013	STX Finland
		Drillship	1 unit (optional vessel awarded on January 19)	Approximately KRW 600 billion	Noble Drilling, U.S.A	Second half of 2014	Hyundai Heavy Industries
	October	Fixed Offshore Platform	–	USD 1.4 billion	Chevron, U.S.A	Second half of 2014	Daewoo Shipbuilding & Marine Engineering
		Drillship	1 unit	Approximately USD 550 million	Offshore drilling company, Americas	–	Daewoo Shipbuilding & Marine Engineering
		Platform Supply Vessel	1 unit	–	Troms Offshore Supply AS, Norway	First half of 2013	STX OSV
		Offshore Plant Module	2 units	–		First half of 2012	STX Finland
		Platform Supply Vessel	4 units	KRW 2 trillion	Island Offshore, Norway	Consecutively from the 3rd quarter of 2013 to the 1st quarter of 2014	STX OSV
	November	Pipe Laying Support Vessel	2 units	USD 500 million	Odebrecht, Brazil	August of 2014	Daewoo Shipbuilding & Marine Engineering
	December	Offshore facilities (Gas platform and various facilities)	–	USD 900 million	Major multinational oil companies	2nd half of 2014	Hyundai Heavy Industries
2012	January	CPF (Central Processing Facility)	–	KRW 2.6 trillion	Australia / INPEX	4th quarter of 2015	Samsung Heavy Industries
		Semi-submersible rig	1 unit	USD 620 million	Norway / Odfjell	by mid 2014	Daewoo Shipbuilding & Marine Engineering
	February	LNG-FSRU		–	Norway / Hoegh	–	Hyundai Heavy Industries
	March	Offshore Platform	1 unit	USD 560 million	Danish / DONG E&P A/S	April 2015	Daewoo Shipbuilding & Marine Engineering
		FPSO	1 unit	USD 2.0 billion	INPEX / Australia	April 2016	Daewoo Shipbuilding & Marine Engineering
	April	Drillship	1 vessel	USD 645 million	Ensco plc	Third quarter 2014	Samsung Heavy Industries

**Note : Based on the press release and public announcements of each shipyards, internal estimation of Monthly KORSHIP (estimation until April 15, 2012)*



People bringing life to ships

A countless number of vessels have been built until Korea became the world's largest shipbuilding country. These vessels which have their own names are sailing around the world.

Generally, vessel names are based on the hull number until they are officially named in the naming ceremony. The hull number based naming system ensures efficient computerized management of the vessels from their design to construction. Shipyards hold the ceremony to name the vessels before delivering them to the ship owners, which is called 'naming ceremony'.

• STX Offshore & Shipbuilding Co., Ltd.

STX Offshore & Shipbuilding (STXOS) held a launching ceremony for 'Noble Globetrotter 2' at the STX Dalian Shipbuilding Complex in China on November 22. The photo shows Lee In-seong, Vice-Chairman of STXOS, Jang Won-gab, Vice-Chairman of STX Dalian Shipbuilding Complex, Gang Deok-soo, Chairman of STX Group, and David Williams, Chairman of Noble Drilling (from the 5th on the left side).

•Sungdong Shipbuilding & Marine Engineering Co., Ltd.

1 2
4 3

Sungdong Shipbuilding & Marine Engineering (SSME) held the naming ceremonies for 4 vessels in March. S1162 (2), a 82,000-ton bulk carrier of Turkey-based AKMAR, was named 'MEHMET AKSOY', after the naming ceremony for S1147 (1) (named 'K.FOUNDATION'), a 180,000-ton bulk carrier of SK Shipping. Following that, S1123 (3) and 1124 (4), the 82,000-ton bulk carriers of U.S.-based NAVIOS, were named 'NAVIOS CENTAURUS' and 'NAVIOS AVIOR', respectively.

• Daehan Shipbuilding Co., Ltd.

Daehan Shipbuilding (DHSC) held a naming ceremony at its Quay Wall on March 1 for HN1051, a 207,000-ton bulk carrier ordered from the Greece-based Golden Flame Shipping S.A. This vessel was named 'SAMJOHN DREAM', wishing for safe voyage.

DHSC held a naming ceremony at its Haenam Shipyard in 2009 for 2 units of 170,500-ton bulk carriers ordered from the Bermuda-based Knightsbridge Tankers Limited. These vessels were named 'BATTERSEA' and 'BELGRAVIA', respectively.

•Hyundai Heavy Industries Co., Ltd.

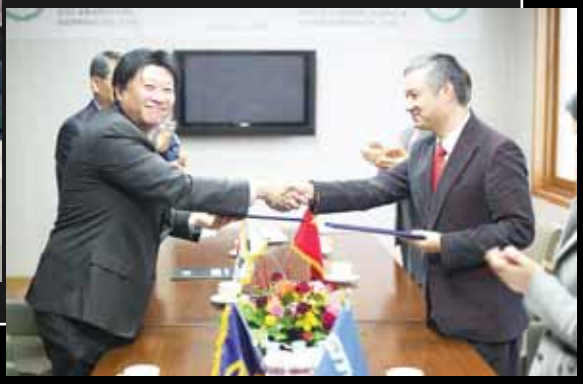
Hyundai Heavy Industries (HHI) held a naming ceremony for its first order of the year on January 6. The 318,000-ton very large crude carriers (VLCCs) ordered from the India-based GESCO (The Great Eastern Shipping CO.,Ltd) were named 'Maneklal Ujamshi Sheth' and 'Ardeshir H Bhiwandiwalla', respectively.

HHI held a launching ceremony for 'Taepyeongyang 12', a state-of-art 3,000-ton patrol ship, at its Ulsan Headquarters in March. This vessel measures 112.7 m in length, 14.2 m in width, and can sail at a maximum speed of 28 knots (approximately 51km/h). Each vessel is equipped with 4 units of 10,000 horsepower diesel engines and 1 unit of 750kW electric propulsion motor.

The photo shows the performance of hacking with an axe during the launching ceremony for 'Taepyeongyang 12'.

• Dae Sun Shipbuilding & Engineering Co., Ltd.

Dae Sun Shipbuilding & Engineering (DSSE) held a naming ceremony for 953TEU Container Carrier 'SITC Kwangyang' in January.



• Daewoo Shipbuilding & Marine Engineering Co., Ltd.

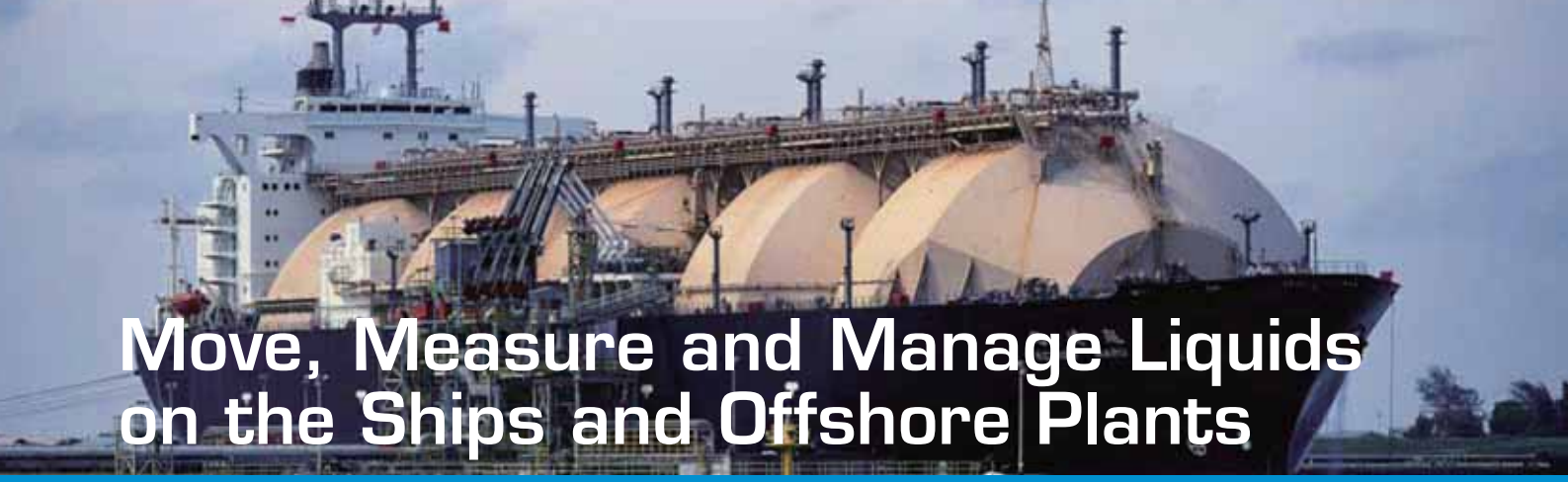
Daewoo Shipbuilding & Marine Engineering (DSME) held a naming ceremony at its Okpo Shipyard for the semi-submersible drilling rig ordered from Brazil's Petroserv in 2006. The vessel was named 'SSV VICTORIA'.

DSME held a naming ceremony for the deepwater drilling rig which was ordered from the U.S.-based Transocean, an offshore drilling company, in 2006. The vessel was named 'DISCOVERER CLEAR LEADER' by Sharron Long, wife of Robert Long.

•Samsung Heavy Industries Co., Ltd.

Samsung Heavy Industries (SHI) held a naming ceremony in 2010 for the LNG-SRV ordered from the Norway-based Hoegh. This vessel, named 'GDF SUEZ CAPE ANN', measures 270m in length, 44m in width, 26m in height, and can sail at a maximum speed of 19.5 knots (36km/h) with LNG carrying capacity of up to 145,000 m3.

SHI held a naming ceremony at its Geojeo Shipyard for a drillship ordered from Brazil's Petrobras in 2009. This drillship ordered in 2006 in a contract worth USD 590 million was named 'PETROBRAS 10000'.



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New Product

Teamcenter 9 Enables better decision making in product development

Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division and a leading global provider of product lifecycle management (PLM) software and services, announced the latest release of Teamcenter® software, the world's most widely used PLM system. Teamcenter 9 delivers new solutions and enhancements across the portfolio in support of Siemens PLM Software's HD-PLM vision, which was established to help companies make better informed decisions more efficiently and with a higher level of confidence.

Teamcenter helps companies deliver increasingly complex products while maximizing productivity and streamlining global operations. The Teamcenter 9 release adds a new integrated systems engineering solution and tightens the integration across the unified architecture so companies can make smarter decisions with better visibility into the impact of those decisions. Enhancements across the entire Teamcenter portfolio significantly improve productivity so companies can get to market faster, while reducing total cost of ownership.

"To face the challenge of increasing globalization of the enterprise and the ever-growing complexity of products, our customers require a more intelligent PLM system that provides the right information to the right person at the right time," said Eric Sterling, Senior Vice President, General Manager, Lifecycle Collaboration Software, Siemens PLM Software. "Teamcenter 9 continues to build on the unified architecture with a more integrated approach to connecting the information generated by teams across the extended enterprise, while giving them a more personalized and productive user experience."

Systems Engineering

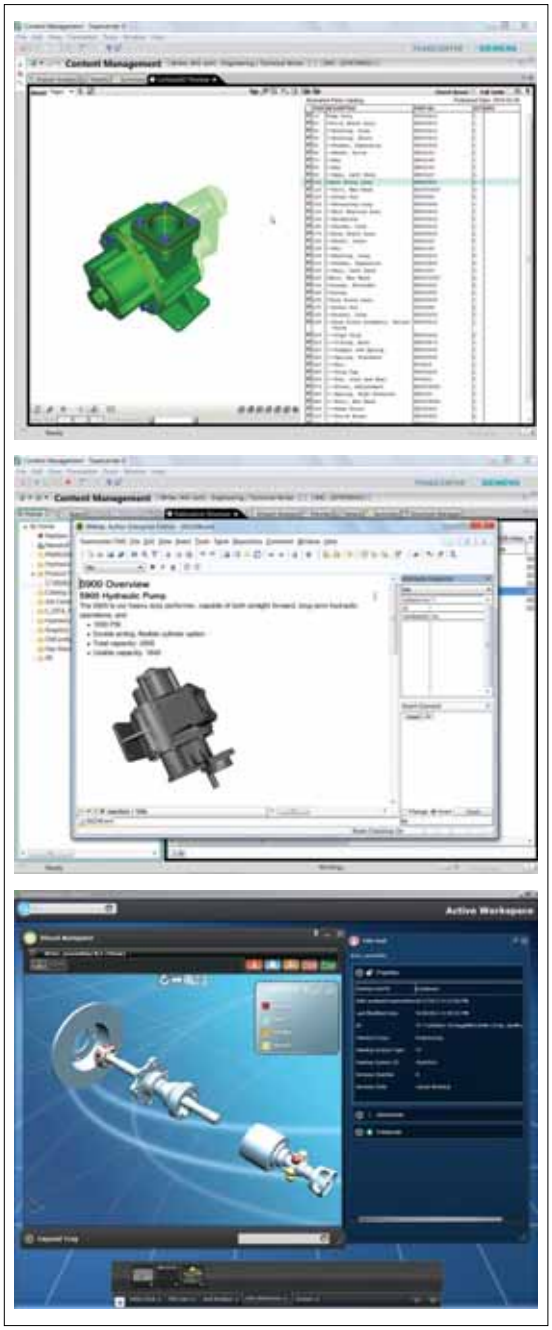
The new Teamcenter systems engineering solution provides a fully-integrated approach to systems engineering and requirements management. Unlike traditional systems engineering solutions that use stand-alone tools for system modeling, documenting interfaces, and documenting requirements, Teamcenter delivers a more systems-driven approach to product development that is managed from within the Teamcenter environment. This enables a common view of the system up and down the value chain, helping to eliminate costly late-stage system integration problems that result from requirements not being tied to physical implementation. Teamcenter 9 accelerates the product development process through intelligently integrated information, and ensures all departments and disciplines are using synchronized product information.

In addition, integrations with familiar best-in-class tools like Microsoft's Outlook® messaging software, Word, Excel® spreadsheet software, and Visio® software, as well as MathWorks' MATLAB® environment and Simulink® environment, support a variety of methodologies for systems definition and modeling using the tools that engineers are used to using.

Content Management

Technical documentation is a critical component of product development as it supports the delivery of documents such as user guides and repair manuals along with the release of a product. In the past, product development needed to be completed before documentation could be created due to the ever-changing nature of design.

The enhanced integration of content manage-



ment in Teamcenter 9 allows product documentation to be created in parallel with the design process. This ensures that changes are communicated as they occur and their impact can drive documentation more efficiently. Moreover, because today's products often have multiple options and variations, Teamcenter content management supports configuration-driven documentation that reuses common components of text, graphics and meta-data. This provides efficient, context-based multi-channel publishing to support the need for multi-media delivery on different devices and in multiple languages to support global markets.

In addition, an even tighter integration to Cortona3D's Rapid Author application enables documents to be created with illustrations that remain linked to the design data they describe so changes can ripple all the way through to the documentation. The new release also supports the latest version of the S1000D standard used in aerospace and government documentation as well as the DITA (Darwin Information Typing Architecture).

Service Lifecycle Management

Siemens PLM Software extends its Service Lifecycle Management vision with a new service scheduling and execution module. Service scheduling and execution have traditionally been separate activities conducted outside of PLM. This has made it difficult to track whether service has been completed in compliance with published procedures, which increases safety risks, product failures, or even downtime that could result in additional costs or fines.

Teamcenter 9 integrates the service scheduling and execution management solutions, enabling companies to more effectively control cost by defining and efficiently scheduling service orders and tasks. Teamcenter 9 helps optimize service organizations' resources, improve service throughput and reduce asset downtime. Teamcenter tracks and captures the execution of these service tasks to maintain an accurate history of assets and service records. Service personnel can also use the feedback capability to provide input to engineers further helping to increase product performance and reliability.

Process-based User Experience

Product development requires the involvement of both occasional and "power-users" who work in varying disciplines with varying needs and who need to access the right PLM data for the task at hand. Teamcenter 9 makes it easy to tailor the user experience with stylesheets that can streamline processes regardless of whether they use the traditional Teamcenter rich client (application) or thin client (web). The layout can now be easily customized to make it much easier for users to access task-specific information, actions, and behaviors, which results in a more streamlined and productive user experience.

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New Product

AquaStar™ Ballast Water Management System

AQUA Eng, Co.,Ltd

The AquaStar™ Ballast Water Management System (BWMS) developed by AQUA Eng. Co., Ltd. is using the method of natural seawater electrolysis system. This system is eco-friendly and energy efficient with own proprietary rights of system configuration, electrolyzer cell design and electrode material etc.

AQUA Eng embarked on the development of ballast water system technology using its unmatched know-how related to the coasting inside the ballast tank and received the IMO final approval in March 2012 and applied for the type approval of the Ministry of Land, Transport and Maritime Affairs (MLTMA).

AquaStar™ BWMS H-650(3000m³/hr) installation (Daisy, Polaris shipping)

In the AquaStar™ BWMS, Active Substances (AS) is produced by in-situ electrolyzing natural seawater. The AS includes sodium hypochlorite (NaOCl), hypochlorous acid (HOCl), etc. The main components of the AquaStar™ BWMS are a Smart Pipe unit, an Electrolyzer unit, a Neutralization unit, and a Control system unit. The Smart Pipe unit and the Electrolyzer unit are installed directly in the ballasting line for disinfection of the ballasting water. The Neutralization unit is installed in de-ballasting line in order to reduce the residual TRO (active Substances) of the discharged ballast water to a concentration similar to that of natural seawater. The Control system unit may operate automatically or manually and the system also collects and stores all operating data of the AquaStar™ BWMS.

The technologies that the company has accumulated in relation to the AquaStar™ Ballast Water Management System are as follows:

- Domestic patent applications
Ballast water treatment system with high efficient electrolyzing apparatus (KP 10-0982195)
Electrolysis apparatus of seawater or fresh water (KP 10-0950415)
Electrolysis apparatus of using cathode protected mesh (KP 10-1063572)
- Overseas patent applications
PCT/KR2010/009485 (2011)
- ISO 9001 (2011), ISO 14001 (2012)
- INNO-BIZ certification (2012)

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FURUNO New ECDIS FMD-3200/FMD-3300

FURUNO announced that the new ECDIS (model names FMD-3200 and FMD-3300) will be ready for launch very shortly. The FMD-3200 (19 inch LCD) and FMD-3300 (23.1 inch LCD) deliver great enhancement in terms of user interface as well as functionality. Fully complying with the performance standard of ECDIS stipulated in IMO resolution MSC.232(82), the new ECDIS is going to be a suitable candidate designated for new installation as well as retrofit to fulfill ECDIS mandatory carriage that is phasing in from July 2012 onward.

The new ECDIS will also bring about streamlined chart management scheme providing easy chart management independent of the chart providers. The new ECDIS is compatible with Jeppesen Dynamic Licensing and it supports the Admiralty Information Overlay (AIO). What is more, its network expandability fully satisfies provisos for paperless operation of vessels.

The new ECDIS FMD-3200/FMD-3300 provide the operator with quick access to the tasks and functions to be performed in the midst of vessel operation. The new ECDIS employs intelligently arranged Graphic User Interface elements: Status Bar and InstantAccess Bar that deliver task-based operation scheme to give the operator direct access to necessary operational procedure. The Status Bar at the top of the screen provides operating status, including modes of operation and presentation. The InstantAccess Bar on the left edge of the screen provides quick access to functions available in each of the ECDIS operating modes.

The contents of the InstantAccess Bar change according to the operating modes selected on the Status Bar.

This combination of the Status Bar and InstantAccess Bar covers virtually the entire operation, hence providing easy and quick access to the tasks to be performed. Subsequently, their need for digging into intricate menu tree to reach the necessary tasks has become a thing of the past. This would streamline the navigation monitoring procedure, reducing the risk of confusion and erroneous operation as well as to enhance situation awareness. Also, the new ECDIS utilises cutting edge chart-drawing engine that delivers instantaneous chart redraw with the seamless zooming and panning, hence making the ECDIS operation stress-free.

Moreover, its operation philosophy is based upon the same logic as the control scheme of a mouse that people are accustomed to in using a PC, and all operations can be controlled with the use of trackball of the control unit by means of left-clicking, right-clicking and using a thumbwheel. Also, full QWERTY style keyboard is available in the ECDIS control unit for easy route, event and waypoint naming.

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LAMBRECHT GmbH, founded 150 years ago with most experienced & accumulated skills and know-how in the production of meteorological instruments is providing large range of applications, which covers all standard and special demands.

Static naval wind sensor "QUATRO" is specialized for offshore operation. The compact space saving construction of the housing, the specially anodized coating as well as the protective paint finish make it extremely resistance to seawater as well as durable and reliable. The specification of "QUATRO" is "very high wind celocities up to 85 m/s measurable; very easy to maintain; no moving parts; varieties with or without heating; varieties with extra sensors for rel.humidity, air pressure and air temperature.

Combind naval wind sensor is for wind direction and wind speed and this is loyal at sea ; the robust, shock - and vibration resistance sensor delivers wind data without compromise. This top quality sensor is first class in extreme weather conditions at sea as well as ashore! The specification of Combind naval wind sensor is seawater-resistant with three coats of paint; glass fiber wedge-shaped wind vane warrants minimal radar signature; low starting values; high measuring accuracy and linearity across the whole measuring range; plug-in connector acc.to MIL standard; meets VG - and IMO-standards and the requirements of the German Lolyd / Nato-Supply number.

Static naval wind sensor - QUATRO

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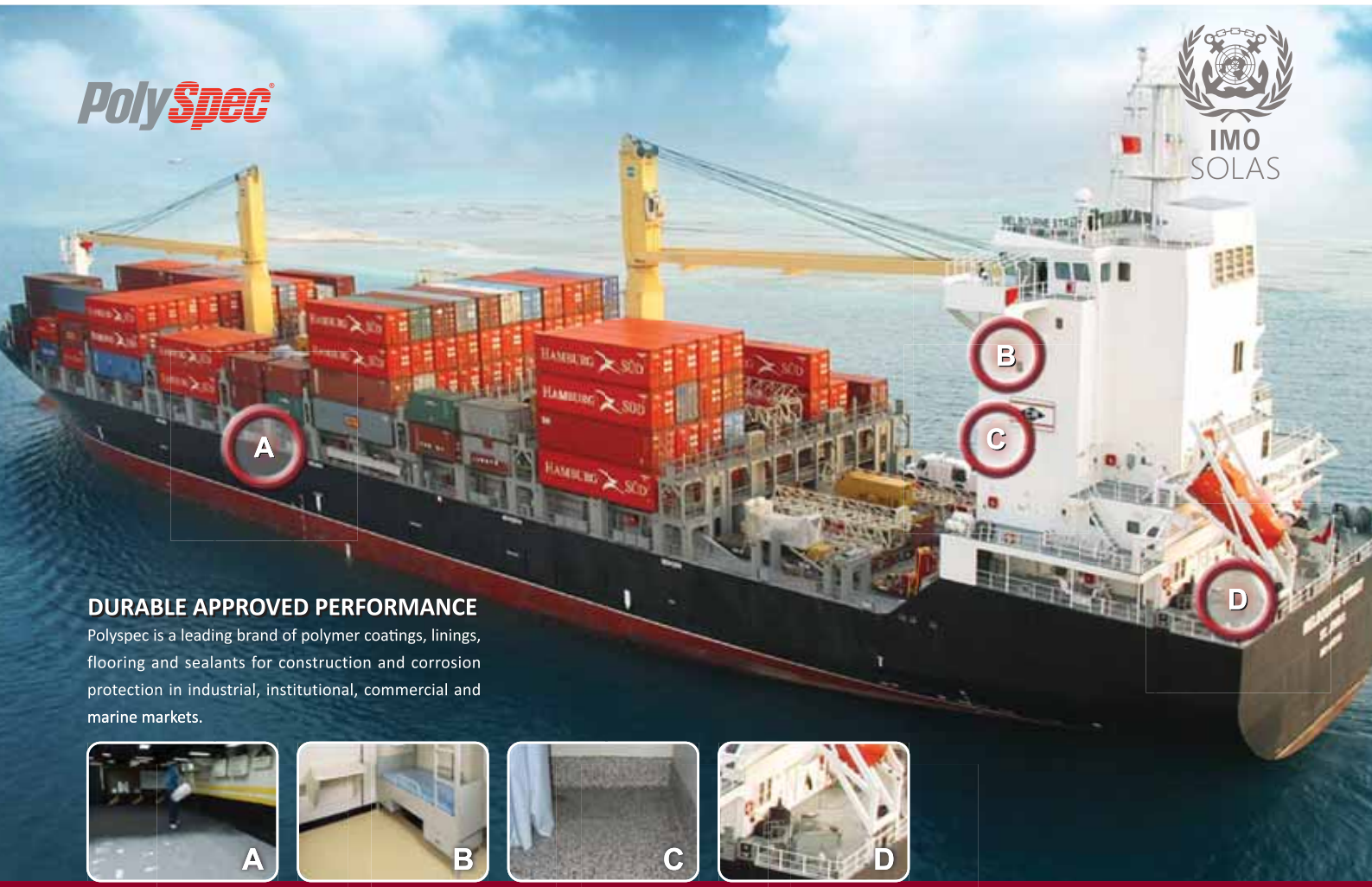

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Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Plate-Baffle
TEL : +82-51-831-2477

EM SYSTEC CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.emsystec.com
Main Products : Marine Switch Board, Control Console
TEL : +82-51-302-8761

FRIEND CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.thefriend.co.kr
Main Products : Marine Cable Tray, Mud Box, Strainer
TEL : +82-51-831-9456

GEO MAEK SHOT&PAINT CO.,LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Deck Machinery Part, Hose Handling Crane
TEL : +82-51-264-3315

GEORIM ENGINEERING CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.kangrim.com
Main Products : Marine Indutrial Boiler, Exhaust Gas Boiler
TEL : +82-51-831-2929

GISUNG ENGINEERING CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Air Reserovir, Heat Exchanger
TEL : +82-51-831-4475

G. M. TEC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.igmtec.com
Main Products : Duct Equip't Seat Support
TEL : +82-51-831-5851

G.S HIGH-TECHER CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.gshightecher.koreasme.com
Main Products : Air Vent Head, Pipe Coupling
TEL : +82-51-832-0456

G&S PRECISION IND CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Cable Tray, Vent, Hull Outfittings
TEL : +82-51-831-0849

HAE DONG METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hdanode.com
Main Products : Zinc Anode, Al Anode
TEL : +82-51-831-3751

HAE DUK RUDDER & R.STOCK CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.rudders.co.kr
Main Products : Rudder & R.Stock, Rudder Horn, Rudder Carrier
TEL : +82-51-831-0101

HAE SUNG INDUSTRIAL.
Head Office : Saha-gu Busan
Homepage Add. : www.hsjs.co.kr/
Main Products : Cable Tray, Cable Way Fitting, Cable Coaming
TEL : +82-51-264-8103

HAEWON INDUSTRIES CO.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : P/Crown, P/Skirt
TEL : +82-51-831-4600

HAEWON IND. CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.heawon.net
Main Products : Copper, Copper-Nickel, Monel Fitting & Flanges
TEL : +82-51-312-2161

HAEYANG FAMILY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : F.P Propeller, C.P Propeller, Propeller Shaft
TEL : +82-51-831-3550

HAEYANG METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : F.P Propeller, C.P Propeller, Propeller Shaft
TEL : +82-51-831-4591

HAEYANG PROPELLER CO., LTD.
Head Office : Gangseo-gu Busan

Homepage Add. :
Main Products : Marine Propeller
TEL : +82-51-831-4599

HANCHANG TRANS CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hctr.co.kr
Main Products : Pole Mounted Transformer, Pad Mounted Transformer
TEL : +82-51-831-3470

HANJULEVEL.
Head Office : Sasang-gu Busan
Homepage Add. : www.hanjulevel.co.kr
Main Products : Level instrument Etc, Vapour Emision Control Sys.
TEL : +82-51-303-0537

HANLA IMS CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hanlalevel.co.kr
Main Products : Cargo Tank Monitoring Sys. Tank Remote Sounding Sys.
TEL : +82-51-601-3019

HANLA IND CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Oil Filter unit, Gas Blower
TEL : +82-51-264-2201

HANMAUM KI-GONG CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hankg.co.kr
Main Products : Air Cooler Housing, Oil Cooler Housing
TEL : +82-51-831-5211

HEARTMAN CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.heartman.co.kr
Main Products : Nozzle Tip, Plunger Ass'y, Fuel Injection V/V
TEL : +82-51-262-8869

H.M.E.
Head Office : Kijang-kun Busan
Homepage Add. : www.hyomyungeng.com
Main Products : Battery Charger, Light Signal Column
TEL : +82-51-709-9000

HOSEUNG ENTERPRISE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hoseung.koreasme.com
Main Products : Tand Package Unit, Pump Package Unit, Cooler Package Unit
TEL : +82-51-831-2233

HWAJIN ENTERPRISE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hwa-jin.com
Main Products : Control Box, Gauge Board System
TEL : +82-512-831-9447

HWAJIN PF CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.hwajinpf.com
Main Products : Butt-Welding Pipe, Fittings Carbon Steel
TEL : +82-51-204-3001

HWA SHIN PRECISION CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Life Boat Winch
TEL : +82-51-831-9839

HYOSUNG STEEL TECHNOLOGIES CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Steel plute cutting, Hy Auto or Manual
TEL : +82-51-831-5093

HYUNDAI HYCRAULIC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hhmc.co.kr
Main Products : TURNING ROLLER, BLOCK LIFT
TEL : +82-51-831-8611

HYUNDAI ZINC METAL CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.hdz.co.kr
Main Products : Sacrificial Anode, Hot Dip Galvanizing, Ship Manufacture
TEL : +82-51-266-4788

HYUNJIN MATERIALS CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.hjmco.co.kr
Main Products : Cross Head, Connecting Rod, Piston Rod
TEL : +82-51-602-7700

ILDO MACHINE ELECT CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Heavy Electric Parts
TEL : +82-51-266-6066

IL - SUNG INDUSTRY CO.
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Silencer, Water Air Filter, Air Intet Trunk
TEL : +82-51-312-4056

IN SUNG INDUSTRY CO.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Profile, Steel Coalming Insulation
TEL : +82-51-293-7550

JAESEUNG ENGINEERING CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Steel Pipe Spool, Sus Pipe Spool, CuNi Pipe Spool
TEL : +82-51-831-8838

JEILSANKI CO.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-831-5398

JEONG-AM SAFETY GLASS CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.jeong-am.co.kr
Main Products : Tempered Glass, Laminated Glass
TEL : +82-51-831-6161

JEONG HWA ACCOMMODATION SYSTEM CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.jeonghwa21.com
Main Products : Wooden Furniture
TEL : +82-51-974-8000

JEONG WOO COUPLING CO., LTD.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.jwcjoint.co.kr
Main Products : Pipe Coupling, Pipe Repair Clamp
TEL : +82-55-339-7666

JIN GU ENGINEERING.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. :
Main Products : Rudder Stock, Stern Tube, Stern Roller, Winch
TEL : +82-55-343-3414

JIN IL BEND CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-832-1919

JINKWANG ELECTRIC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Pull Card Switch, Belt Sway Switch, Belt Speed Switch
TEL : +82-51-831-2571

JINYOUNG METAL CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.jymct.co.kr
Main Products : Multi Core Tube, Welded Stainless, Steel Tube
TEL : +82-51-313-4001

JMC HYDRAULICS.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Hydraulic Motor For Marine, Hydraulic Control Valve
TEL : +82-51-204-4046

JNC HI-TECHNOLOGIES.
Head Office : Gangseo-gu Busan
Homepage Add. : www.jnchitec.com
Main Products : Junction Box, Elect panel bard, Tel Booth
TEL : +82-51-974-9500

JOKWANG I.L.I CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-602-0200

JONGHAP POLESTAR ENGINEERING CO., LTD.
Head Office : Youngdo-gu Busan
Homepage Add. :
Main Products : Diesel Engine Piston, Cylinder, Valve
TEL : +82-51-403-5514

JUNG GONG IND. CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.jung-gong.com
Main Products : Ordinary Window Side, Scuttle, Heated Window
TEL : +82-51-261-2911

JUNG - WOO MACHINERY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Carrier Housing, Split Bearing,Stock, Up.Lower Sleeve
TEL : +82-51-831-5394

KANG BACK INDUSTRY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Electric Control Box, Valve & Similar , Equipment
TEL : +82-51-831-9025

KANGIL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Pressure Vessel, Deaerator, Heat Exchanger
TEL : +82-51-972-5672

KANGRIM HEAVY INDUSTRIES CO., LTD.
Head Office : Changwon Gyeongsangnam-do
Homepage Add. : www.kangrim.com/
Main Products : Marine Indutrial Boiler, Exhaust Gas Boiler
TEL : +82-55-269-7701

K.C. LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.iccp-mgps.com
Main Products : M.G.P.S, I,C,C,P, System Fe Ion, Generator
TEL : +82-51-831-7720

KEO HUNG MACHINERY.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Deck Crane, Provision Crane, Hose Handling Crane
TEL : +82-51-831-6296

KEYSUNG METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.keysungmetal.com
Main Products : Valve(Cryogenic, Ball), Strainer
TEL : +82-51-831-3391

KOC ELECTRIC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Cast Resin Transformer, Dry Resin Transformer
TEL : +82-51-832-0550

KOREA HYDRAULIC CO.
Head Office : Gangseo-gu Busan
Homepage Add. : www.enpos21.com
Main Products : Electtric Motor Pump, Hand Pump, Single/Double Acting Ram
TEL : +82-51-832-1100

KOREA PHE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.kphe.co.kr
Main Products : Plate Heat Exchanger, Tank Cleaning Heater
TEL : +82-51-261-2664

KOREA STEEL SHAPES CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.ekosco.com
Main Products : Flat Bars, Equal Angles, Unequal Angles
TEL : +82-51-323-2611

KOREA TRADING & INDUSTRIES CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.kticopper.co.kr
Main Products : Copper alloy coil, Plate
TEL : +82-51-293-4423

KORINOX CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.korinox21.com
Main Products : Cold Mill Stainless, Steel Coil
TEL : +82-51-832-0031

KORVAL CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.korval.co.kr
Main Products : Crank Case Relief Valve, Main Starting Valve, Rotary Valve
TEL : +82-51-790-9700

KSP CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Ship Engine Valve Spindle, Flange, Ring Gear
TEL : +82-51-831-6274

KSV
Head Office : Youngdo-gu Busan
Homepage Add. : www.ksv-valve.co.kr
Main Products : Valve Spindle, Seat-Ring for marine Engine
TEL : +82-51-415-4466

KTE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.kte.co.kr
Main Products : Electrical Equipment (Switchboard & Console)
TEL : +82-51-265-0255

KUKDONG ELECOM CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.kukdongelecom.com
Main Products : Naviagtion/Signal LT, EX-Plosion Proof LT, Fluorescent LT
TEL : +82-51-266-0050

KUKDONG INDUSTRIAL ENGINEERING.
Head Office : Sasang-gu Busan
Homepage Add. : www.kdie.co.kr
Main Products : Exhaust Gas Pipe With Insulation, Fuel Injection Pipe and Bloc
TEL : +82-51-303-6900

KUKJE METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.kjmetal.co.kr
Main Products : Manhole Cover, Portable Tank, EXH. Gas Pipe
TEL : +82-51-831-1541

KUM HAW PRECISION CO.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Coupling Flange, Bellows Flange
TEL : +82-51-831-5685

KUMKANG ENGINEERING.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Hand Rail, Storm Rail, Platform, Inc. Ladder
TEL : +82-51-831-0091

KUMKANG PRECISION.
Head Office : Saha-gu Busan
Homepage Add. : www.kkmarine.co.kr
Main Products : Engine Parts, (Air Reservoir) & Valve
TEL : +82-51-262-4893

KWANGIL CORP.,
Head Office : Sasang-gu Busan
Homepage Add. : www.k-i.co.kr
Main Products : Stainless Steel, HR Coil
TEL : +82-51-324-0006

KWANG JIN E.N.G CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Pipe Piece, Pipe Spool
TEL : +82-51-831-1435

KWANG JIN IND. CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Part of Heat Exchanger
TEL : +82-51-831-4131

KWANG JIN TECH.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Non Asbestos, Teflon, Rubber
TEL : +82-51-973-5566

KWANG LIM MARINE TECH. CO.,LTD.
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Window Box, (STEEL, AL, SUS) Vent Hole
TEL : +82-51-313-0055

KWANG SAN CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.kwangsan.com
Main Products : Heating Coil unit, Expansion joint
TEL : +82-51-974-6301

KWANGWOON CO.,LTD.
Head Office : Youngdo-gu Busan
Homepage Add. : www.kwang-woon.com
Main Products : Square Window, Side Scuttle, Door, Hatch, Window Wiper
TEL : +82-51-414-9494

KYEONG SIN FIBER CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.ksfiber.co.kr
Main Products : Rudder Bearing Bush, Insulation
TEL : +82-51-831-0268

KYOUNGWON BENDING CO.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.bending4u.com
Main Products : Hwase Pipe, Chain, Locker
TEL : +82-55-313-1277

KYUNGIL METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Marine Equipment Plating, Head Rest Pipe Plating
TEL : +82-51-831-1677

KYUNGSUNG INDUSTRY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.e-clamp.com
Main Products : Svs Corner & Anchor, Strip, Clamp
TEL : +82-51-831-4960

LHE CO., LTD.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.lhe.co.kr
Main Products : Heat Exchanger
TEL : +82-55-340-0624

MANZU INDUSTRY. CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Phosphate Coat, Pipe & Structure Painting, Special Painting
TEL : +82-51-832-0944

MARINE RADIO CO., LTD.
Head Office : Youngdo-gu Busan
Homepage Add. : www.mrckorea.co.kr
Main Products : Public Addressor Sys, Common Aerial Sys.
TEL : +82-51-414-7891

MARINE TECHNICAL ENGINEERING CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Oily Water Seperator, Bilge Alarm, Air Dryer
TEL : +82-51-831-1118

MARSEN CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.marsen.com/
Main Products : Cargo Tank Monitoring System, Tank High/Overfill Alarm System
TEL : +82-51-831-2108

MAX TECH.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.maxtech21c.com
Main Products : Engine, Shock Absorper, Gasket
TEL : +82-55-327-9652

MCM CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.mcm21.co.kr
Main Products : Valve, Junction Box, Switch Cover
TEL : +82-51-832-0505

MI JIN PRECISION.
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Valve, Tube, Vend, Pipe for ship
TEL : +82-51-315-3143

MIJOO INDUSTRY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-831-1588

MIRAE ENGINEERING CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.miraeship.co.kr
Main Products : Hull Block, Steel Outfitting, Pipe Spool/Unit
TEL : +82-51-790-5800

MJ TSR CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.mjtsr.com
Main Products : Rubber Sheets & Hats, All Types of Parts for Shipbuilding & Industries
TEL : +82-51-832-0002

MODERN INTECH CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Curtain, Carpet, Upholstery, Mattress for Marine
TEL : +82-51-325-0260

MT.H CONTROL VALVES CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : 82-51-974-8831

MYTEC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.imytec.com
Main Products : Heat Exchanger, Pressure Vassel
TEL : +82-51-831-7474

NAMSUNG SHIPBUILDING CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Rescue Boat Davit & Winch, Assembly, Line Hauler
TEL : +82-51-200-1277

NAMYANG METAL.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Stair Way Body, Bulk Head Hnlon, Galley Hood
TEL : +82-51-832-1721

NARA CORPORATION CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-790-7505

NAVUTEC.
Head Office : Kijang-kun Busan
Homepage Add. : www.navutec.com
Main Products : Fire fighting & Safety, equipment for marine & Offshore
TEL : +82-51-728-5055

NEW-OHSEUNG CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Manifold, Spool piece, Chain compressor
TEL : +82-51-266-5724

NK CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Ballast Water Treatment System, Co2 System
TEL : +82-51-204-2211

NOKSAN FLANGE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Flange for ship
TEL : +82-51-831-7956

OBOK ELECTRIC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Transformer
TEL : +82-51-832-1751

OK KWANG ENG CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.okv.co.kr
Main Products : Marine valves, Strainers
TEL : +82-51-326-7741

OK KWANG METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.okkwang.com
Main Products : Std Flange, Tube Sheet, Forging Material
TEL : +82-51-831-9885

ORIENTAL PRECISION & ENGINEERING CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.opco.co.kr
Main Products : Deck house, Engine room Casing, Life Boat
TEL : +82-51-202-0101

ORIENTAL PRECISION MACHINERY CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.opco.co.kr
Main Products : Crane Component
TEL : +82-51-831-0202

O.S.C.G CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.oscg.net
Main Products : Cable grand, Junction box
TEL : +82-51-305-3910

PACO HITEC CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.pacohitec.com
Main Products : Hydraulic hose, Fitting
TEL : +82-51-266-6994

PAL MI METAL IND CO., LTD.
Head Office : Jinhae Gyeongsangnam-do
Homepage Add. :
Main Products : Valve, Yoke, Fork, Knuckle, Carrier
TEL : +82-55-552-3840

PANASIA CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.worldpanasia.com
Main Products : Hi-level Alarm Sys. Tank level Gauge
TEL : +82-51-831-1010

PI PLUS CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.pharmaidsolutions.com
Main Products : Rudder stock, Pintle, Intermediate Shaft
TEL : +82-51-831-9338

POONG JIN METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Emergency Shut-Off Valve, Veneral Bronze Casting Valve
TEL : +82-51-831-8510

PSM CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.psminc.co.kr
Main Products : Ring Flange, Shaft, Nozzle
TEL : +82-51-970-3000

SAEJIN INTECH CO., LTD.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.saejinintech.com
Main Products : Emergency Towing, Arrangement, Universal Swivel Fairlead
TEL : +82-55-328-1458

SAMBOO METAL CO,, LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.samboometal.com
Main Products : Wheel, Shaft, Hyd-Net, Hyd Coupling Bolt, Flange
TEL : +82-51-831-1478

SAMGONG CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.sam-gong.co.kr
Main Products : Oil Purifiers, Ship' Accommodation, Ladders
TEL : +82-51-200-3040

SAMJOO ENG. CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.sam-joo.co.kr
Main Products : Catering Furniture, Galley Hood, Laundry Equipment
TEL : +82-51-264-6677

SAMJUNG MACHINERY.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Piston Rod, Cross Head, Inter Shaft
TEL : +82-51-832-0190

SAM KWANG HI-TEC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Rectangle Windows
TEL : +82-51-832-0177

SAMSUNG NONFERROUS METAL CO., LTD.
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.metalsamsung.co.kr
Main Products : Bushing, Liner, Sleeve, Pintle Bush
TEL : +82-55-329-1067

SAMYANG METAL IND. CO., LTD.
Head Office : Saha-gu Busan
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