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# Guide

# Offshore & Shipbuilding

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Publisher: Procon / Monthly KORSHIP
Date of Publication: around in June, 2016
TEL: 82-2-2168-8898
FAX: 82-2-6442-2168
Homepage: http://www.korship.co.kr
(&. The date of publication and number of pages is subject to change.)

## Offshore & Shipbuilding 기업 총람 2016년 개정판

월간 KORSHIP 은 국내 조선해양 기업들의 정보를 수록한 'Offshore & Shipbuilding 기업 총람' 2016년 개정판을 발간합니다. 본 총람은 조선소 및 조선기자재 업체, 해양플랜트 구조물 건조, 관련 기자재, 해운, 항만, 물류 등 분야별로 구성됩니다

발 행 사: 프로콘 (Procon) / 월간 KORSHIP
발 행 일: 2016년 6월경
연 락 처: (02) 2168-8898
팩　　스: (02) 6442-2168
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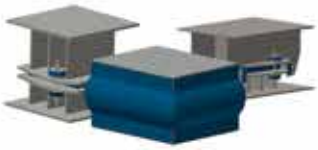

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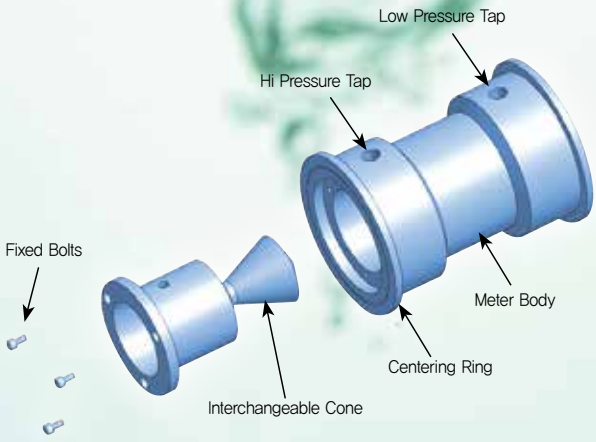


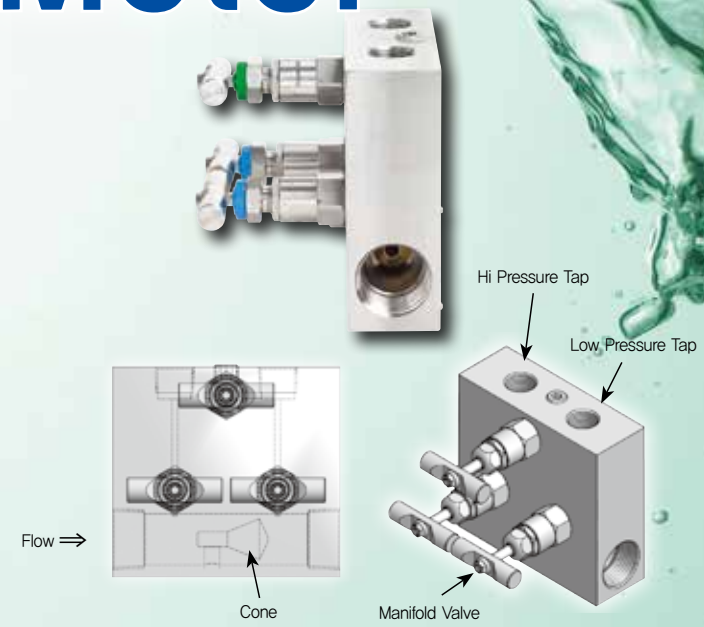


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**±8 %** Cone Meter는 제조공정상의 사소하게 보이는 차이에도 교정하지 않으면 최대 ±8 % 의 오차가 발생할 수 있습니다. 정확도 ±0.5~1 % 수준의 정밀한 유량측정을 위해서는 반드시 교정을 해야 합니다. (미국 CEESI에서 발표한 내용중)

하이트롤에서 생산되는 Cone Meter는 **ISO 17025 국제공인 교정시스템**에 의해 교정하며 ±0.5 %의 정확도를 가집니다.

## HFV-WM

HFV-WM은 Meter body의 교체 없이 Cone을 교체하여 유량 범위를 변경할 수 있으며, 과도한 유속 또는 슬러그 뭉치의 충격으로 인한 Cone의 변형에 쉽게 교체 사용할 수 있는 특징을 가지고 있다. 또한, Wafer형태로 설치가 용이하고 모든 구성품이 정밀 기계가공되어 측정정확도가 우수하며, 용접부가 없어 압력부의 건전성이 확보 되었다.

(특 허 : 제 10-0915088호)

## IVCM

IVCM은 차압식 유량계의 필연적 구성품인Manifold Valve를 Meter body와 일체형으로 제작하여 공정시 발생할수 있는 연결부의Leak를 최소화 하고, 설치시 공사 비용 및 시간을 줄이는 장점을 가진다.

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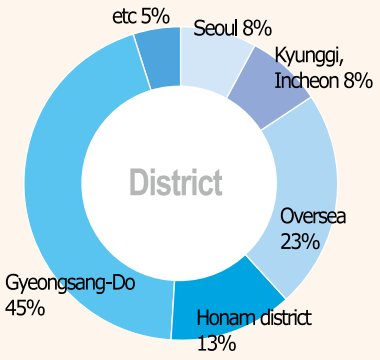


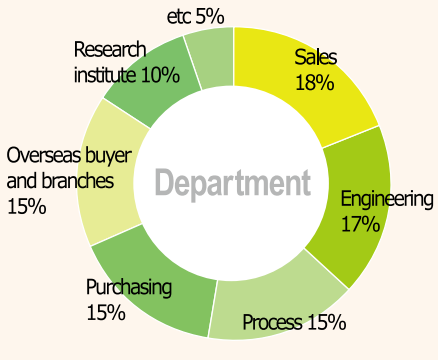


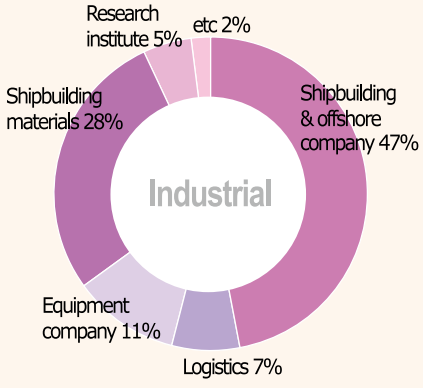

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KOREAN REGISTER

## HHI and Doosan Collaborate in Localizing Main Equipment for Offshore Plants

Hyundai Heavy Industries (HHI) announced on February 4 that it has signed a memorandum of understanding to collaborate on the localization of main equipment and materials for offshore plants with Doosan Heavy Industries & Construction (DHIC) and Center for Creative Economy & Innovation in Ulsan and Gyeongnam.

HHI and DHIC agreed to develop six main items of equipment for offshore plants such as floating, production, storage and offloading (FPSO) units and tension leg platforms (TLP), by sharing engineering and construction technology and prowess in on- and offshore plant sectors where the two companies have been actively played.

HHI will apply DHIC's flagship power technology of gas turbine generators and heat recovery steam generators (HRSG) to its offshore plants, and the two companies will jointly develop metallic materials for offshore floating structures.

Since forming a task force team that took on the localization of main equipment in September 2014, HHI has successfully installed onto offshore plants under its yards 38 major items including pressure vessels, air compressors and heat exchangers that local subcontractors developed and manufactured.

DHIC also completed the development of 'low-temperature cast and forged materials for offshore plants' in 2012 and has been striving to secure technology for the 'localization of high efficiency large-sized gas turbines' as the leading company of government's national research project since 2013.

"With most of the major equipment and materials imported from abroad, our localization initiative will drive our competitiveness forward in the offshore plant business. We are also enhancing our efforts to help local partner companies localize more items under the alliance with Center for Creative Economy & Innovation In Ulsan and Gyeongnam," said Kim Sook-hyun, COO of HHI's Offshore & Engineering Division.

### 현대중공업, 두산중공업과 '해양기자재 개발' 손 잡다

현대중공업과 두산중공업이 해양플랜트 기자재의 국산화를 위해 손을 맞잡았다. 현대중공업은 지난 2월 4일 경남 창원시 두산중공업 본사에서 고석희 두산중공업 주단BG장(Business Group), 이상록 현대중공업 해양설계부문장, 최상기 경남창조경제혁신센터장, 조희철 울산창조경제혁신센터 본부장 등 관계자 30여명이 참석한 가운데, '해양플랜트 기자재 국산화 협력 MOU(양해각서)'를 체결했다고 밝혔다.

이날 양사는 해양플랜트 설계기술과 생산기술을 공유해 FPSO(부유식 원유생산저장 · 하역 · 설비), TLP(부유식 구조 플랫폼) 등 해양플랜트에 설치되는 핵심 기자재 6종을 함께 개발하기로 합의했다.

현대중공업은 두산중공업과 함께 육상플랜트 기술을 해양으로 확대 적용하고, 부유식 해양구조물에 사용되는 주단조품(금속소재) 등을 공동 개발하게 된다. 아울러 울산 · 경남창조경제혁신센터도 우수한 중소기업들을 발굴해, 이번 해양플랜트 기자재 연구개발에 참여시킴으로써 대기업과 중소기업의 동반성장을 이끌어낼 예정이다.

현대중공업은 지난 2014년 9월 해양플랜트 기자재 국산화를 위한 TFT를 구성한 이후 압력용기, 공기압축기, 열 교환기 등 중소기업이 개발한 각종 기자재들을 제작 중인 해양플랜트에 실제로 적용하는 등 지금까지 총 38종의 해양기자재를 국산화했다.

두산중공업도 지난 2012년 '해양플랜트용 저온 주단강 소재'를 개발 완료한데 이어, 지난 2013년부터 '고효율 대형 가스터빈 국산화' 국책사업을 주도하는 등 플랜트 시장에서 자체 기술을 확보하는데 힘써왔다.

김숙현 현대중공업 해양사업 대표는 "대다수의 해양기자재를 수입하는 상황에서 기자재 국산화는 해양플랜트의 경쟁력을 높이는 원동력이 될 것"이라며, "중소기업들이 우리가 개발한 기술을 이용해 기자재 국산화에 나설 수 있도록 울산 · 경남창조경제혁신센터과의 연계활동도 강화할 예정"이라고 말했다.

한편, 현대중공업은 지난해 12월에도 한국조선해양기자재연구원, 울산창조경제혁신센터 등과 함께 '엔진 기자재 국산화를 위한 MOU'를 체결하고, 유압장치와 압력센서 등 18개의 엔진기자재 개발에 나서는 등 기자재 국산화를 통한 경쟁력 강화에 노력하고 있다.

## Emerson meets tough demands of bulk solids applications with enhanced level measurement technology

Further addressing the tough challenges of accurately measuring level and volume of bulk solids and powders in large vessels, bins and silos, Emerson Process Management has enhanced its range of level measurement devices. A number of new functions and certifications will help to minimize maintenance, enable easy integration and expand the range of suitable applications.

"Uneven surfaces, irregular build-up and harsh, dusty and potentially explosive environments make measuring the level of solids in large vessels problematic, impacting inventory control decisions," said Asael Sharabi, technical director at Emerson Process Management. "Emerson's enhanced Rosemount instrumentation meets these challenges to provide users with greater control of inventories and entire manufacturing processes, with significant financial benefits."

Supporting manufacturers' need for improved inventory control, the Rosemount 5708 Series 3D Solids Scanner, which uses acoustic measurement and 3D mapping technology to provide highly accurate continuous level and volume measurement, is now suitable for a broader range of applications. The device is now ATEX/IECEx certified for installation in areas with potentially explosive atmospheres, often found in solids measurement applications. A new mounting adaptor also allows the device to be installed within electrostatic precipitator (ESP) hoppers. By using its 3D visualization capability to map out the surface of the fly ash that builds up in the hopper, operators can optimize the process, reducing cost, risk and wear and tear on the hopper.

To overcome the difficulty of installation and integration, Emerson has introduced full SCADA integration support for the solids scanner. Users can now seamlessly integrate 3D visualization of the surface level into Emerson's Ovation™ or DeltaV™ distributed control systems, delivered directly to control room operators.

For remote solids applications or where there is no existing cable infrastructure, wireless can be the key for a successful project. Both the solids scanner and the Rosemount 5402 Non-contacting Radar, which provides bulk solids level measurement for applications with smaller sized vessels, can now be connected to a WirelessHART® network using a Smart Wireless THUM™ Adapter. This enables easy integration to the automation architecture, reducing installation cost and time.

New functions help to further reduce if not

eliminate device maintenance requirements. The new air purging connection for the Rosemount 5402 prevents clogging of the antenna in applications with very dusty environments. The already present self-cleaning function on the Rosemount 5708 can now be complemented with a new PTFE coated antenna which helps extend maintenance intervals even further, especially where extremely sticky materials are present.

## 에머슨, 강화된 레벨 계측 기술에 따라 벌크 고체 애플리케이션 충족

대형 선박, 빈(bin), 사일로(silo) 내 벌크 고체 및 파우더의 레벨과 볼륨을 정확하게 측정하는 것과 관련된 어려운 과제를 해결하기 위해서, 에머슨 프로세스 매니지먼트는 레벨 계측 장치의 범위를 확대했다. 새롭게 추가된 기능과 인증들은 장치의 유지보수를 최소화하고, 간편한 통합을 가능하게 하며, 적합한 애플리케이션을 확장할 것으로 예상된다.

에머슨 프로세스 매니지먼트의 기술 디렉터 아자엘 사라비(Asael Sharabi)는 "고르지 않은 표면이나 불규칙한 빌드업(build-up) 그리고 거칠고 먼지가 가득한, 심지어 폭발 가능성이 있는 환경은 대형 선박 내 고체 레벨의 측정을 어렵게 만들며 결국 재고 관리 결정에 영향을 미치게 된다"며, "에머슨의 향상된 Rosemount 계측(instrumentation)은 이런 난제들을 처리해 사용자들이 재고와 전 제조 공정을 잘 관리할 수 있도록 돕는다"고 말했다.

어쿠스틱 측정 및 3D 맵핑 기술을 사용하여 매우 정확한 연속 레벨 및 볼륨을 계측하는 Rosemount 5708 시리즈 3D 솔리드 스캐너가 이제 더욱 폭넓은 애플리케이션에 적합해짐에 따라, 향상된 재고 관리를 필요로 하는 제조업자들을 지원한다. 이 장치는 고체 계측 애플리케이션에서 흔히 찾아볼 수 있는 폭발 가능성이 있는 환경에서의 설치를 위한 ATEX/IECEx 인증을 획득하는데 성공했다. 또한 새로운 마운팅 어댑터를 통해 전기 집진기(electrostatic precipitator; ESP) 애플리케이션 내에 장치를 설치하는 것이 가능하다. 3D 시각화(visualization)를 통해 호퍼 내 쌓이는 플라이애시(fly ash)의 표면을 맵핑하여 공정을 최적화하고 호퍼의 비용, 위험 요소, 마모 등을 절감할 수 있다.

어렵기만 한 설치와 통합을 해결하기 위해 에머슨은 솔리드 스캐너를 위한 완전한 SCADA 통합을 도입했다. 이제 사용자들은 에머슨의 Ovation™ 또는 DeltaV™ 분산제어시스템으로 표면의 3D 시각화(visualization)을 완벽하게 통합해 이를 곧바로 제어실 오퍼레이터로 전달할 수 있다.

원격 고체 애플리케이션이나 케이블 인프라(infrastructure)가 없는 곳에서의 성공적인 프로젝트를 위해서는 무선이 필수적이라고 할 수 있다. 이제 솔리드 스캐너와 더 작은 크기의 선박과 관련된 애플리케이션에서 벌크 고체 레벨 계측을 제공하는 Rosemount 5402 Non-contacting Radar는 모두 스마트 무선 THUM 어댑터(Smart Wireless THUM™ Adapter)를 사용해 WirelessHART® 네트워크에 연결된다. 결과적으로 자동화 아키텍쳐로의 더욱 간편한 통합이 가능해지고, 그에 따르는 설치 비용과 시간을 줄일 수 있다.

새로운 기능은 장치의 유지보수에서 요구되는 사항들을 그저 줄이는 것만이 아니라 완전히 제거할 수 있도록 돕는다. Rosemount의 새로운 기포식(air purging) 연결은 먼지가 심한 환경에서 애플리케이션 안테나의 막힘을 방지한다. Rosemount 5708에 이미 내장되어 있던 자동세척(self-cleaning) 기능은 이제 새로운 PTFE 코팅 안테나와 결합해, 특히나 끈적이는 물질이 있는 환경에서 장치의 유지보수 주기를 늘릴 수 있게 되었다.

## DSME built a complete lineup of LNG re-gasification facilities

Daewoo Shipbuilding & Marine Engineering (DSME) came to a definite decision to build LNG-FSU (Floating Storage Unit), successfully wining orders for all types of vessels related to LNG re-gasification. DSME announced on February 17 that it signed a contract with Canada-based Teekay to alter specifications of LNG carrier ordered in February last year, converting the vessel to LNG-FSU. Teekay won a contract to operate LNG import terminal located off the coast of Bahrain for the next 20 years which will be operational from mid 2018, supplying up to 800 million cubic feet of natural gas per day. For Teekay, LNG-FSU with upgraded specifications has been considered essential for carrying out LNG re-gasification project successfully. Teekay had placed orders for many LNG carriers at DSME, including natural gas-powered LNG carriers, icebreaking LNG carriers, etc, and also recently selected DSME as its partner for new project.

LNG-FSU is designed to provide storage and onshore supply capabilities, upgrading conventional LNG carrier. This LNG-FSU, which will be moored at LNG terminal in Bahrain after delivery, will store liquefied natural gas (LNG) unloaded from shuttle carrier and supply the LNG stably to onshore re-gasification facilities.

By signing this contract, DSME has successfully built complete lineup of facilities related to LNG re-gasification. Additionally, this contract will help DSME further sharpen its responsiveness and competitiveness in LNG re-gasification system market. DSME became the first shipyard in the world to build LNG-RV (Re-gasification Vessel) in 2005 and clinched the world's first order for LNG-FSRU in 2011. DSME also won an order for the world's largest LNG-FSRU with a capacity of 263,000㎥ in 2013, which is currently under construction at its Okpo shipyard.

### 대우조선해양, LNG 재기화 설비 풀라인업 구축

대우조선해양이 부유식 액화천연가스 저장 설비(LNG-FSU: Floating Storage Unit) 건조를 확정하며 LNG 재기화(Re-gasification)와 관련된 모든 선종을 수주하는 데 성공했다.

대우조선해양은 캐나다 티케이(Teekay)가 지난해 2월 발주한 LNG운반선을 LNG-FSU로 사양 업그레이드하는 선종변경 계약을 체결했다고 지난 2월 17일 밝혔다. 티케이는 바레인 연안에 위치한 LNG 수입 터미널을 20년간 운영하는 사업을 따내, 2018년 중순부터 하루 최대 8억 입방피트의 천연가스를 육상으로 공급할 계획이다.

티케이가 처음으로 진출하는 LNG 재기화(Re-gasification) 사업의 성공을 위해서는 기존 운반선보다 사양이 업그레이드 된 LNG-FSU가 필수적이었다. 티케이 측은 천연가스 추진 LNG운반선과 쇄빙 LNG운반선 등 다수의 LNG운반선을 발주한 티케이는 이번에도 새로운 사업을 추진하며, 대우조선해양을 사업 파트너로 선정했다.

LNG-FSU는 기존 LNG운반선에 저장 및 육상 공급 기능을 추가하는 방식으로 제작된다. 인도 이후에는 바레인 터미널에 장기간 계류하면서 셔틀 운반선으로부터 공급받은 액화천연가스를 저장하는 동시에 육상 재기화설비로 안정적으로 공급하는 역할을 수행할 예정이다.

이번 계약으로 대우조선해양은 LNG 재기화 관련 설비의 풀라인업을 완성하는데 성공했다. 향후 LNG 재기화 시스템 시장에 대한 대응력 및 경쟁력을 한층 강화할 수 있게 됐다는 평가다. 대우조선해양은 2005년 세계 최초로 LNG-RV를 건조하는데 성공했고 2011년에도 세계 최초로 발주된 LNG-FSRU를 수주한 바 있다. 2013년에는 세계 최대 규모인 263,000㎥(입방미터)급 LNG-FSRU를 수주해 현재 옥포조선소에서 건조 중이다.

## Korea Eximbank provide financial support worth KRW 75 billion this year

Export-Import Bank of Korea (Korea Eximbank) held a briefing session revolving around the theme, '2016 Korea Eximbank Key Strategies', on January 26 in a bid to help overcome downturn in exports and domestic consumption. Korea Eximbank's executives and major directors of divisions took the podium to present this year's key policy directions and strategies for financial support to each industry at the briefing session which was attended by officials from about 300 major domestic companies.

Specifically, Korea Eximbank offered an overview of strategies for financial support to industries including construction, plant, offshore, service industries, along with strategies underpinning small and medium-sized enterprises (SMEs) and middle-standing businesses and strategies for financial support for development of Northeast Asia.

At the briefing session, Korea Eximbank announced that it earmarked KRW 75 trillion for loans this year. Funding worth KRW 57 trillion will be set aside for loans and investment support to facilitate liquidity supply to businesses, which represents an increase by 1 trillion from last year (KRW 56 trillion). Additionally, funding worth KRW 18 trillion will be provided for guarantees related directly to contracts awarded to companies by overseas clients in consideration of market demand, which represents a decrease by KRW 6 trillion from last year (KRW 24 trillion).

This year, Korea Eximbank is scaling back the loans due to slump in new orders throughout construction, plant, and ship sectors which are main beneficiaries of support, and expectation of weaker demand for export financing amid world economic recession. Loans earmarked for construction sector and plant sector were scaled back to KRW 18 trillion this year from KRW 20 trillion last year. Meanwhile, loans for ship sector were curtailed to KRW 13 trillion this year from KRW 17 billion last year. However, Korea Eximbank indicated that the loans would be increased immediately upon improvement of market conditions.

Moreover, Korea Eximbank unveiled measures to help increase exports by SMEs and middle-standing businesses and spur their entry into overseas markets. Korea Eximbank will provide preferential treatment for export transaction in conjunction with 'creative economy innovation centers' operating in provinces and metropolitan cities nationwide. Furthermore, Korea Eximbank will design 'creative industry support program' that provides customized business information, joining the endeavor of government to boost exports by SMEs and ease the path for Korean companies to move beyond domestic market into international export market.

An official from Korea Eximbank said, "We will play more active role as policy-based financial institution with more rigorous review of profitability to eliminate irrationality from order-taking process and help place major industries better positioned to win new orders, rather than simply expanding the fund support. Particularly, we will ensure that redeployment of workforce and organizations can lead to more strict review process and risk control, maintaining the Bank in even better shape."

**한국수출입은행, 올해 총 75조원 금융 지원**

한국수출입은행은 수출부진 및 내수 침체 위기를 극복하기 위해 지난 1월 26일 '2016년 수출입은행 핵심전략 설명회'를 개최했다.

한국수출입은행의 경영진과 주요 부서장들이 직접 나서 올해 주요 정책 방향과 산업별 금융지원 전략을 설명한 이날 행사에는 약 300여 개 국내 주요기업의 임직원이 참석했다. 이 자리에서 한국수출입은행은 건설, 플랜트산업, 해양산업, 서비스산업 등 산업별 지원 전략과 중소 · 중견기업 지원 전략, 동북아개발금융지원 전략 등을 소개했다.

이날 한국수출입은행은 올해 여신지원 규모를 75조원으로 책정했다고 밝혔다. 대출 및 투자는 기업에 원활한 유동성 공급을 위해 지난해 56조원보다 1조원 증가한 57조원을 제공할 계획이며, 기업의 해외수주와 직접적으로 연관된 보증은 시장수요를 감안해 지난해 24조원보다 6조원 감소한 18조원을 지원한다.

한국수출입은행이 올해 여신지원을 축소한 것은 주요 지원산업인 건설 · 플랜트 및 선박 부문의 수주부진과 세계 경기침체에 따라 수출금융 수요 감소가 예상되기 때문이다. 건설 및 플랜트는 지난해 20조원에서 18조원으로, 선박은 17조원에서 13조원으로 축소됐지만, 시장상황이 개선되면 즉각적으로 여신규모를 확대한다는 방침이다.

아울러 중소 · 중견기업의 수출 및 해외진출을 활성화하기 위한 방안도 나왔다. 한국수출입은행은 전국 도 · 광역시에 설치된 창조경제혁신센터와 연계한 수출거래에 대해 우대 지원하는 한편 맞춤형 경영정보를 제공하는 '창조산업 지원 프로그램'을 신설해 정부의 중소기업 수출 증진 및 내수기업의 수출기업화 등에 적극 부응할 계획이다.

한국수출입은행 관계자는 "주요 수주산업 경쟁력 강화를 위해 단순 자금공급 확대보다는 수익성 심사 강화를 통한 수주과정 불합리성 제거 등 정책금융기관으로서 역할을 강화하겠다"며, "특히 심사 및 리스크관리 기능을 강화하도록 조직과 인력을 재배분해 은행 내실을 더욱 다지겠다"고 말했다.

## Establishment of FURUNO China

FURUNO announced that the new subsidiary in Hong Kong has been established and commencing its business operation on the 1st of February 2016. The new subsidiary, FURUNO China Co., Ltd is FURUNO's wholly-owned subsidiary company incorporated in Hong Kong.

FURUNO China's main task is to further enhance the sales activities as well as technical service provision scheme covering Mainland China / Hong Kong market which is viewed as one of the most important geographical locations with remarkable market potentials for New buildings, Retrofit and Services for commercial ships, River and Workboat, Fishing and growing Pleasure market.

In addition, FURUNO China, in a close cooperation with FURUNO group of companies, is honored and pleased to support all the commercial ships whenever they need to be served during their calling at and/or stay in Mainland China / Hong Kong.

It is strongly believed that, with the establishment of FURUNO China, FURUNO will be able to further solidify and rationalize its operation, hence to earn further confidence from the global maritime industry as a whole.

## KR signed an agreement with HHI for joint research on ultra-large containership

Korean Register of Shipping (KR) announced on February 22 that it entered into a joint research agreement with Hyundai Heavy Industries (HHI) for evaluation of whipping effects in order to improve structural stability of 19,000 TEU containership.

Whipping refers to excessive shaking of hull impacted by waves at rough sea. Particularly, whipping was blamed for a marine accident in 2013 which a containership broke into two pieces during navigation under bad weather in the Indian Ocean. To ensure stability of ultra-large containerships, structural designing needs to consider the whipping effects.

An official from KR said, "This joint research aims at application of latest technologies and development of safe ultra-large containership through bilateral cooperation. I hope that this agreement will help promote technical exchange between KR and HHI to further improve technologies for ship structure safety evaluation."

Moreover, KR will also team up with HHI in follow-up research to evaluate the effect of springing phenomenon on fatigue strength.

### KR, 현대중공업과 초대형 컨테이너선 공동 연구 협약 체결

한국선급(KR)은 현대중공업과 19,000 TEU 컨테이너선의 구조 안정성 확보를 위한 휘핑(whipping) 영향도 평가에 관한 공동 연구 협약을 체결했다고 지난 2월 22일 밝혔다.

휘핑 현상은 선박이 거친 바다 위를 항해할 때 파도에 의한 충격으로 인해 발생하는 선체가 과도하게 흔들리는 것을 의미하며, 지난 2013년 인도양에서 악천후 항해 중 선체가 두 동강 났던 컨테이너선호의 사고 원인으로 지목된 바 있다. 이에 초대형 컨테이너선의 경우 안정성을 확보하기 위해 이러한 영향을 고려해 구조 설계를 해야 한다.

한국선급 관계자는 "이번 공동 연구는 양사의 협력을 통해 최신기술을 적용 및 안전한 초대형 컨테이너선을 개발하는데 목적이 있다"며 "이번 협약을 통해 한국선급과 현대중공업이 상호간 기술 교류를 활발히 하여 선박 구조 안정성 평가 기술을 더욱 향상시킬 수 있을 것으로 기대한다"고 말했다.

한편 한국선급과 현대중공업은 후속 연구로서, 스프링잉(Springing) 현상이 피로강도에 미치는 영향 평가 역시 공동으로 수행 할 것을 추진키로 협의했다.

## ClassNK releases new PrimeShip-HULL (HCSR) system

PrimeShip-HULL (HCSR) has long been the go-to design support system for ship designers worldwide. To date, over 800 licenses have been provided to more than 90 shipyards. In response to the latest amendments to the IACS Common Structural Rules for Bulk Carriers and Oil Tankers (CSR BC & OT), ClassNK has just released its latest version, PrimeShip-HULL (HCSR) Ver. 3.0.0.

Adopted in 2013, the CSR BC & OT were designed to enhance safety and reliability. Although they represent a major step forward for ship safety, they also present a number of new challenges for shipyards and designers due largely to the increase in overall vessel design time. To alleviate the burden of these new rules on ship designers and cut down the required man hours, ClassNK released PrimeShip-HULL (HCSR), a multi-functional vessel design support tool that makes it easy for designers to carry out rule calculations and optimize their designs.

The new version builds on the success of ClassNK's existing system with some nice tweaks and capabilities. As always with PrimeShip-HULL (HCSR) upgrades, ver. 3.0.0. is up to speed on all the latest rules and is fully compliant with the February 2016 corrections (Corrigenda 1) made to CSR BC & OT.

The prescriptive calculation software includes enhanced data linkage with popular commercial CAD systems, which further streamlines the design process. In particular, data linkage with the widely used 3D ship design system NAPA Steel has been updated to include all structural members in the fore and the aft of bulk carriers and

oil tankers. This makes it possible to exchange an entire ship model from NAPA Steel so that ship designers will be able to benefit from even further reduced modelling time.
Its familiar interface ensures a smooth user experience while designers can expect more streamlined direct strength analyses thanks to the improved fine-mesh FE model creation function and a new entire ship batch analysis function for the direct strength assessment software. Input errors are minimized as whole ship FE models are automatically split into hold models, and then analyzed and evaluated in line with CSR BC & OT.
This free, easy-to-use tool supports the design of safer ships compliant with CSR BC & OT and is available completely free of charge to all ClassNK clients.

## Rockwell Automation launches road-show featuring smart manufacturing solutions

Rockwell Automation Korea announced that it would invite customers to '2016 Rockwell Automation On Tour' program at Hotel Lewin in Jeonju, North Jeolla Province on March 17, featuring the latest IoT-based integrated control and information solutions supporting implementation of smart factory and smart manufacturing at real sites.
The On Tour program consists of technical session on the latest IoT-based integrated control and information solutions and demonstration session. Particularly, the On Tour program will introduce currently feasible solutions for customers in North Jeolla Province, high-performance automation architecture, measures for introduction and application at production sites, realistic value and economic benefits for customers, etc.
The On Tour program will begin with introduction of 'connected enterprise' for implementation of smart manufacturing that goes beyond smart factory. It will satisfy the needs of attendees through various sessions covering issues such as industry security that should be considered for smart manufacturing; migration techniques for aged manufacturing assets; information solution and smart motor control solution; and maintenance solution.
An official from Rockwell Automation said, "This program will showcase feasible solutions to equipment manufacturers and end users in North Jeolla Province who are exploring expertise in planning, implementing, maintaining, and developing smart manufacturing, including engineers in manufacturing industry, IT professionals and developers, plant operators and maintenance managers, corporate executives and mid-level managers, and corporate innovation and business planning professionals.
Furthermore, this program will be practically useful for SI solution providers trying to develop and provide smart factory solutions incorporating the latest automation and information technologies."
Following this road-show in Jeonju, Rockwell Automation Korea will hold safety symposium for domestic customers in manufacturing industry, road-show for power industry, and petrochemical road-show for local customers in Daesan.

### 로크웰 오토메이션, 스마트 제조 솔루션 로드쇼 개최

로크웰 오토메이션 코리아는 최신 IoT 기반의 통합 제어 및 정보 솔루션을 통해 스마트 팩토리 및 스마트 제조를 실제 현장에 구현할 수 있도록 지원하는 고객 대상 세미나인 'Rockwell Automation on Tour 2016(로크웰 오토메이션 온 투어)'를 오는 3월 17일 전주 르윈호텔에서 개최한다고 밝혔다.
최신 IoT 기반의 통합 제어 및 정보 솔루션에 대한 기술 세션 및 데모 시연으로 구성되는 온 투어는 무엇보다도 전북 지역의 고객을 위해 현재 구현 가능한 솔루션과 고성능 자동화 아키텍처, 생산 현장에서의 도입 및 실행 방안과 이를 통해 고객이 누릴 수 있는 현실적인 가치와 경제적인 혜택 등을 소개할 예정이다.
스마트 팩토리를 넘어 스마트 제조 구현을 위한 '커넥티드 엔터프라이즈' 소개로 시작하여, 스마트 제조 구현 시 고려해야 할 산업 보안, 노후화된 제조 자산에 대한 마이그레이션 방안, 정보 솔루션과 스마트 모터 제어 솔루션, 유지 보수 솔루션까지 다양한 세션을 통해 참가자의 니즈를 만족시킬 계획이다.
로크웰 오토메이션 관계자는 "이번 세미나는 제조업의 엔지니어, IT담당자 및 개발자, 플랜트 운영자 및 유지보수 관리자, 기업 경영자 및 중간 관리자, 기업 혁신 및 사업 기획 담당자 등 스마트 제조를 어떻게 계획, 실행하고 유지 발전할 수 있는 것인지를 고민하는 전북지역의 엔드유저 및 장비제조사에게 실현 가능한 솔루션을 제시할 계획이다. 그 외 최신 자동화 및 정보 기술을 활용하여 스마트 팩토리 솔루션을 개발하고 제공하려는, SI, 솔루션 프로바이더에게도 실질적인 도움이 될 것"이라고 말했다.
로크웰 오토메이션 코리아는 이번 전주 로드쇼를 시작으로 국내 제조 고객을 위한 세이프티 심포지엄, 전력 산업 로드쇼, 대산 지역 고객을 위한 석유화학 로드쇼를 개최할 예정이다.

## KR established a leadership position in Iranian maritime market

Korean Register of Shipping (KR) is making swift response as economic sanctions on Iran were lifted in 37 years, infusing new vitality into world economy.

KR announced on February 12 that it was pressing ahead with registration of 27 vessels with approximately 2 million GT from Iran's state-run shipping company IRISL (Islamic Republic of Iran Shipping Lines) and Iran's largest tanker operator NITC (National Iranian Tanker Company).

This is the result of constant support which KR has provided for inspection/screening and Iran's maritime industry development through technical seminar, etc., even in the midst of many difficulties since it made entry into Iran and launched Tehran office in 2010.

An official from KR said, "We have maintained strong cooperative relationship with Iran's maritime industry, and based on that, achieved a leading position in classification market. We will continue to reinforce the bond of friendship with Iran's government, shipping companies, and shipyards, paving the way for Korean maritime industry to make inroads into Iranian market."

KR signed agreements with IRISL shipping company and Iranian Classification Society (ICS) on November 16, 2015 to strengthen cooperation.

### KR, 이란 해사시장을 선점하다

37년만에 이란 경제제재가 해제되며 세계 경제의 신성장동력으로 부상하고 있는 가운데, 한국선급이 발빠른 행보를 보여 주목을 받고 있다.

한국선급(KR)은 이란 국영선사인 IRISL(Islamic Republic of Iran Shipping Lines)과 이란 최대의 탱커 선사인 NITC(National Iranian Tanker Company)로부터 27척의 선박, 약 200만 GT에 대해 등록을 추진 중에 있다고 지난 2월 15일 밝혔다.

이는 한국선급이 지난 2010년부터 이란에 진출하여 테헤란지부를 운영하며, 그동안 수많은 어려움 속에서도 검사와 심사관련 업무 지원은 물론 이란 해사업계의 발전을 위해 기술세미나를 실시하는 등 지속적인 협력 관계를 유지해 왔기 때문으로 평가된다.

한국선급 관계자는 "한국선급은 그 동안 이란 해사업계와 깊은 신뢰관계를 쌓아왔으며, 이를 바탕으로 선급시장에서 선도적인 위치를 확보하는 성과를 거두었다"며 "앞으로도 이란 정부, 선사 및 조선소 등과 우호적인 관계를 지속함으로써, 이를 통해 국내 해사업계의 이란시장 진출에도 기여할 수 있도록 적극 노력하겠다"고 밝혔다.

한편 한국선급은 지난해 11월 16일, IRISL선사 및 이란선급인 ICS(Iranian Classification)와 협력 강화를 도모하기 위한 상호협력 약정서를 체결했다.

## HHI announces 2015 consolidated earnings

Hyundai Heavy Industries (HHI) issued a public disclosure of its 2015 consolidated earnings. According to a regulatory filing, HHI racked up 46.2317 trillion Korean won in sales, 12.1 % decline from the previous year while operating loss and net loss came in at 1.5401 trillion won and 1.3632 trillion won, a 52.6 % and 38.2 % drop, respectively, from a year earlier.

An HHI officer said, "2015 was a tough year for us due to unfavorable market conditions such as prolonged low oil prices and global economic downturn. We suffered losses incurred from the cancellation of semi submersible rigs and increased manhours and delivery delays of offshore projects triggered by design changes."

Consolidated 4Q 2015 Earnings (Unit: Korean won)

| | 4Q 2015 | 3Q 2015 | Changes | 4Q 2014 |
|---|---|---|---|---|
| Sales | 11.1391trillion | 10.9184 trillion | +2.0% | 13.8461 trillion |
| Operating Profit | -279.1 billion | -897.6 billion | - | -22.3 billion |
| Net Profit | -378 billion | -617.6 billion | - | -37.9 billion |

On a quarter-on-quarter basis, HHI posted sales of 11.1391 trillion won during the October-December period while generating an operating loss and net loss of 279.1 billion won and 378 billion won, respectively. On the other hand, compare to the 3Q 2015, sales increased 2% thanks to the completion of, and the change order payment from major offshore projects. Operating loss and net loss narrowed by 618.5 billion won and 239.6 billion won respectively.

HHI remained in deficit due to a one-off maintaining cost for drillships it delivered, loss provision for NASR offshore project, and increased on-site installation costs for Jeddah South and Shuquaiq power plant projects. Construction equipment business also stayed in red due to lackluster sales caused by global economic downturn and restructuring costs for ailing subsidiaries. Meanwhile refinery sector saw profit increases

on the back of the refining margin growth.
Engine & Machinery, Electro Electric System and Green Energy business also reported profits with the help of continuing cost cutting efforts.
"Even though we have failed to turn a profit in 2015, We believe that we laid the groundwork for a turnaround for 2016 with a series of comprehensive restructuring measures ranging from liquidating unprofitable overseas subsidiaries and launching HR efficiency enhancement program to shoring up our finances by selling off stock assets. We are committed to returning to profitability this year with rigorous cost cutting and manufacturing process stabilization," the officer added.

### 현대중공업, 2015년 매출 전년대비 12.1% 감소

현대중공업은 공시를 통해 매출 46조 2,317억원, 영업손실 1조5,401억원, 당기순손실 1조3,632억원으로 2015년 연간 실적을 발표했다. 이는 전년(매출 52조5,824억원, 영업손실 3조2,495억원, 순손실 2조2,061억원)에 비해 매출은 12.1% 줄었고, 영업손실과 순손실은 각각 52.6%, 38.2%가 감소한 수치다.
현대중공업 관계자는 "지속되는 저유가와 글로벌 경기침체로 힘든 한 해였다"며 "조선부문의 반잠수식 시추선 계약 취소, 해양부문에서의 잦은 설계변경에 따른 공수 증가와 공정 지연 등의 영향으로 적자가 지속됐다"고 밝혔다.
현대중공업은 2016년 흑자달성에 대한 강한 의지를 보였다. 현대중공업은 계열사 사장단의 급여 전액 반납과 임원 및 부서장 급여 일부 반납, 시설투자 축소 또는 보류 등 긴축경영에 돌입한 바 있으며, 각 사업본부마다 독자적인 경쟁력을 갖추기 위해 사업본부 책임경영체제를 확고히 하고 있다.

2015년 4분기 실적

| 구분 | 2015년 4분기 | 2015년 3분기 | 증감률 | 2014년 4분기 |
|---|---|---|---|---|
| 매출액 | 11조1,391억원 | 10조9,184억원 | +2.0% | 13조8,461억원 |
| 영업이익 | -2,791억원 | -8,976억원 | - | -223억원 |
| 순이익 | -3,780억원 | -6,176억원 | - | -379억원 |

현대중공업 관계자는 "지난해에는 부실법인 청산, 인력 효율화, 주식 매각을 통한 재무건전성 확보 등 다양한 구조개혁 노력으로 실적 개선을 위한 발판을 마련했다"며 "올해는 전 사업부문의 지속적인 원가절감과 공정 안정화 등을 통해 반드시 흑자 달성을 이뤄낼 것"이라고 밝혔다.
현대중공업은 매출 11조 1,391억원, 영업손실 2,791억원, 당기순손실 3,780억원으로 2015년 4분기 실적도 발표했다. 매출은 해양부문의 주요 프로젝트 인도 완료와 체인지 오더 환입으로 전 분기 대비 2.0% 늘었으며, 영업손실과 당기순손실은 각각 6,185억원, 2,396억원 줄었다.
현대중공업은 조선부문의 드릴십 하자보수비용 발생으로 인한 일회성 비용 증가와 해양부문에서 나스르(NASR) 프로젝트의 공사손실충당금 반영, 플랜트부문의 제다사우스(Jeddah South), 슈퀘이크(Shuqaiq) 등 프로젝트 현장 설치비 증가 등으로 적자를 기록했다고 밝혔다.
또한 건설장비부문은 세계 경기침체에 따른 판매 부진과 일부 법인의 구조조정 진행에 따른 비용 발생 등으로 적자를 기록했다. 이외에 정유부문은 정제마진 상승으로 흑자 규모가 확대됐으며 엔진기계, 전기전자, 그린에너지 사업부문도 지속적인 원가절감 노력으로 흑자를 이어갔다.

## LR and ABS join forces to deliver new industry standard software

Common Structural Rules Software LLC, a joint venture company formed by Lloyd's Register (LR) and ABS, has released new software tools for meeting the requirements of the IACS Common Structural Rules (CSR), which entered into force on 1 July 2015.
Developed from the technical strengths of LR and ABS, version 2.5 of the CSR Prescriptive Analysis and the new CSR Finite Element (FE) Analysis software, allow assessment of whole vessel structures, including new bulk carrier and oil tanker designs. Both class societies will use these new tools to evaluate new designs to the CSR.
"I am pleased that the strategy laid out more than a decade ago is achieving our objectives," said LR's Marine Director Tom Boardley. "Following the development of the CSR in 2005, LR and ABS quickly realized that only common software would support the industry desire for common scantlings, and our CSR Software tools had become widely used. With the introduction of the new Common Structural Rules, we have developed a completely new generation of CSR software that will enable shipbuilders and shipowners to easily and consistently address the requirements of the new IACS Rules."
"This software constitutes a new industry standard," said ABS Chairman, President and CEO Christopher J. Wiernicki. "In our collaboration as two of the world's leading class societies, we continue to achieve our primary objective to enable the advancement of the maritime industry through reliable and dependable software applications."
The CSR Prescriptive Analysis software requires only that the user input the appropriate data. All of the outputs are clear, straightforward and easy to read. A summary report provides required and offered scantlings with graphic representation of any deficiencies. An intermediate report summarises dominate criteria for each structure and a detailed report provides data for every parameter value. In conjunction with CSR FE Analysis, this complete tool makes verifying compliance with CSR possible with minimal effort.
The software has quickly become popular with users. Nearly 500 licenses were issued prior to the production release. This release will be followed with regular updates for additional structural coverage and functionality and to address ongoing CSR changes.

## MOF embarked upon development of manned submersible operating in water depths of up to 6,500 m

The Ministry of Oceans and Fisheries (MOF) will develop deepwater manned submersible operating in water depths of up to 6,500 m. MOF will begin evaluation of feasibility in the second half of this year to develop 20-ton deepwater manned submersible for the next 6 years from 2017 to 2022.

At present, only 5 countries, such as the United States, France, Russia, Japan, and China, have manned submersibles operating in water depths greater than 6,000 m. If this submersible is developed successfully, Korea will be the sixth country in the world to have deepwater manned submersible.

Deepwater manned submersible represents culmination of cutting-edge science technology and is the symbol and yardstick of national marine science technological prowess. The manned submersible capable of operating in water depths of up to 6,500m will enable exploration of 99% of deepwater areas around the globe, except for extremely few deepwater areas such as Mariana Trench.

Deepwater manned submersible will also enable precise marine scientific exploration of deepwater area, facilitating acquisition of data necessary for deepwater resource exploitation and providing support for operations. Additionally, deepwater manned submersible can find wide-ranging applications, such as marine scientific exploration, installation/maintenance of offshore structures, rescue and salvage in marine accidents, marine territory and offshore environment management, subsea relic discovery, etc.

An official from MOF said, "The deepwater manned submersible will not only help expand marine economic territory but also mark a milestone in elevating the nation's status as international maritime powerhouse. We will work closely and consult extensively with related ministries for early construction of deepwater manned submersible."

### 해수부, 심해 6500m 탐사 유인잠수정 개발 추진

해양수산부는 수심 6,500m까지 내려가 심해를 직접 탐사할 수 있는 심해유인잠수정의 개발을 추진한다. 올해 하반기 중 사업 타당성 조사를 거쳐 2017년부터 2022년까지 6년간 20톤 규모의 심해유인잠수정을 개발한다는 계획이다.

현재 6,000m이상 심해를 탐사할 수 있는 유인잠수정은 미국, 프랑스, 러시아, 일본, 중국 등 5개국가만이 보유하고 있다. 우리나라가 개발에 성공할 경우 세계에서 6번째 보유 국가가 되는 셈이다.

심해유인잠수정은 최첨단 과학기술의 결정체로 국가 해양과학기술력의 상징이자 척도가 되고 있다. 6,500m급 유인잠수정을 보유하게 될 경우 마리아나 해구 등과 같은 극히 일부 심해를 제외하고 전세계 심해의 99%를 탐사 가능하게 된다.

심해유인잠수정은 심해의 정밀 해양과학 탐사를 통하여 심해저 자원개발에 필요한 정보취득과 작업을 지원하는 역할을 수행하게 된다. 아울러, 심해유인잠수정은 해양과학 탐사는 물론 해양구조물의 설치 및 유지보수, 해양 사고시 구조 및 구난, 해양영토 및 해양환경 관리, 해저유물 발굴 등의 다양한 분야에 활용 가능하다.

해양수산부 관계자는 "심해유인잠수정의 개발은 해양 경제영토 확보는 물론 해양강국으로서의 위상제고에 획기적 전기를 마련하게 될 것"이라며, "심해유인잠수정의 조기 건조를 위해 관계부처와 적극 협의해나갈 예정"이라고 말했다.

## MFC launches an in-house organization evaluating shipbuilding project feasibility

Marine Finance Center (MFC) is adding fresh fuel to its effort to establish Shipbuilding & Offshore Business Information Center, its in-house organization evaluating the feasibility of projects in shipbuilding and offshore industries. The Shipbuilding & Offshore Business Information Center will be organized in MFC. Evaluation of project feasibility will become mandatory for shipyards seeking financial support from policy-based financial institutions for any order worth over USD 500 million. Currently, MFC is forming independent evaluation board to set up the Shipbuilding & Offshore Business Information Center and moving ahead with working-level consultation to draw up guidelines on evaluation process.

An official from Korea Eximbank said, "We are currently focusing on working-level matters for the Shipbuilding & Offshore Business Information Center slated for launch in February. This Center will serve as a starting point for preventing below-cost orders at shipyards and promoting loan/credit health of policy-based financial institutions."

### 해양금융종합센터, 조선업 사업성 평가 전담기구 설립 추진

해양금융종합센터는 조선산업 사업성 평가 전담기구인 조선해양사업 정보센터 설립에 박차를 가하고 있다. 이 정보센터는 해양금융종합센터 내에 설립될 예정으로 조선사가 5억 달러 이상의 수주사업에 대해 정책금융기관의 금융지원을 받고자 하는 경우, 사업성 평가가 의무화된다. 현재 정보센터의 설립을 위해 외부인력 평가위원 Pool 구성 작업이 진행 중이며, 평가 가이드라인 마련을 위한 실무협의를 하고 있다.

한국수출입은행 관계자는 "오는 2월 중 정보센터의 출범을 목표로 실무작업을 진행 중이며, 센터의 설립은 조선사의 부실 수주 방지 및 정책금융기관의 여신건전성을 동시에 확보하는 출발점이 될 것으로 기대된다"고 말했다.

## Inmarsat, Global Marine Networks and Network Innovations successfully trial of Fleet Xpress

Inmarsat, the leading provider of global mobile satellite communications services, together with Global Marine Networks and Network Innovations, announced the successful trial and subsequent commercial order for Fleet Xpress in Antarctic waters on 22 Feb. Fleet Xpress, installed on board the adventure cruise ship Ocean Nova, delivered robust communications in one of the most hostile environments on the planet.

Fleet Xpress, the hybrid Ka and L-band service using Inmarsat's Global Xpress network, delivers the world's first globally available high-speed broadband service from a single network operator. The trial was successfully conducted on board the 1992 built ice class Ocean Nova, owned by Nova Cruising Ltd and operated by Nova Logistics, a polar expedition specialist.

"Our customers rely on us to provide cutting-edge satellite services," said Dr Luis Soltero, CTO of Global Marine Networks which offers a range of internet based services, hardware and software to commercial clients. "Fleet Xpress delivered on its promise of high-speed seamless mobile broadband service in one of the world's most difficult areas for most satellite systems. Antarctica requires low-horizon satellite views thr-ough heavy cloud cover and precipitation. Fleet Xpress successfully overcame these conditions," he added.

In this trial, Network Innovations, one of Inmarsat's first value-added resellers of Fleet Xpress, was able to provide its expertise and support to Global Marine Networks and the crew of the Ocean Nova which used a Cobham SAILOR 100GX antenna.

Noting the first-rate performance of the Fleet Xpress service throughout the trial, Eric Verheylewegen, Vice President and General Manager of Network Innovations commented on the successful outcome of tests aboard the Ocean Nova. "Throughout this test, the Fleet Xpress service allowed passengers and crew to conduct daily communication activities beyond our expectations in this extreme location. Now they have decided to install Fleet Xpress, we could not be more satisfied with the results."

"This trial marks another important milestone for the launch of Fleet Xpress. By testing Fleet Xpress in such harsh conditions we are pushing the boundaries of what we can offer," said Ronald Spithout, President of Inmarsat Maritime. "Fleet Xpress is set to redefine maritime communications and will transform the way vessels are managed and optimised throughout the globe. We are thrilled that Nova Cruising Ltd have chosen to rely on and invest in Fleet Xpress with a commercial order for the rest of their fleet."

## 아즈빌, 안전계장시스템용 긴급차단밸브 스마트 ESD 디바이스 공급

석유정제나 석유화학 등의 플랜트에서의 안전성 유지, 사고를 방지하기 위한 프로세스의 상태 감시, 위험한 상태가 되었을 경우에 적절한 동작으로 플랜트의 운전을 정지시키는 안전계장시스템에 대한 관심이 높아지고 있다.

아즈빌은 스마트 ESD(Emergency Shut Down) 디바이스 700 시리즈의 판매를 지난 1월13일부터 본격적으로 시작했다. 스마트 ESD 디바이스 700 시리즈는 플랜트의 안전계장시스템으로 사용되는 긴급차단밸브의 인터페이스 기기로써, 기능안전에 관한 국제규격인 IEC61508에 규정된 SIL 2 또는 3 인증을 이미 취득했다.

스마트 ESD 디바이스 700 시리즈는 긴급차단밸브의 부속되어 긴급시 정확하게 동작하는지를 진단하기 위해서 플랜트 운전 중에 긴급차단밸브를 부분적으로 움직이는 PST(Partial Stroke Test)기능을 탑재되어 있다.

안전계장시스템 규격에서는 안전수준을 유지하기 위해서, 안전계장시스템을 구성하는 기기의 고장률과 SIL의 Level에 의해 결정되는 주기로 구성 기기의 작동 검사가 요구된다. 이 제품으로 긴급차단밸브의 PST를 작동 검사 주기보다 짧은 간격으로 실시하면, 동작하지 않는 확률을 낮출 수 있어 안전성을 확인하기 위해서 작동 검사의 주기를 연장할 수 있다. 이로써 안전성을 유지하면서 작동 검사에 드는 보전 비용을 절감할 수 있다.

또한 오랜 시간 운전을 정지할 수 없는 플랜트에서는 안전계장시스템의 작동 검사를 운전 중에 하기

위해서 긴급차단밸브의 바이패스(by-pass) 라인의 설치가 필수적이었다. 그로 인해 설치 비용이 들고, 작동 검사 시 바이패스라인의 변경 등에 공수도 들었다. PST로 작동 검사 주기를 연장하면 바이패스라인을 설치하지 않고 플랜트 운전 정지시 작동 검사를 실시할 수 있으며, 비용도 절감할 수 있다.

## DNV GL and Russian Maritime Register of Shipping sign cooperation agreement

DNV GL's Maritime CEO Knut Ørbeck-Nilssen recently met with Konstantin Palnikov, Director General of the Russian Maritime Register of Shipping (RS), at the RS head office in St. Petersburg to sign a bilateral framework agreement for cooperation between both class societies

During the talks, DNV GL and RS expressed satisfaction at the positive experience of cooperation in dual classification of ships. As of today, about 20 ships are in dual RS–DNV GL class. The two companies discussed prospective areas of further cooperation that would enable them to effectively complement each other's unique competencies. Priority cooperation areas include ensuring compliance of ships with the requirements of the Polar Code, rendering of relevant expert assistance to stakeholders, and developing interpretations of the Code's provisions building on RS and DNV GL's experience. The talks also touched upon cooperation aimed at improving technical standards for the safety of gas-fuelled ships.

The new framework document sets out the general procedure for delegating authority in cases where one society performs surveys of ships classed by the other, and lays down general terms and conditions for cooperation in the area of dual classification of newbuildings and ships in service, surveys of materials and equipment for ships.

Konstantin Palnikov, Director General of the Russian Maritime Register of Shipping (right), signed the framework agreement with Knut Ørbeck-Nilssen, CEO DNV GL – Maritime

"We look forward to strengthening our cooperation with RS, which will benefit the Russian maritime industry and our long-term partnerships with Russian clients," said Knut Ørbeck-Nilssen.

## Alfa Laval training for engineering partners is securing skills and capacity for ballast water treatment retrofits

The retrofit market for ballast water treatment systems is poised to boom in the coming years. To ensure that requisite design and installation skills are in place to meet the demand, Alfa Laval is actively training its network of engineering partners for Alfa Laval PureBallast.

PureBallast is a ballast water treatment system sold and serviced by Alfa Laval. A vital component of the system is the Enhanced UV Reactor, which was developed jointly by Alfa Laval and Wallenius Water based on Wallenius Water Technology.

When the retrofit market for ballast water treatment systems gains speed, the ability of suppliers to deliver treatment systems will only be one part of satisfying it. Specific knowledge and skills will also have to be in place among design and installation partners. For this reason, Alfa Laval has developed a comprehensive training programme for engineering companies preparing to work with PureBallast.

PureBallast Test and Training centre in Tumba, Sweden.

"Alfa Laval is bolstering resources to meet the retrofit boom," said Stephen Westerling Greer, Global Business Manager for PureBallast. "Alfa Laval will be ready, not only with the technical solutions, but also with an internal network of well-trained engineers and a strong external network of engineering partners."

Alfa Laval's multi-day training courses cover

all technical aspects affecting PureBallast design and installation. But they also deal with cooperation, workflow and documentation handling, so as to ensure a smooth process along with a technically correct result.
"Engineering companies are keen to prepare for what's coming, and they want access to the deep insights Alfa Laval has gained in many years of working with retrofit solutions in ballast water treatment," said Westerling Greer, who notes that the courses in February and March alone involve 40 participants from 14 companies, representing 11 countries worldwide. He added, "The participants are as focused on building a strong working relationship with Alfa Laval as we are on securing our global retrofit capacity. For all of us, this is a key investment in the future and in the peace of mind of our customers in ballast water treatment."

## Busan Metropolitan Government spearheads shift to clean marine fuel for the first time nationwide

Busan Metropolitan Government signed an agreement with Korea Gas Corporation (KOGAS) on February 23 for promotion of shift to clean marine fuel bringing environmental and economic benefits, driven by the need for clean fuel to mitigate fine particle emissions from ships generating 24% of fine particles in Busan, a port city with heavy maritime traffic. The signing ceremony was attended by officials from KOGAS and related officials.
To spur the shift to clean fuel, 2 ships owned by local governments (environment cleaning vessel with a weight of 118 tons, fishing guard ship with a weight of 9.77 tons) will be retrofitted with natural gas-fuelled engines, removing current diesel engines, as private sector is difficult to participate in clean fuel projects. After evaluating of environmental impact, safety, and economic feasibility, the project will be expanded to cover private sector.
The clean marine fuel project will be participated jointly by KOGAS, Samjin Yard, etc. KOGAS will carry out empirical study on development of LNG (Liquefied Natural Gas) engines applicable to existing vessels, along with installation of LNG supply system (bunkering) in Busan North Port, through consultation with related organizations.
Clean marine fuel project is expected to reduce dusts by 99%, sulfur oxides (SOx) by 100%, nitrogen oxides (NOx) by 92%, and carbon dioxide ($CO_2$) by 23%. Vessels outfitted with LNG-fuelled engines reduce fuel costs by 30% and requires less maintenance compared to existing vessels using foreign-made engines, thereby bringing significant environmental and economic benefits. In Western Europe and other countries, vessels powered by clean fuel have already been operating.

An official from Busan Metropolitan Government said, "Converting vessels owned by local governments into LNG-fuelled vessels is a small step towards full-fledged shift to clean fuel, but it represents the nation's first endeavor of its kind at policy level. This project is significant for spurring a shift to clean fuel in privately owned vessels. We also anticipate development of related industries, including acquisition of technology for conversion to LNG as clean fuel, advancement of port, as well as environmental and economic benefits."

### 부산시, 국내 최초 선박 연료 청정화에 나선다

부산시는 해양 항만도시 특성상 선박의 미세먼지 발생량이 24% 차지하고 있어 기존선박 등의 청정연료 전환을 통해 환경 · 경제적 실익 창출과 관련 사업 발전을 도모하기 위해 지난 23일 한국가스공사와 관계자 등이 참석한 가운데 '선박연료 청정화 추진을 위한 업무협약을 체결했다.
기존 선박의 연료전환 사업은 민간참여가 어려운 점을 감안, 관용선박 2척(환경정화선 118톤, 어업지도선 9.77톤)을 활용하여 디젤 엔진을 천연가스(LNG) 엔진으로 개조해 환경성, 안전성, 경제성을 평가 후 민간으로 점차 확대하기로 했다.
선박연료 청정화 전환사업은 한국가스공사, 삼진야드 등에서 공동으로 참여하게 되며, 한국가스공사는 관계기관과 협의해 북항에 LNG공급시스템(벙커링) 설치와 기존 선박의 천연가스(LNG) 엔진개발 실증연구를 추진한다.
선박연료 청정화 전환사업은 대기오염물질인 분진 99%, 황산화물 100%, 질소산화물 92%, 이산화탄소 23% 저감되고, LNG 사용으로 연료비의 30% 절감과 기존외산 엔진사용에 따른 유지관리비가 적어 환경 · 경제적으로 상당한 효과가 있는 것으로 이미 선진 유럽 등에서는 청정연료 사용선박이 운영되고 있다.
부산시 관계자는 "관용선박연료 전환 시범사업은 작은 출발이지만 국내 최초 선도적인 시책으로 이는 민간선박의 청정연료 전환의 마중물 역할로 시사하는 바가 크고 환경적, 경제적 실익창출과 LNG 전환 기술확보와 항만선진화 등 관련사업의 발전도 기대된다"고 밝혔다.

## Gibdock mobilises world's largest windfarm jack-up

Gibdock has confirmed its role as one of the offshore industry's pre-eminent shiprepair and conversion yards through its selection for the afloat mobilisation of Seajacks Scylla, the largest and most advanced windfarm installation jack-up ever built.

Following delivery to Seajacks by Samsung Heavy Industries at the end of 2015, Scylla was discharged to Gibraltar waters from the heavy-lift transporter Osprey before being towed into Gibdock for reactivation works at the yard's South Mole.

"This is a remarkable acknowledgement of Gibdock's emergence as a yard of choice for owners wishing to mobilise offshore assets," said Richard Beards, Managing Director, Gibdock. "Our location at the gateway to the Mediterranean and our accreditation for offshore work are proving pivotal for owners in the high specification offshore industry. The arrival of this state-of-the-art jack-up also demonstrates that the sector's true innovators recognise Gibdock as their first option for quality workmanship and on time completion."

Kevin Alcock, Seajacks Vice President New Build Projects, said "We are very pleased with the assistance given by Gibdock in the successful reactivation of Seajacks Scylla following delivery to Europe. Gibdock has proved to be a very competent and flexible shipyard. We look forward to working with them again in the future."

Seajacks Scylla completed reactivation in record time (five days) and departed for Great Yarmouth (UK) in preparation for starting her first contract with on the Veja Mate offshore windfarm in March, off the coast of Germany.

Scylla has been designed to meet demands set by North West European markets, including those associated with working UK Round 3, Scottish territorial waters. The self-propelled jack-up is equipped with a 1,540 T leg-encircling crane, can install components in water depths of up to 65 m, and can transport monopoles and turbines of up 7-8 MW capacity. She is the fifth modern, specialised offshore vessel to join the fleet of UK-based Seajacks.

Gibdock was chosen for the mobilization of Seajacks Scylla, the largest windfarm jack-up ever built

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# ULCS - THE NEXT GENERATION WILL BE SUEZMAX!

The increase in the maximum length and beam of ULCS (Ultra Large Container Ships) has stalled for the last five years. However, it has been considered what the next generation of ULCS will look like. DNV GL has carried out a study to investigate which dimension it would be most efficient to increase. It turns out that the main particulars of the next-generation ULCS will be seriously affected by size limits imposed by the Suez Canal.

DNV GL
by Uwe.Hollenbach@dnvgl.com, Joerg.Roerup@dnvgl.com and Jost.Bergmann@dnvgl.com

The maximum capacity of container ships has grown quite substantially during the last couple of years. After an initial order for twenty 18,200 TEU ULCS in 2011, today more than 100 vessels of this size or with even higher capacity are on order or in operation.

ULCS promise to reduce slot costs due to the “economy of scale” factor and most liner companies engaged on the Far East – North Europe trade are keen to operate this size of vessel in order to catch up with the prime movers, which have enjoyed the expected slot-cost advantages for some

time now. However, recently some concerns were raised in the industry about whether the trend for ever-larger vessels will continue or whether we have already seen the maximum size of ULCS.
These concerns were apparently fuelled by concerns about the stability of freight volume growth, the need to utilize the increasing numbers of ULCS as well as the increasing infrastructure investment costs to allow ports and terminals to handle ULCS.
Nevertheless, the ULCS size is expected to grow further, but maybe at a more moderate rate than in the last decade.
DNV GL has studied possible options for further increasing ULCS capacity with a focus on two areas:

- *A possible increase in the transport efficiency (needed propulsion power per TEU) of larger ULCS, with increased length, beam and draft for an assumed operating profile and for a range of homogeneous container weights, also considering typical infrastructural limitations imposed by seaways and ports*
- *The structural feasibility of possible future designs*

## Transport efficiency of next-generation ULCS

Using a DNV GL in-house methodology called "Concept Design Assessment" (please refer to the separate article on this subject), 21 variants of possible future ULCS designs with different lengths, beams and drafts have been analysed:

- *Three different lengths - the present 24 bays, 26 bays and 28 bays*
- *Three different beams the present 23 rows, 24 rows and 25 rows*
- *Three different draught conditions - 15 m, 16 m and 17 m*

For all variants, 12 tiers of containers in the hold and 11 tiers on deck were considered, corresponding to a ship depth of about 33 m.
The following parameters were then analysed for all variants:

- *Nominal container intake*
- *Deadweight at draft conditions 15 m, 16 m and 17 m*
- *Lightship weight, corrected to take account of the results*

| Bays | Rows | Tiers | TEU Nominal | Loa m | Lpp m | B m | T m | DWT |
|---|---|---|---|---|---|---|---|---|
| 24 | 23 | 12 | 20,332 | 400.00 | 383.00 | 58.60 | 15.00 | 178,895 |
| 24 | 23 | 12 | 20,332 | 400.00 | 383.00 | 58.60 | 16.00 | 198,592 |
| 24 | 23 | 12 | 20,332 | 400.00 | 383.00 | 58.60 | 17.00 | 218,756 |
| 24 | 24 | 12 | 21,325 | 400.00 | 383.00 | 61.10 | 15.00 | 186,599 |
| 24 | 24 | 12 | 21,325 | 400.00 | 383.00 | 61.10 | 16.00 | 207,131 |
| 24 | 24 | 12 | 21,325 | 400.00 | 383.00 | 61.10 | 17.00 | 228,149 |
| 24 | 25 | 12 | 22,228 | 400.00 | 383.00 | 63.60 | 15.00 | 194,581 |
| 24 | 25 | 12 | 22,228 | 400.00 | 383.00 | 63.60 | 16.00 | 215,947 |
| 24 | 25 | 12 | 22,228 | 400.00 | 383.00 | 63.60 | 17.00 | 237,819 |
| 26 | 23 | 12 | 22,212 | 430.00 | 413.00 | 58.60 | 15.00 | 192,420 |
| 26 | 23 | 12 | 22,212 | 430.00 | 413.00 | 58.60 | 16.00 | 213,669 |
| 26 | 23 | 12 | 22,212 | 430.00 | 413.00 | 58.60 | 17.00 | 235,468 |
| 26 | 24 | 12 | 23,301 | 430.00 | 413.00 | 61.10 | 15.00 | 200,719 |
| 26 | 24 | 12 | 23,301 | 430.00 | 413.00 | 61.10 | 16.00 | 222,900 |
| 26 | 24 | 12 | 23,301 | 430.00 | 413.00 | 61.10 | 17.00 | 245,592 |
| 26 | 25 | 12 | 24,264 | 430.00 | 413.00 | 63.60 | 15.00 | 208,940 |
| 26 | 25 | 12 | 24,264 | 430.00 | 413.00 | 63.60 | 16.00 | 232,022 |
| 26 | 25 | 12 | 24,264 | 430.00 | 413.00 | 63.60 | 17.00 | 255,636 |
| 26 | 25 | 12 | 26,316 | 460.00 | 443.00 | 63.60 | 15.00 | 222,849 |
| 26 | 25 | 12 | 26,316 | 460.00 | 443.00 | 63.60 | 16.00 | 247,652 |
| 26 | 25 | 12 | 26,316 | 460.00 | 443.00 | 63.60 | 17.00 | 273,014 |

Table 1. ULCS design options

*of the structural feasibility study*

- *Main engine power demand for a speed range from 12kn to 21kn*

The selected key characteristics of the chosen designs are shown in table 1.

Further, for each of the designs, the possible loading capacity with a homogeneous intake of 8t, 10t, 12t, 14t and 16t per TEU has been calculated, initially based on the available slots and DWT. It was then checked whether the resulting loading condition would provide sufficient minimum stability. In cases where this was not achieved, the amount of ballast water needed to achieve a minimum GM of 0.6 m was calculated. If the remaining available deadweight was not sufficient to load the required amount of ballast water, the corresponding number of containers was virtually replaced with ballast water.

An "Average required ME power demand" for each of the variants was then calculated based on an operating profile with an assumed speed distribution as shown in table 2.

In the next step, the "Average required ME power demand" per TEU for each of the considered homogeneous loading conditions was derived.

Finally, the results were normalized and the difference in percentage was calculated for all variants in relation to the selected "base case" - the design with 24 bays and 23 rows at 16 m draft.

The results are shown in table 3.

What can be concluded from this analysis?

- *Increasing the draft improves the transport efficiency of all variants for most homogeneous loading conditions*
- *Increasing the beam by one or two rows but maintaining the length only improves the transport efficiency for the condition with low homogeneous container weight*

| Speed | kn | 12 | 14 | 16 | 18 | 20 | 21 |
|---|---|---|---|---|---|---|---|
| Time Share | % | 5 | 10 | 35 | 38 | 10 | 5 |

Table 2. Assumed Operating Profile

| Bays | Rows | Tiers | TEU Nominal | T m | kW % | kW/ DWT % | kW/ 8t % | kW/ 10t % | kW/ 12t % | kW/ 14t % | kW/ 16t % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 23 | 12 | 20,332 | 15.00 | 96.4 | 107.1 | 100.7 | 105.2 | 108.1 | 108.1 | 108.1 |
| 24 | 23 | 12 | 20,332 | 16.00 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 24 | 23 | 12 | 20,332 | 17.00 | 104.1 | 94.5 | 102.6 | 99.7 | 94.3 | 93.8 | 93.8 |
| 24 | 24 | 12 | 21,325 | 15.00 | 100.9 | 107.4 | 95.8 | 105.1 | 108.0 | 108.0 | 108.0 |
| 24 | 24 | 12 | 21,325 | 16.00 | 104.5 | 100.2 | 98.2 | 97.2 | 99.8 | 99.8 | 99.8 |
| 24 | 24 | 12 | 21,325 | 17.00 | 108.8 | 94.7 | - | 95.1 | 93.6 | 93.6 | 93.6 |
| 24 | 25 | 12 | 22,228 | 15.00 | 105.4 | 107.6 | 95.0 | 104.9 | 107.8 | 107.8 | 107.8 |
| 24 | 25 | 12 | 22,228 | 16.00 | 109.1 | 100.4 | - | 97.0 | 99.7 | 99.7 | 99.7 |
| 24 | 25 | 12 | 22,228 | 17.00 | 113.5 | 94.8 | - | 91.4 | 93.5 | 93.5 | 93.5 |
| 26 | 23 | 12 | 22,212 | 15.00 | 99.5 | 102.7 | 95.4 | 100.3 | 103.0 | 103.0 | 103.0 |
| 26 | 23 | 12 | 22,212 | 16.00 | 103.3 | 96.0 | 95.0 | 95.0 | 95.4 | 95.4 | 95.4 |
| 26 | 23 | 12 | 22,212 | 17.00 | 107.5 | 90.7 | 97.0 | 94.7 | 89.5 | 89.5 | 89.5 |
| 26 | 24 | 12 | 23,301 | 15.00 | 104.0 | 102.9 | 90.8 | 100.1 | 102.8 | 102.8 | 102.8 |
| 26 | 24 | 12 | 23,301 | 16.00 | 107.9 | 96.1 | 92.8 | 92.7 | 95.2 | 95.2 | 95.2 |
| 26 | 24 | 12 | 23,301 | 17.00 | 112.2 | 90.8 | - | 90.2 | 89.3 | 89.3 | 89.3 |
| 26 | 25 | 12 | 24,264 | 15.00 | 108.7 | 103.3 | 90.3 | 100.2 | 102.9 | 102.9 | 102.9 |
| 26 | 25 | 12 | 24,264 | 16.00 | 112.6 | 96.4 | 93.0 | 92.7 | 95.2 | 95.2 | 95.2 |
| 26 | 25 | 12 | 24,264 | 17.00 | 117.1 | 91.0 | - | 86.9 | 89.2 | 89.2 | 89.2 |
| 28 | 25 | 12 | 26,316 | 15.00 | 112.1 | 99.9 | 86.9 | 96.3 | 99.0 | 99.0 | 99.0 |
| 28 | 25 | 12 | 26,316 | 16.00 | 116.3 | 93.3 | 88.6 | 89.3 | 91.7 | 91.7 | 91.7 |
| 28 | 25 | 12 | 26,316 | 17.00 | 121.0 | 88.0 | - | 83.7 | 85.9 | 85.9 | 85.9 |

Table 3. Benchmarking of design options against the base case

- *Increasing the length by one hold (two bays) but maintaining a beam of 23 rows improves transport efficiency by about 5% for all loading conditions. Increasing the beam in addition increases the capacity but has no positive impact on transport efficiency*
- *Increasing the length by two holds (28 bays in total) in connection with increasing the beam to 25 rows would increase transport efficiency by about 8% - 11% depending on the average weight of the containers*

## Infrastructural limitations on the Far East – North Europe trade

Most container ports in Asia do not impose any restrictions on ULCS dimensions. It is mainly ports in Europe that have limitations, mainly due to the fact that some of them are located in tidal waters at the mouth of, or even many miles up, a river.

Major ports with limitations are given in table 4.

As can be seen from table 4, a maximum length restriction of 400 m is nowadays imposed in several ports in Northern Europe.

The port of Hamburg seems to be in a particularly challenging position here. However, plans to enlarge the available turning basin are expected to be implemented by 2017.

Furthermore, it is believed that ULCS with a length of up to 430 m which are specifically prepared for efficient manoeuvring (e.g. with sufficient bow/stern thruster power or twin propeller propulsion, strong and sufficient tug pushing areas and bollards/checks for towing lines, etc.) could be handled in areas where the ship length is currently limited to 400 m.

| Port | Location | Restrictions |
|---|---|---|
| Antwerp | Located at the mouth/delta of the River Schelde, about 35 nm away from the open sea | Draft limitations<br>• 16.0 m with tide, incoming<br>• 15.2 m with tide, outgoing<br>Length and beam limitations not found |
| Bremerhaven | Located at the mouth of the River Weser in an area of the Wadden Sea, about 20 nm away from the open sea | Draft limitations<br>• 12.8 m if independent of tide<br>• 14.5 m with tide, incoming<br>Length and beam limitations not found |
| Hamburg | Located on the River Elbe, about 60 nm away from the open sea | Draft limitations for 57.5 m < B < 60 m, L < 400 m<br>• 11.6 m if independent of tide<br>• 13.9 m with tide, incoming<br>• 12.4 m with tide, outgoing<br>Length limitation<br>• Turning basin diameter = 450 m, vessels longer than 335 m can enter the port only with special permission<br>Additional limitations, also related to the air draft, apply for vessels bound for the ACT terminal |
| Le Havre | Located at the mouth of the River Seine | Draft limitations<br>• 14.5 m<br>Length and beam limitations not found |
| Valencia | | Draft limited to 16 m but expansion planned<br>Length and beam limitations not found |
| Zebrugge | | Max length = 400 m<br>Max draft (container terminal) = 16 m |
| Remark: data based on own Internet research/not verified by the ports in question | | |

Table 4. Infrastructure limitations of selected ports

Several North European ports also have a beam and/or draft restriction. The number of ports which can serve as the final loading or first discharge port is assumed to decrease if ULCS dimensions increase in the future. This will impose limitations on the set-up of networks/possible sequence of port calls for ULCS, but will probably not stop the growth in ship size.
The Suez Canal also imposes restrictions on the maximum main dimensions of ULCS, as has already been reported in "Container Ship Update 2014".
The present common maximum draft for ULCS designed for the Far East – North Europe trade is around 16 m, which could be utilized at least for the final loading and first discharge port. For the considered main dimensions, the limitations of the Suez Canal are as per table 5.

| Row | Beam | T max |
|---|---|---|
| | [m] | [m] |
| 23 | 58.6 | 17.16 |
| 24 | 61.1 | 16.46 |
| 25 | 63.6 | 15.42 |

Table 5. Present maximum Suez Canal dimensions

It is understood that the Suez Canal Authority plans to increase the water depth in the Canal from 66 feet to 72 feet: however no detailed information can be retrieved with regard to the schedule and how this will impact the allowable beam/draft matrix.
Current Suez Canal limits allow passage for ships with a beam of up to 59 m beam and a draft of up to 17 m. Increasing the draft by about 1 m results in an increase of roughly 20,000 DWT with the same length and beam. This reduces the required average propulsion power per TEU by roughly 6% for heavier containers but is slightly disadvantageous for lighter boxes.
Wider vessels could face limitations on their maximum draft. However, whether or not this leads to a real limitation for the owners depends very much on the current loading condition. When passing through the Suez Canal, vessels might have a somewhat lower draft, as they had in the final loading port, due to the fuel oil consumed during the voyage.
Another limitation on the infrastructure side is the available shore crane technology in the ports along the trade route, with regard to both the outreach of the cranes and the height of the boom, which may limit the number of tiers that can be carried on the deck of a ULCS.
Unfortunately, it is not easy to obtain a detailed overview from public sources. However, it is understood that most ports on the Far East – North Europe trade have upgraded their gantry cranes in the meantime, so that vessels with up to 25 rows across can be served. Nevertheless, in some ports crane height may still be a factor limiting the number of tiers that can be stowed on deck, in particular when considering a design with a depth of around 33 m.

## Structural feasibility study

For all the design variants given in table 1, a structural analysis of the mid-ship section was carried out in order to check the section modulus and whether the vessels could be designed and built in line with the current design principles/structural arrangements, materials and technologies.
The maximum plate thickness considered was 90mm of steel with a yield strength of 460 N/mm$^2$ (YP460) in the deck area. In the bottom area the aim was not to use steel with a higher strength than 355 N/mm$^2$ (YP355).
The still-water and wave-bending moments which need to be considered for the strength analysis always have a linear relationship with the ship's breadth and a quadratic relationship with the ship's length. Obviously, due to this physical relationship with the vertical bending moment, increasing the container capacity by an additional bay affects the steel weight much more than by introducing an additional row.
Consequently, for the longer variants with 26 bays, considerably more steel had to be placed in the upper deck area to fulfil the necessary section modulus requirement and this increased the steel weight and building costs.
However, this was not sufficient for the ultra-long variants with 28 bays and their structural arrangement had to be modified in the deck area. A second "strength coaming" on top of the sheer strake had to be introduced to fulfil the necessary section modulus requirement, see Figure 1.
Consequently, particularly for the variant with strength coaming, the neutral axis of the cross-section was shifted upwards and resulted in higher hull girder stresses in way of the double bottom. To maintain the use of steel with a yield strength of 355 N/mm$^2$ (YP355) in the bottom area, the plate thicknesses had to be increased here too.
To cater for additional stress components, e.g. double bottom bending, which are normally analysed during later stag-

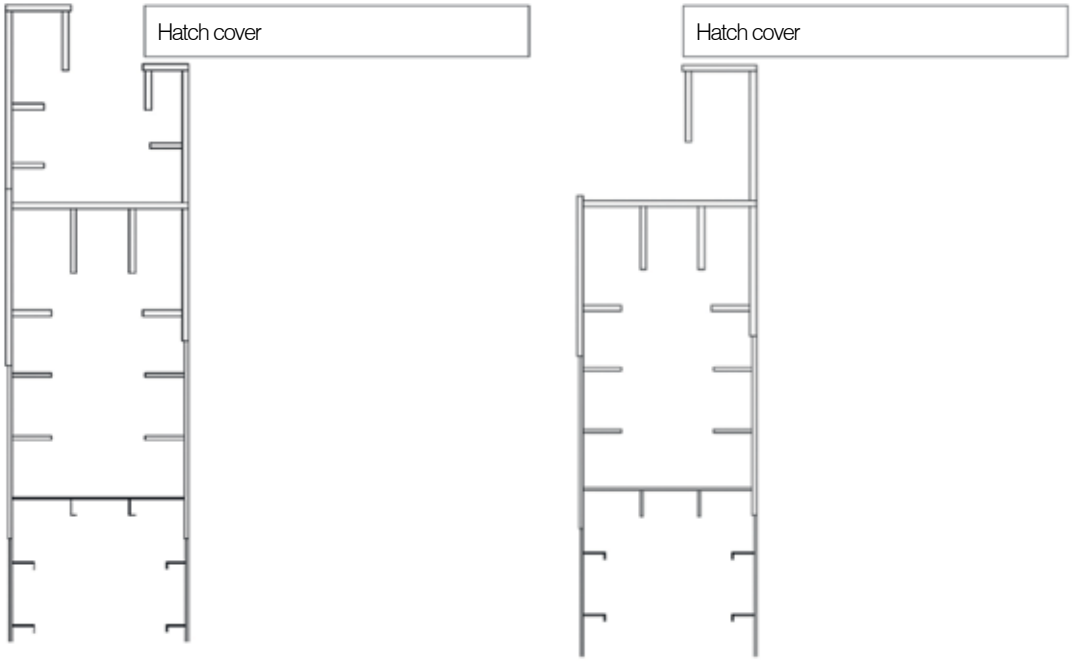


Figure 1. Upper hull girder with and without strength coaming

es of the design process using FEM-based methods, the section modulus at the outer bottom has been dimensioned with a minimum margin of 13% for all variants.

One option to reduce the weight of the longitudinal structures by about 4% would be to introduce steel with a yield strength of 390 N/mm$^2$ in the outer bottom in the mid-ship area. However, this introduces other challenges and would require further investigation.

Table 6 shows the described effects for selected variants. Based on the mid-ship cross-sectional analysis, the dead-weight of the variants in the parametric analysis discussed above was adapted.

When studying possible variations in draft, it was found that increasing the scantling draft from today's 16 m to a possible future 17m only has a marginal impact on the steel structures.

## Conclusion

From a study carried out by DNV GL, it can be concluded that the next generation of ULCS can be designed, built and operated without major changes to the design concept/

| | | | | Bottom with YP355 | | Bottom with YP390 | |
|---|---|---|---|---|---|---|---|
| TEU | Bay | Rows | Moment or section modulus | Bottom thickness [mm] | Mid ship section weight | Bottom thickness [mm] | Mid ship section weight |
| 20300 | 24 | 23 | 100% | 24 | 100% | | - |
| 22200 | 26 | 23 | 117% | 28 | 113% | 24 | 109% |
| 23300 | 26 | 24 | 123% | 29 | 117% | 24 | 114% |
| 26300 | 28 | 25 | 146% | 30 | 135% | 26 | 129% |

Table 6. Structural and weight characteristics

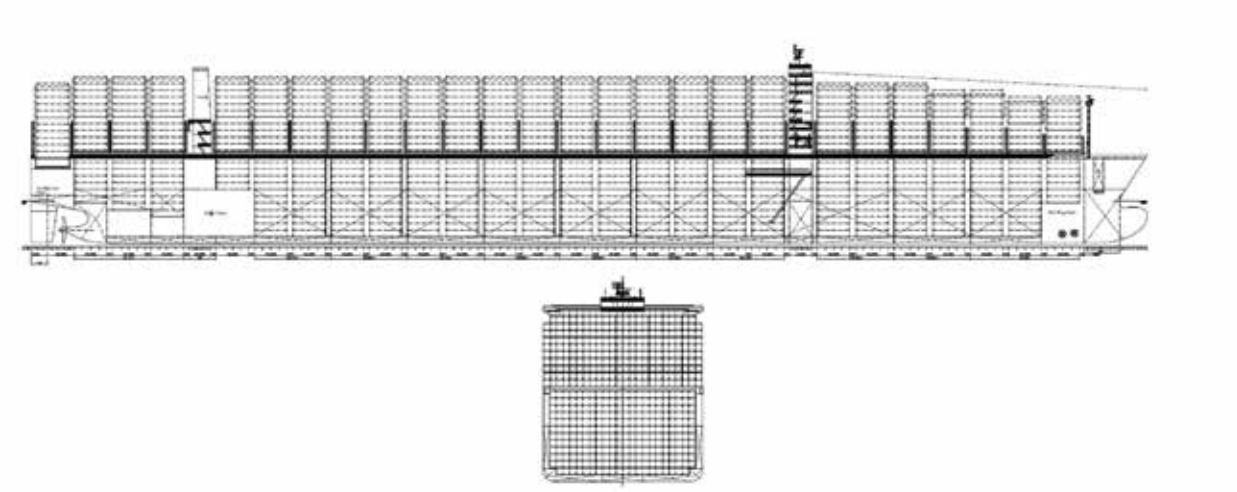

Figure 2. 26 bay/24 row, 23,000 TEU ULCS

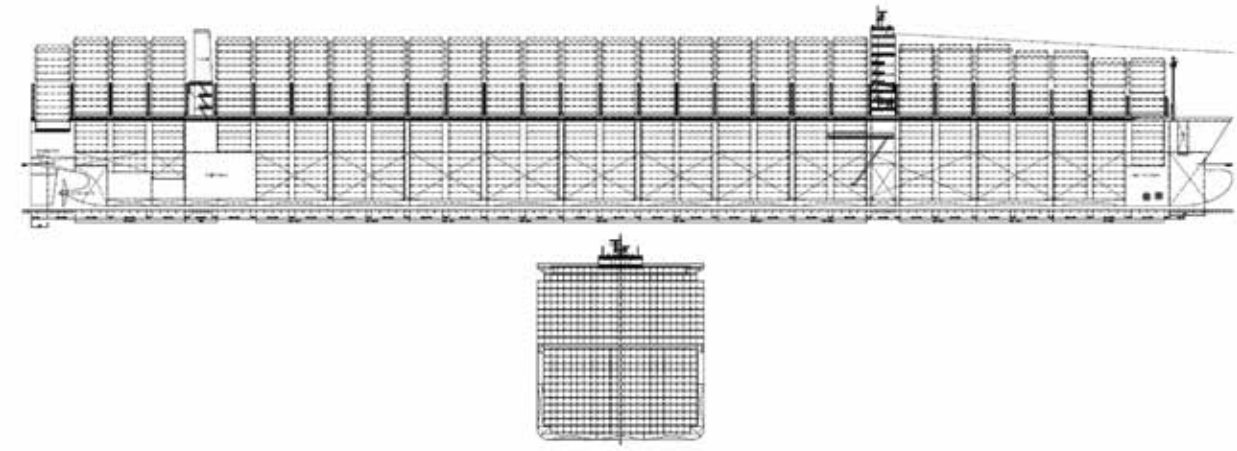

Figure 3. 26 bay/25 row, 26,000 TEU ULCS

structural arrangement of present large container ships.

It appears likely that the beam will be increased to 24 rows in the next step, increasing the nominal capacity by roughly 1,000 TEU while keeping the fuel costs per TEU almost unchanged.

By increasing the maximum draft of the 24-row-wide ULCS from 16 m to 17 m, the deadweight capacity can be increased by about 10%, which increases the fuel efficiency - in particular for heavier containers.

If an even higher nominal capacity is required than a lengthening of the vessel by one cargo hold (2 bays = 26 bays in total), this would result in a TEU intake of about 23,300, with fuel costs per TEU reduced by roughly 4.5%. A general arrangement for such a concept is shown in figure 2.

The infrastructure of seaways and ports is not believed to impose barriers to this development that cannot be handled.

By increasing the beam to 25 rows and length to 26 bays, the capacity of a ULCS could reach 26,300 TEU. However, such a design would be restricted from entering a number of ports and would not be able to pass through the Suez Canal with its current restrictions in a fully laden state. This would also require a new structural design concept, introducing "strength coaming" on top of the sheer strake. That is why it is not likely that such a size of vessel will be ordered in the near future, even though it would promise another 3.5% reduction in fuel costs per TEU. A general arrangement for such a concept is shown in figure 3. ⚓

# Balancing cost efficiency whilst meeting regulatory requirements in maritime human resource management

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# ABB technology to help vessels operate safely 5 km below sea level

**Marine software and hardware to assist multi-purpose diving support vessels in complex deep-water projects**

ABB, the leading power and automation technology group, will provide the technology that will help three vessels safely carry out construction and maintenance tasks up to 5 kilometers under water. The vessels will be equipped with ABB's OCTOPUS software that uses sensors and the Internet of Things, Services and People (IoTSP) to interpret weather conditions, allowing the crew to make informed decisions during sensitive operations. The ships will be built for Ultra Deep Solutions (UDS) at CSIC Huangpu Wuchang Shipbuilding Company Limited and China Merchants Heavy Industry.

UDS specializes in the design, construction and operation of World-Class Ultra Deep Diving Heavy Construction Vessel to the offshore industry. Its onshore and offshore expertise provides top-class quality offshore-related services/knowledge with excellent high standards.

The largest vessel's apparatus will include two remotely operated underwater vessels (ROVs), that will dive up to 3000 meters, and a 400 ton crane that can drop 5 200 meters. It will measure 142 meters in length.

The OCTOPUS suite of products is a powerful tool that provides onboard decision support and operational advice during weather-sensitive offshore operations by monitoring and forecasting vessel motions. When working in deep-water without mooring or anchoring lines, an important part of the set-up is the OCTOPUS-Operational forecast function. This extension within OCTOPUS makes it possible to define an optimal operational window during weather sensitive operations on DP.

Juha Koskela, Managing Director of ABB's Marine and Ports business, said, "The broad scope of supply we have on these vessels is a demonstration of the wide range of solutions we have to offer the maritime sector. These vessels will benefit from some of the most established software and hardware technologies in the shipping industry."

The vessels also will feature ABB generators, motors, drives and switchboards.

Jithu Sukumaran Nair, General Manager of Shipbuilding at Ultradeep Solutions said, "We are proud to be the first offshore vessel operator in the world to install the OCTOPUS weather monitoring system on board high tech dive vessels"

ABB offers the widest portfolio of marine software and optimization systems to the maritime market. Its performance management solution consists of the OCTOPUS advisory suite and the 'Emma' advisory suite, a decision support toolkit to minimize the overall fuel and energy costs for a whole fleet.

# DSME opened up new horizon for LNG carrier market!

**Daewoo Shipbuilding & Marine Engineering (DSME) delivered the world's first natural gas-powered LNG carrier, opening up new era of vessels powered by natural gas.**

DSME completed about 3-year construction process of world's first natural gas-powered LNG carrier (173,400㎥) ordered from Canada-based Teekay in 2012 and delivered the vessel to the ship owner successfully.

This vessel will be deployed for LNG export project at the Sabine Pass LNG terminal off the coast of Louisiana in the Gulf of Mexico, which has the largest reserves of natural gas in the United States, to export the first cargo of LNG from the United States. The charterer of this vessel is Cheniere, a U.S.-based energy company. Creole Spirit, which departed Okpo shipyard on February 19, has been thrust into limelight in industry as it is the first LNG carrier outfitted with natural gas-powered engine (ME-GI Engine).

Particularly, this vessel incorporated various technologies related to natural gas, including FGSS (Fuel Gas Supply System) and PRS(Partial Re-liquefaction System) developed independently by DSME. This vessel increased fuel efficiency by about 30% and can reduce pollutants such as carbon dioxide ($CO_2$), nitrogen oxides (NOx), and sulfur oxides (SOx) by over 30%, compared to existing LNG carriers.

FGSS is the system compressing the LNG, the fuel, in high pressure and supplying the compressed LNG to ME-GI (MAN Electronic Gas-Injection Engine) which was developed by MAN Diesel & Turbo of Germany and operates on natural gas as main fuel. PRS is a system reducing the boil-off losses from cargo containment system while LNG carrier is operating at economical speed. Usually, natural gas is converted in liquid form for transportation and boil-off gas occurs naturally during transit. PRS developed by DSME recovers and re-liquefies boil-off gas which is then sent back to cargo containment system, resolving boil-off losses fundamentally. Furthermore, this PRS uses the natural boil-off gas as refrigerant and thereby reduces operating costs drastically, unlike similar technology requiring separate power system or refrigerant compressor.

World's first natural gas-powered LNG carrier departing from the port

Teekay has placed orders for 30 vessels at DSME thus far, out of which 16 units have been delivered to the ship owner. The 14 remaining vessels under construction include 7 natural gas-powered LNG carriers, 1 LNG-FSU (Floating Storage Unit), and 6 ice-breaking LNG carriers. Teekay ordered all of world's first vessels at DSME, reflecting strong cooperative relationship with the shipbuilder.

An official from DSME said, "Our relentless effort to build better vessels has been key to our successful delivery of vessels opening up new era of LNG carriers. We will cement our position as unmatched leader in shipbuilding market based on timely delivery, new technology development, and higher productivity."

DSME is also building LNG carriers outfitted with X-DF engine of Wartsila, in addition to ME-GI engine of MAN Diesel & Turbo, to accommodate various demands of customers.

Moreover, DSME is diversifying its lineup of PRS, the LNG re-liquefaction system, into PRS+ and FRS for ME-GI engine, MRS-F for Wartsila engine, and PRS for DFDE engine.

# Emerson expands its gas analysis products, further sharpening its market competitiveness

**Emerson took over Casecade Technologiues headquartered in Stirling Scotland. last year. This acquisition has allowed Emerson to expand its gas analysis portfolio with laser-based measurement analyzers and systems, further strengthening its competitiveness in fields related to industrial emission monitoring, productivity, environmental regulations, etc. MONTHLY KORSHIP had an interview with Sundeep Saraf, Vice President for Rosemount Analytical, Emerson Process Management.**

Sundeep Saraf, Vice President for Rosemount Analytical, Emerson Process Management

Cascade Technologies first formed in 2003 as an engineering startup company who developed the first Quantum Cascade Laser (QCL) Analyzer and patented the "chirp" technique. Today, they are the world's leading developer and manufacturer of QCL analyzers, solving some of the most challenging measurement applications for the process gas, chemical, refining, pharmaceutical and food packaging industries. Emerson acquired Cascade Technologies in December 2014 and it is now a part of Rosemount.

**Q: Please explain in detail more about QCL measurement technology and what differentiates it from other gas analyzers.**

**A: (Sundeep Saraf)** Cascade has patented the laser chirp technique, which is a way of pulsing the QCL laser to scan a small spectrum, typically between 1 and 5 wavenumbers. The laser is pulsed very rapidly (typically 100,000 times per second) which has two advantages. Firstly multiple spectra can be averaged to improve signal to noise ratio and give excellent sensitivity, and secondly data is acquired very rapidly (each pulse is less than a millionth of a second) which gives continuous and fast data analysis.

As QCL lasers emit in the mid IR, they can access the strong fundamental absorption bands of many molecules. This gives excellent sensitivity down to ppb level. The technique also offers a wide dynamic measurement range by utilizing absorption lines of differing strength, giving ranges from ppb to % level.

QCL analyzers do not require utility gases and have minimum calibration requirements as the way the concentration is calculated using the Beer Lambert law (first principle physics) means the measurements do not drift with time.

**Q: What benefits does QCL provide the Oil & Gas industry?**

**A: (Sundeep Saraf)** The advantages are as mentioned above, but in particular the ability to measure the gas of

Table. Differentiated competitiveness of QCL gas analyzer

| Industry Challenges | QCL Solution |
|---|---|
| Multiple analyzers required for gas measurements | Single analyzer with multi-component capability |
| High running costs (utility gas, frequent calibration) | QCL system has low running costs – no utility gas required and minimal calibration |
| Changing gas measurement requirements or different ranges required | QCL system can be upgraded by replacing a laser module (plug and play) to give a different measurement or change the measurement range |
| Highly skilled technicians required for servicing | Modular QCL system makes servicing easy |

interest in a complex background without interference is key. Also the ability to measure multiple species per analyzer cuts down on the number of systems required in a plant and the running costs are lower than other analyzer types as utility gas is not required.

**Q: How can one analyzer measure multiple gases simultaneously?**
**A: (Sundeep Saraf)** Using the pulsed chirp technique, multiple lasers can be incorporated into a single analyzer. Each laser can measure between 1 and 3 different components, so for a 6 laser system typically between 10 and 20 separate measurements can be made (application dependent).

**Q: What is the plan for development of new products targeting the oil and gas markets?**
**A: (Sundeep Saraf)** Emerson is currently developing a new product for the oil and gas industry. This new product will be capable of measuring H2O, $CO_2$ and H2S in a single flameproof instrument for natural gas quality monitoring. This product is planned to launch towards the end of 2016.

**Q: With the acquisition of Cascade Technologies, Emerson now offers a broader range of gas analyzers. Please tell us what growth strategy in Korean market.**
**A: (Sundeep Saraf)** The South Korean market is important to Emerson as we have a solid, long-established base of top customers which represent the leading industrial, oil and gas, and processing companies in the country. We're so pleased to serve this market and are committed to continuing to grow and expand our reach and position in South Korea.

**Q: What does the future hold for Rosemount's gas analyzers?**
**A: (Sundeep Saraf)** We will continue developing products that meet customer requirements in not only a cost effective manner, but technologically advanced to support our customers' process availability. Currently, we are developing various products, including CT5100, CT5200, CT5400, and CT5800.

CT5100 : QCL analyzer for CEMS applications, Hazardous area certified (Ex-p)

CT5200 : QCL analyzer for range of process applications, Hazardous area certified (Ex-p)

CT5800 : Flameproof QCL analyzer for purity applications (high sensitivity measurement of impurities in a sample gas stream, Hazardous area certified (Ex-d)

CT5400 : General purpose PGA – safe area and highly configurable for a range of different applications

# HHI completed the world's first Tier III-compliant high pressure SCR

**Hyundai Heavy Industries (HHI) secured source technology reducing nitrogen oxides (NOx) by up to 99%. This technology can satisfy the requirements of Tier Ⅲ standards set forth by International Maritime Organization (IMO) which comes into force this year.**

HHI, the world's largest shipbuilder and a leading marine engine maker, announced that it produced the world's first High Pressure Selective Catalytic Reduction (HP SCR) system for the dramatic reduction of NOx emission from 2-stroke marine engines.

HP SCR system decomposes NOx, the high-pressure exhaust gas from large engines, into nitrogen and water through catalytic reaction with ammonia. To meet the standards of Tier Ⅲ, large engine outfitted with low-pressure selective catalytic reduction (LP SCR) system needed to use only marine gas oil (MGO) containing 0.1% sulfur or less as fuel thus far.

The HP SCR can reduce NOx emission up to 99 percent by using ammonia as a catalyst, and thus complies with IMO NOx Tier III requirement that took effect in January 2016. The eco-friendly marine engine add-on already draws keen attention from major shipping companies in that it can run on heavy fuel oil that costs half as much as marine gas oil.

IMO Tier Ⅲ represents environmental regulations for vessels built from January this year and requires to reduce NOx emitted from engine to below 3.4g per kWh.

HHI completed the certificate test of the HP SCR, the fruit of an 18-month long research and development, in December 2015 with the presence of DNV-GL. The first HP SCR is slated to be installed in a 20,600 $m^3$ LPG carrier under construction at Hyundai Mipo Dockyard, a shipbuilding affiliate of HHI on February 5, 2016.

HHI Completes Certificate Test of High Pressure SCR Attached to 2-stroke Marine Engine in December 2015.

HHI won the orders of five HP SCR to date, and set the annual order target of more than 100 units by 2018. In response to the harsh challenges in the shipbuilding industry, HHI is stepping up efforts to develop new technologies targeted at the market demands for 'eco-friendly, more efficient and smarter ships.'

In addition, HHI Group announced that it set annual new order target of USD 16.7 billion in shipbuilding, offshore, and plant sectors, excluding electrical/electronics, green energy sectors, etc., in its New Year' address.

HHI aims to overcome current difficulties through development of smart ship combining eco-friendly and high efficiency eco-ship and IT (Information Technology), localization of offshore plants, etc. Having secured adequate order backlog in shipbuilding sector, HHI is putting primary focus on increasing profitability in tandem with agile response to the changes in market conditions based on its capability to build vessels of various models.

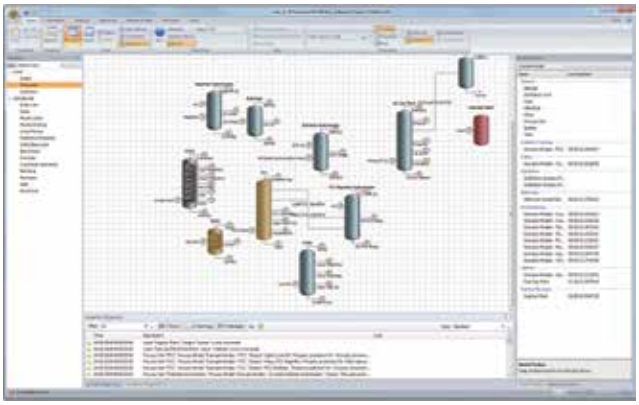
# Schneider Electric announces Global Software Agreement with BP for SimSci Spiral Suite

## BP licenses SimSci Spiral Suite, Schneider Electric's enterprise solution for supply chain optimization

BP and Schneider Electric Software, a global leader in industrial software and part of Schneider Electric, the global specialist in energy management and automation, have signed a global agreement for Spiral Suite that includes planning and supply & distribution optimization modules. Spiral's expert development and support teams will work with BP to deploy the software across its global refinery portfolio. Deployment of this enhanced hydrocarbon supply chain optimization solution is a key milestone for BP's fuels business in improving delivery of commercial performance.

Spiral Suite is the only industry planning and scheduling solution designed from the ground up as an integrated solution. It fully supports all supply chain work processes across large and small enterprises, bringing together feedstock data management, planning, scheduling and envelope optimization activities in a single, fully-integrated toolset.

Also, Spiral Suite is a modern enterprise supply chain management solution for the hydrocarbon processing industry that eliminates inefficiencies experienced with existing point solutions. In-tool Analytics enable better decisions with cloud-based distributed calculation enabling rapid analysis of many more scenarios. Its modern, scalable, architecture enables collaboration across the enterprise.



Spiral Suite is built using the latest technologies which provides an efficient, flexible and familiar user experience. The Spiral Plan and Spiral Network modules support all planning and product distribution work processes across large and small refineries. All activities are supported within a single application, with a single user interface and a single source of data with version and data management control. Spiral Suite enables information to be shared easily between users, improving understanding and collaboration between traders, planners and analysts.

"We have a long-term collaboration with BP on enterprise crude knowledge management and this new agreement builds on the two companies' long-standing relationship. Spiral Suite promises to enhance the refinery business environment, fully supporting all supply chain work processes and driving operational excellence through universal improvement," said Ravi Gopinath, Ph.D., Executive Vice President, Schneider Electric Software.

"Spiral Suite brings together enterprise crude knowledge management, planning, scheduling and envelope optimization activities in a single software application. The result is a unified solution that uses more accurate, up-to-date data to better explore new opportunities and shrinks the gap between planned and actual results. Driving greater collaboration between diverse user groups across the enterprise, Spiral Suite enables smarter purchasing decisions, reduce operational risk and increase efficiency"

# DNV GL improve the service specification for wind power plants

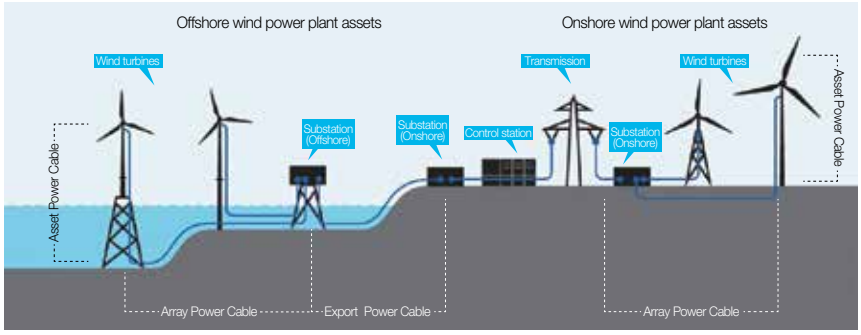
**The fully revised certification scheme DNVGL-SE-0190 features more risk-related features than any other project certification standard available on the market to date.**

DNV GL has published the world's latest and most comprehensive service specification for project certification of wind power plants, the DNVGL-SE-0190. The set of specifications is designed to ensure the safe and reliable operation of wind power plants, their assets and components throughout the project life cycle.

Since issuing its first wind certification standard in 1986, DNV GL continuously worked together with the industry to develop up to date certification schemes tailored to the demands of the advancing renewables market.

This fully revised certification scheme is the most complete set of specifications to date and designed to mitigate risks at each stage of the project certification phases, ensuring that wind power plants operate safely and cost efficiently and all technical, design and construction requirements are met.

The new service specification DNVGL-SE-0190 encompasses more risk-related features for state-of-the art power plant certification than any other project certification standard available on the market, adding value beyond common certification practices. To provide ultimate flexibility, the new DNV GL scheme addresses individual project needs. By reducing the costs over the project lifetime without compromising on quality, it allows the split into project




phases and asset related certifications, providing stakeholders the opportunity to add optional service elements based on individual needs and preferences.

To address the demand for standards spanning across the entire project life cycle, the set of specifications provides a toolbox of certification elements, including:

- *New complementary services such as site suitability, met masts, navigation and aviation aids or power plant performance certifications to increase the possibilities and value of the wind power plant if desired*
- *Opportunity to implement an optional asset-related certification procedure for wind turbines, substations, power cables and newly control station*
- *New optional phases such as concept, lifetime extension, decommissioning and repowering*

Reducing the levelized cost of energy is the key driver for the advancement of the wind energy industry and can be achieved through the optimisation of practices from all sources during the project life cycle from development, manufacturing, construction and operational lifetime of the wind power plant. This implicitly includes increased focus on state-of-the-art technical requirements, safety aspects and quality.

Fabio Pollicino, Service Line Leader for Project Management at DNV GL Renewables Certification commented: 'Providing better guidance and simplifying the applicability for developers, owners, contractors and other stakeholders during the whole life cycle of the wind power plant, lies at the heart of the new service specification. We see that the wind energy sector is rapidly progressing, which is why we put a strong emphasis on ensuring that this certification scheme and our standards ensure the safety and reliability of current state-of-the-art projects and beyond."

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# 에머슨, 가스 분석 제품군 확장으로 시장 경쟁력 강화에 나서다

에머슨은 스코틀랜드 스털링에 본사를 둔 Casecade Technologiues를 인수했다. 이를 통해, 레이저 기반 측정 분석기 및 시스템으로 가스 분석 포트폴리오를 확장함으로써 산업용 배출 모니터링, 생산 효율성, 환경규제 등 제품 경쟁력 강화에 나섰다. 월간 KORSHIP은 에머슨 프로세스 매니지먼트의 산딥 사라프(Sundeep Saraf) 로즈마운트 분석기 사업부 아태지역 부사장과 인터뷰를 가졌다.

에머슨 프로세스 매니지먼트의 산딥 사라프(Sundeep Saraf) 로즈마운트 분석기 사업부 아태지역 부사장

Cascade Technologies는 2003년에 설립되어 업계 최초로 양자 기술을 바탕으로 한 캐스케이드 레이저(Quantum Cascade Laser; QCL) 분석기를 개발했고, '처프(chirp)' 기술 특허를 획득한 엔지니어링 기업이다.

Cascade Technologies는 2014년 12월 에머슨에 의해 인수되어 현재 Rosemount 브랜드 그룹에 속해 있다. 세계적인 QCL 분석기의 개발 및 제조업자로서 공정 가스, 화학, 정유, 제약 및 식품 포장 산업을 위한 측정 어플리케이션의 가장 어려운 과제들을 해결하고 있다.

**Q: QCL 측정 기술에 대해 설명바라며, 기존 가스 분석기와 비교해 차별화된 제품 경쟁력은?**

**A: (Sundeep Saraf)** Cascade는 QCL 레이저를 펄싱(pursing)해 파동수가 1~5 사이의 작은 스펙트럼을 스캔하는 레이저 처프(chirp) 기술에 대한 특허를 가지고 있다. 레이저는 매우 빠르게 (일반적으로 초당 100,000번) 펄스되면서 두 가지 장점을 제공하는데, 첫째로 여러 스펙트라를 평균화해 신호 대 잡음비를 개선함으로써 감도를 향상시킨다. 둘째로, 매우 빠르게 (각 펄스는 100만분의 1초보다 짧음) 데이터를 취득해 지속적이고 빠른 데이터 분석을 가능하게 한다.

QCL 레이저는 중간 적외선(mid IR)을 발산하며, 분자가 많은 강력한 기초 흡수대역에 접근하는 것이 가능한데, 이는 Ppb 레벨까지의 뛰어난 감도를 제공할 뿐 아니라 강도를 다르게 하는 흡수 라인을 활용해 ppb에서 % 레벨까지의 넓은 범위를 측정할 수 있다.

QCL 분석기에는 비어람버트법칙(Beer Lambert Law: 제1원리 물리)에 따라 농도를 계산해 측정치가 시간을 따라 표류(drift)되지 않기 때문에 유틸리티 가스가 필요 없으며, 교정(Calibration) 작업은 최소한으로 요구된다.

**Q: 조선해양 시장에서 QCL 기술이 제공하는 이점들(benefit)은 무엇인가?**

**A: (Sundeep Saraf)** 위에 언급한 장점들 이외에도, 특히 키(key)를 방해하지 않고 복잡한 조건에서 원하는 가스를 측정할 수 있다. 또한 각 분석기 당 여러 종류를 측정할 수 있어 발전소에 필요한 시스템의 수를 줄어들고, 발전용 가스가 필요 없기 때문에 기존 분석기에 비해 비용이 절감된다.

**Q: 하나의 분석기로 다양한 종류의 가스 분석 및 모니터링이 가능한 이유는?**

**A: (Sundeep Saraf)** 펄스 처프(chirp) 기술

Table. QCL 가스 분석기의 차별화된 경쟁력

| 산업 과제 | QCL 솔루션 |
|---|---|
| 가스 측정을 위해 요구되는 여러 대의 분석기 | 단일 분석기로 다수의 구성요소 분석이 가능 |
| 높은 운전비(발전용 가스, 빈번한 교정) | 낮은 운전비의 QCL 시스템 – 발전용 가스가 필요 없으며 최소한의 교정 |
| 가스 측정 조건이 바뀌거나 또는 각기 다른 범위가 요구됨 | 레이저 모듈(플러그&플레이)을 교체하는 것으로 QCL 시스템을 업그레이드해 각기 다른 측정을 제공하거나 측정 범위를 변경 |
| 서비스를 위해 고도로 숙련된 기술자 필요 | 모듈형 QLC 시스템으로 쉬운 서비스 |

을 통해 다수의 레이저들을 하나의 분석기에 결합했기 때문에, 각각의 레이저는 1~3개의 각기 다른 요소를 측정할 수 있다. 즉, 6개의 레이저 시스템의 경우 보통 10~20개의 독립된 측정이 가능하다. 단, 어플리케이션에 따라 다를 수 있다.

**Q: 오일 & 가스 시장을 겨냥한 신제품 개발 계획은?**

**A: (Sundeep Saraf)** 에머슨은 현재 오일 & 가스 산업을 위한 새로운 제품을 개발 중이다. 이 제품은 천연 가스의 품질을 모니터링을 위한 내압 방폭형 단일 계기로 $H_2O$, $CO_2$ 및 $H_2S$를 측정이 가능하다. 2016년 말에 출시할 것으로 예상한다.

**Q: 에머슨은 Cascade Technology의 인수를 통해 가스 분석기 시장에서 폭넓은 제품라인을 갖추게 됐다. 향후 한국시장에서의 성장 전략은?**

**A: (Sundeep Saraf)** 한국은 에머슨에게 있어 매우 중요한 시장이다. 에머슨은 한국에서 석유 및 가스, 기타 공정업체를 대표하는 최고의 고객들과 오랫동안 견고한 관계를 쌓아왔다. 한국에 에머슨의 서비스를 제공할 수 있어 매우 기쁘게 생각하며, 한국 내에서 에머슨의 영향력과 위치를 키우고 확장하기 위해 꾸준히 노력할 것이다.

아울러 우리는 고객의 프로세스 이용성을 지원하기 위해 비용 효과적이고 앞선 기술을 적용해 고객 요구사항을 만족하는 제품들을 지속적으로 개발하고 있다. 현재 CT5100, CT5200, CT5400, CT5800 등 다양한 제품들을 개발 중이다.

CT5100 : CEMS 적용 QCL 분석기, 위험 지역 인증(Ex-p)

CT5200 : 공정 Range QCL 분석기, 위험 지역 인증(Ex-p)

CT5800 : 순도 측정용 내압 방폭형 QCL 분석기(샘플 가스 흐름 내 불순물을 고감도 측정), 위험 지역 인증(Ex-p)

CT5400 : 범용 PGA – 안전 지역 적용, 다양한 어플리케이션을 위한 높은 설정 수준


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# 대우조선해양, LNG 운반선 시장의 새 지평을 열다!

대우조선해양이 '천연가스 직분사 추진방식 LNG운반선'을 세계 최초로 인도하며, 천연가스 추진 선박 시대의 새로운 장을 열었다.

대우조선해양은 지난 2012년 캐나다 티케이(Teekay)로부터 수주한 세계 최초의 천연가스 직분사 추진방식 LNG운반선(173,400㎥급)을 약 3년간의 건조 공정을 마치고 성공적으로 선주사에 인도했다. 이 선박은 미국 최대 천연가스 생산지역인 멕시코만 연안 루이지애나 주에 건설되는 미국 최초 LNG 수출 사업인 'Sabine Pass' 프로젝트에 투입될 예정인데, 선박의 용선주는 미국 에너지 업체인 셰니에르(Cheniere)이다.

지난 2월 19일 실제 노선에 투입되기 위해 옥포조선소를 떠난 크레올 스피릿(Creole Spirit)호는 천연가스 추진 엔진(ME-GI 엔진)이 탑재된 최초의 LNG운반선으로 업계의 주목을 받고 있다. 특히 대우조선해양이 독자 개발한 연료공급시스템(FGSS: Fuel Gas Supply System)과 재액화장치(PRS: Partial Re-liquefaction System) 등 천연가스 관련 기술이 대거 적용되었다. 기존 LNG운반선보다 연료 효율이 30% 가량 높고, 이산화탄소, 질소화합물(NOx), 황화합물(SOx) 등 오염물질 배출량도 30% 이상 낮출 수 있다.

FGSS는 연료인 LNG를 고압으로 압축한 후에 독일 만디젤앤터보(MAN Diesel & Turbo)가 개발한 천연가스를 주 연료로 구동되는 ME-GI(MAN Electronic Gas-Injection Engine) 엔진에 공급하는 장치이다. PRS는 LNG운반선이 경제속도로 운항할 때, 화물창 내에서 발생하는 천연가스의 손실을 보존하는 장치이다.

출항 중인 세계 최초의 '천연가스 직분사 추진방식 LNG운반선'

일반적으로 천연가스는 액체상태로 바꿔 운송되는데, 운송 과정 중 자연 기화 현상이 발생해 일부가 손실된다. 대우조선해양이 개발한 PRS는 기화된 천연가스를 모아 재액화해 화물창으로 돌려보내기 때문에 손실 문제를 근본적으로 해결했다. 더욱이 별도의 동력이나 냉매 압축기가 필요한 유사 기술과 달리, 자연기화가스(natural boil-off gas) 자체를 냉매로 활용하기 때문에 선박 운영 비까지 획기적으로 절감할 수 있다.

티케이는 현재까지 총 30척의 선박을 대우조선해양에 발주했으며, 이중 16척을 성공적으로 인도했다. 현재 건조중인 나머지 선박들은 천연가스 추진 LNG선 7척, LNG-FSU 1척, 쇄빙 LNG선 6척 등 총 14척으로, 티케이는 세계 최초로 발주하는 선박 모두를 대우조선해양에 맡길 만큼 대우조선해양과 긴밀한 협력관계를 유지하고 있다.

대우조선해양 관계자는 "더 좋은 선박을 만들기 위한 끊임없는 노력이 있었기에, LNG운반선 분야의 새 시대를 여는 선박을 성공리에 인도할 수 있었다"며, "프로젝트 적기 인도, 신기술 개발 그리고 생산성 향상을 통해 조선시장 최강자의 지위를 굳건히 다지겠다"고 말했다.

한편, 대우조선해양은 다양한 고객사들의 요구에 대응하기 위해, 만디젤앤터보의 ME-GI 엔진 외에도 바르질라(Wartsila)사의 X-DF엔진이 탑재된 LNG운반선 역시 건조하고 있다. LNG 재액화 장치인 PRS 역시 ME-GI 엔진에 적용되는 PRS+와 FRS, 바르질라 엔진에 적용되는 MRS-F, DFDE 엔진용 PRS 등 세분화를 통한 제품군 다양화에도 힘쓰고 있다.

# 현대중공업, 세계 최초 고압용 질소산화물 저감장치 완성

현대중공업이 질소산화물 최대 99%까지 줄일 수 있는 원천기술을 확보했다. 이 기술을 통해 올해부터 도입되는 국제해사기구(IMO)의 Tier Ⅲ를 만족시킬 수 있다.

현대중공업이 세계 최초로 고압의 엔진 배기가스를 정화할 수 있는 친환경 장치를 제작하는데 성공했다. 독자기술로 개발한 이 고압용 질소산화물 저감장치(HP SCR)는 2월 5일 현대미포조선에서 건조 중인 2만600입방미터(㎥)급 LPG선에 설치됐다.

HP SCR은 대형엔진의 고압 배기가스인 질소산화물을 암모니아와의 촉매반응을 이용해 질소와 물로 분해한다. 지금까지 대형엔진에 저압용 질소산화물 저감장치(LP SCR)로 TierⅢ 기준을 충족시키려면 연료로 0.1% 이하의 황만 함유한 선박용 경유(MGO)를 사용해야 했다.

이 장치는 선박용 대형엔진에서 고온(300~520℃), 고압(1~5bar)으로 배출되는 대기오염 물질인 질소산화물(NOx)을 암모니아 촉매로 분해해, 최대 99%까지 저감할 수 있다. 또한 선박용 경유(MGO)보다 가격이 절반가량 저렴한 일반 중유(HFO)를 연료로 사용해도 올해 1월 발효된 국제해사기구의 대기오염방지 3차 규제(TierⅢ)를 충족할 수 있어 대형 해운사를 중심으로 큰 관심을 받고 있다.

국제해사기구의 Tier Ⅲ는 올해 1월부터 새로 건조되는 선박에 적용하는 친환경 규제로, 엔진에서 배출되는 질소산화물을 1킬로와트(kWh)당 3.4그램(g) 이하로 줄여야 한다.

현대중공업의 고압용 배기가스 저감장치

현대중공업은 지난 2012년 저압(1bar 이하)용 질소산화물 저감장치(LP SCR)를 개발했지만, 이 장치는 유해물질이 적은 선박용 경유를 사용해야 하고 중형엔진에만 장착할 수 있었다.

현대중공업은 지난 2014년 6월 고압용 질소산화물 저감장치 개발에 착수, 18개월만인 지난해 12월 노르웨이-독일 선급협회인 DNV-GL의 입회 하에 대형엔진 성능시험을 성공적으로 끝마쳤다.

현대중공업 관계자는 "오는 2018년까지 연간 100기 이상을 수주하는 것이 목표"라며 "급변하는 시장상황 속에서 경쟁력 강화를 위해 친환경 엔진과 스마트십 등 신기술 개발에 최선을 다하고 있다"고 말했다.

한편 현대중공업은 올해 초 신년사를 통해 전기전자, 그린에너지 등을 제외한 조선·해양·플랜트 사업부문 수주목표를 167억 달러로 발표했다. 이는 지난해 대비 12% 정도 하향 조정한 수치다. 이에 따라 현대중공업은 친환경, 고효율 선박인 에코십과 조선에 정보기술(IT)을 접목한 스마트십 개발, 해양플랜트 국산화 등으로 현재 난관을 극복하겠다는 전략이다. 특히 조선 부문에서는 충분한 수주잔량을 확보하고 있는 만큼, 다양한 선종을 제작할 수 있는 건조능력을 바탕으로 시장변화에 빠르게 대응하는 한편 수익성을 최우선으로 하는 영업전략을 펼쳐나갈 방침이다.

# 슈나이더 일렉트릭, BP에 '심싸이 스파이럴 스위트' 글로벌 공급 계약

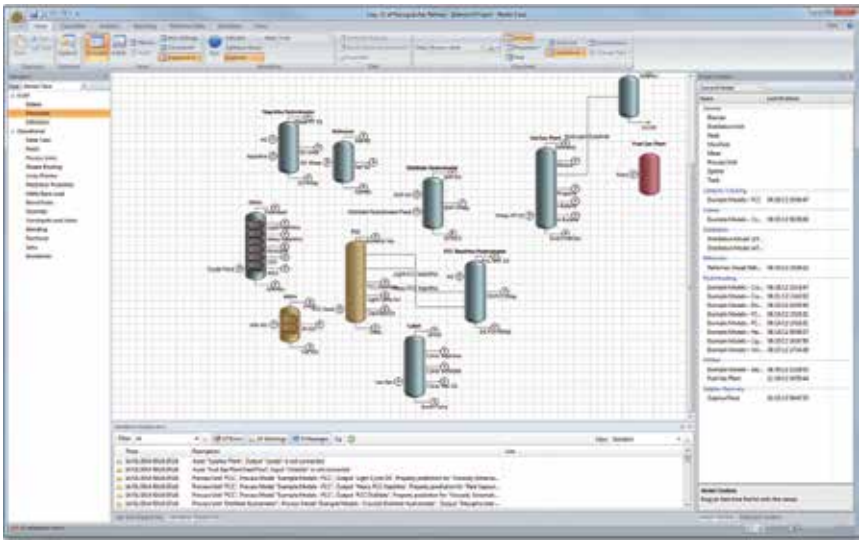
BP가 공급망 최적화를 위해 슈나이더 일렉트릭의 엔터프라이즈 솔루션인 심싸이 스파이럴 스위트(SimSci Spiral Suite)를 라이선스했다.

글로벌 에너지 관리 및 자동화 전문기업 슈나이더 일렉트릭이 영국 석유업체인 BP에 '심싸이 스파이럴 스위트' 솔루션을 공급하는 글로벌 계약을 체결했다고 밝혔다.

심싸이 스파이럴 스위트는 탄화수소 공정에 특화된 산업용 공급망 관리 솔루션으로, 업계 유일의 통합 플래닝 및 스케줄링 솔루션으로서 기존의 포인트 솔루션이 갖고 있던 비효율성을 제거한 것이 특징이다. 인 툴 애널리틱스(In-tool Analytics) 기능을 통해 클라우드 기반으로 더 다양한 시나리오들을 빠르게 분석할 수 있고, 이를 통해 고객이 더욱 현명한 의사결정을 내릴 수 있도록 돕는 솔루션이다.

스파이럴 스위트는 업계 유일의 통합 플래닝 및 스케줄링 솔루션으로, 크고 작은 사업부 전체에 걸쳐 모든 공급망 공정을 지원하며 공급원료 데이터 관리, 플래닝, 스케줄링, 앤벨로프 최적화 활동을 하나의 완벽하게 통합된 툴세트에서 관리할 수 있도록 해준다. 스파이럴 스위트는 하나의 사용자 인터페이스와 데이터 소스, 버전 관리 및 데이터 관리 제어를 기반으로, 모든 활동을 하나의 애플리케이션으로 관리할 수 있게 해주며, 패럴렐 데스크탑과 웹 인터페이스를 통해 모두 사용할 수 있다.

특히 스파이럴 스위트 솔루션은 효율적이고 유연하며 친숙한 사용자 경험을 제공하는 최신 기술을 바탕으로 개발되었다. 스파이럴 플랜(Spiral Plan)과 스파이럴 네트워크



(Spiral Network) 모듈이 크고 작은 정유 공정 전체의 플래닝과 제품 유통 작업 전반을 지원한다. 또한, 단일 사용자 인터페이스와 데이터 소스, 버전 관리 및 데이터 관리 제어를 기반으로, 정유 산업 전반의 모든 활동을 하나의 애플리케이션으로 관리할 수 있게 해준다. 아울러, 사용자 간 정보 공유를 용이하게 해 영업 담당자, 설계 담당자, 공정 분석가 등 여러 부서 사이의 이해와 협업을 향상시켜 주는 것이 장점이다.

슈나이더 일렉트릭은 스파이럴 스위트 전문 개발 및 지원팀을 통해 BP와 협업, BP의 글로벌 정유 산업 포트폴리오 전반에 걸쳐 소프트웨어를 원활하게 사용할 수 있도록 지원할 계획이다. BP는 이번 공급 계약을 통해 자사 원유 사업의 재무 성과를 향상시킬 수 있을 것으로 기대하고 있다.

슈나이더 일렉트릭 라비 고피나스(Ravi Gopinath) 소프트웨어 사업부 수석 부사장은 "슈나이더 일렉트릭은 BP와 원유 정보 관리에 있어 오랜 기간동안 협업해왔고, 이번 공급 계약은 두 회사의 지속적이고 오랜 신뢰 관계를 바탕으로 가능했다"며 "스파이럴 스위트는 정유 정보 관리, 플래닝, 스케줄링, 엔벨로프 최적화 등을 하나의 애플리케이션으로 관리하도록 돕는다. 또한 계획과 실제 결과 간의 오차를 줄이고, 여러 사업부 간의 협업을 통해 고객들의 현명한 구매 결정을 도우며, 운영 상의 위험을 줄이는데 기여하게 될 것"이라고 밝혔다.

# 친 환경 PCB 모듈 & 정밀 금속 부품 수 세정기

Aqueous ZESTRON

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alpha GLOBAL

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경기도 광명시 하안로 60 (A-1404, 광명테크노파크) (우 14322)
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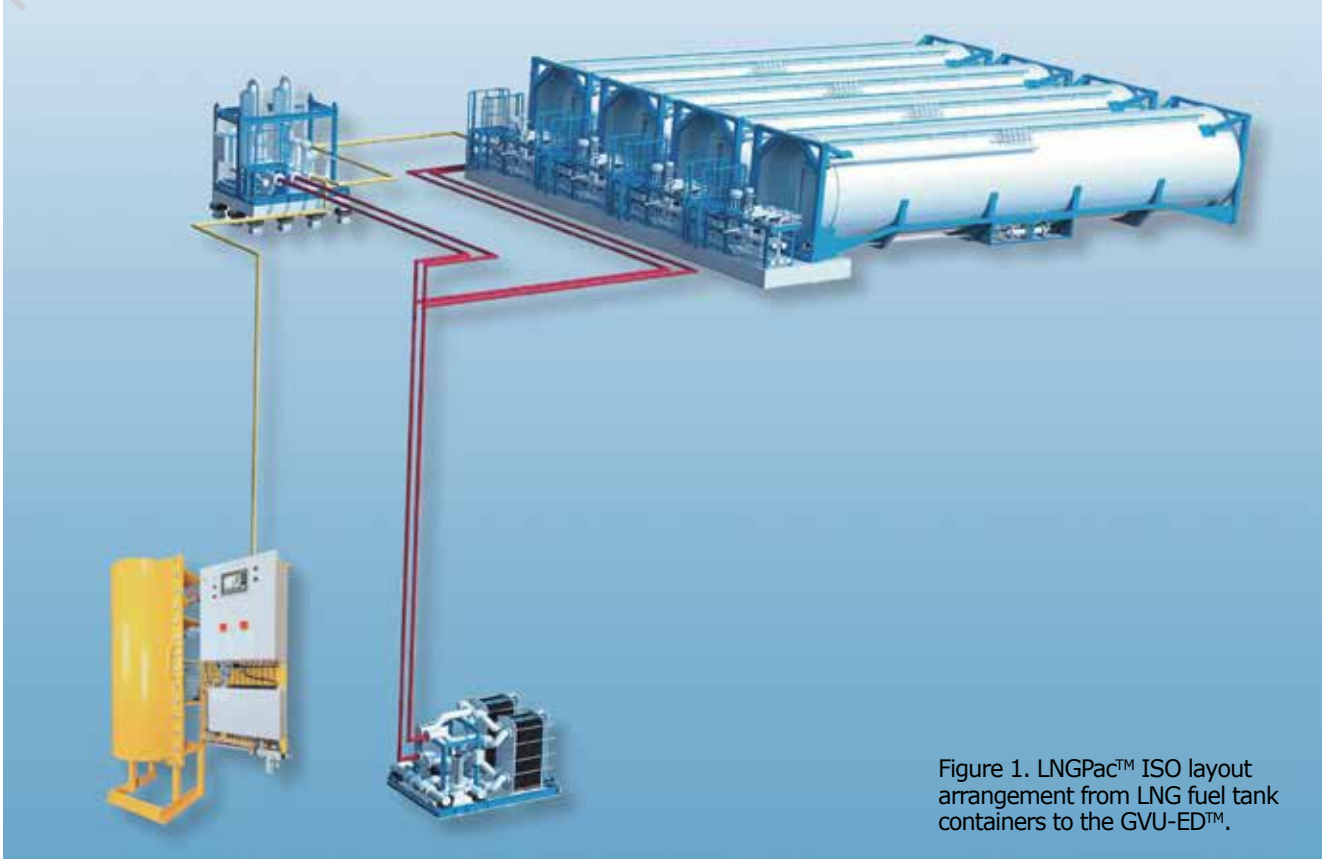

Figure 1. LNGPac™ ISO layout arrangement from LNG fuel tank containers to the GVU-ED™.

# Increasing flexibility in LNG fuel handling – the LNGPac™ ISO

**The option of having LNG as fuel for a variety of different ship types is already available. Emission reduction requirements and cost competitive gas prices are the main driving forces behind this increasing trend towards LNG. The LNGPac™ ISO, a fuel gas handling system based on removable LNG fuel tank containers, is a new way of making LNG fuel available when a stationary tank solution is not possible.**

*Wärtsilä Corporation*

*by Jonatan Byggmästar, Development engineer, Fuel Gas Handling, Ship Power*

*Sören Karlsson, General Manager, Fuel Gas Handling, Ship Power*

Wärtsilä's fuel gas handling system, LNGPac™, has aroused huge interest, and many customers have already selected the LNGPac™ system for their new-buildings or gas conversions. However, while conventional fuel gas handling systems with stationary tanks (LNGPac™) are, and will remain, the most popular choice, they might not be best suited for all ships.

A fuel gas handling system utilizing removable LNG fuel tank containers

is an option worth considering in many different cases. For small and medium sized vessels, which do not require a large LNG capacity, such a solution offers a viable alternative to conventional stationary LNG tanks.

If LNG bunkering facilities are not available or bunkering is not possible, using LNG as fuel can still be realised by using LNG fuel tank containers. These containers can be transported by road to the nearest LNG terminal for refilling, and then loaded onboard the ship with no bunkering procedures required at the port.

The LNG container can also be used as a cost effective and standardized LNG fuel tank for stationary applications. The frame standard size dimensions and the modularised skid-based fuel gas handling system make installation fast and cost competitive.

## LNGPac™ ISO

The LNGPac™ ISO is a fuel gas handling system based on mobile LNG fuel tank containers. Besides the LNG fuel tank container, the system consists of a docking station and an evaporator skid installed permanently on the ship. The LNGPac™ ISO is intended to be installed on an open and naturally ventilated deck.

Tank containers intended for the transportation of cryogenic liquids, e.g. LNG, are an alternative for use as fuel storage tanks onboard LNG fuelled ships. However, a normal tank container intended for transporting LNG cannot be used since it does not fulfil all the requirements for marine LNG fuel tanks. Modifications relating to remote monitoring and safety systems, IMO type C tank requirements, and leakage & spill protection are a few items that need to be specifically considered for marine fuel tanks.

## LNG fuel tank containers

Removable and transportable LNG fuel tank containers are used as fuel tanks in the LNGPac™ ISO fuel gas handling system. The containers, which are designed to fulfil all marine LNG tank requirements, are of standard ISO frame dimensions (20 ft, 40 ft and 45 ft) and can be transported by road, rail and sea, although the maximum gross weight may vary in different countries for land transportation.

The fuel tank is an IMO type C pressure vessel enclosed within an outer tank. Both the inner and the outer tanks are made of stainless steel, which means that the outer enclosure will act as a secondary containment. The LNG fuel tank container is fitted with process equipment, namely the valves and instruments required for operational and safety purposes.

The LNG fuel tank container is also fitted with a pressure build-up evaporator (PBE) for building up and maintaining an operational pressure of approximately 5 bar in the tank. The pressurized tank is used instead of

| | Wärtsilä LNG fuel tank container | Standard ISO tank container |
|---|---|---|
| Standard ISO frame | ✔ | ✔ |
| Compliance with transportation regulations (IMDG, TPED, ADR, RID, CSC among others) | ✔ | ✔ |
| Compliance with rules for use as LNG fuel tank on board ships: | ✔ | — |
| IMO Type-C tank | ✔ | — |
| Water spraying system | ✔ | — |
| Tank safety relief valves designed for fire case | ✔ | — |
| Connection to external vent mast | ✔ | — |
| LNG leakage detection and protection | ✔ | — |
| Class approved equipment & design | ✔ | — |
| Stainless steel outer shell | ✔ | — |
| Dry disconnect quick couplings | ✔ | — |
| Connections at end for connecting to ship | ✔ | — |
| Connection to automation system on the ship | ✔ | — |
| Connection to safety systems on the ship | ✔ | — |

Table 1. A standard ISO tank container used for transport of cryogenig fluids does not fulfil the requirement of a LNG fuel tank on a ship.

having rotating equipment, such as pumps and/or compressors to feed the gas to the engines. Having a PBE on the container makes the LNG fuel tank containers completely redundant. If, for some reason, a container is out of service another container can be easily taken into operation.
The connection points are located at the end of the LNG fuel tank container for easy and smooth hook-up of the LNG fuel tank container to the onboard fuel gas handling system. These connections consist of the LNG discharge, the vent mast connection, heating media connections, and a connection to the water spraying system built onto the LNG fuel tank container. For fuel tanks located above deck, a water spray system is required to cool the LNG tank in case of fire.

## Fastening and securing

The LNG fuel tank containers have to be rigidly fastened and secured to the deck. The fastening and securing system has to be designed for the maximum dynamic and static inclinations, as well as the maximum accelerations, of the vessel. A number of feasible solutions exist.
On RoRo and RoPax vessels it is possible to use terminal tractors with trailers for loading and unloading the LNG fuel tank containers. The containers are located on cassettes and secured by twistlocks. On board the ship the cassette is secured to the deck, for example with twistlocks and lashing as a secondary fastening arrangement.
Another possible fastening and securing option is to directly secure the LNG fuel tank container with twistlocks and lashing to the deck. This would be a suitable solution for container feeders and other vessels where the containers can be lifted on and off. It is also possible to utilize these containers as stationary LNG tanks, which are not removed frequently for filling. In this case, a bunkering station can be installed to allow the LNG fuel tank container to be bunkered directly on the vessel.

## Docking station

The docking station is the module whereby the LNG fuel tank containers are connected to the fuel gas handling system onboard the ship. The number of LNG fuel tank container slots in the docking station is defined according to the required LNG capacity for the specific vessel. The engine gas consumption, sea voyage length, and the interval between changing the containers defines the required number of LNG fuel tank containers.
All the necessary connections between the LNG fuel tank container and

Figure 2. Terminal tractor loading LNG fuel tank containers onboard a RoRo ship.

the fuel gas handling system are located in the docking station for easy and practical connecting operations. Flexible hoses fitted with quick couplings are used to attach the process connections. The quick couplings have a closing valve in both coupling units to prevent any leakage when connecting and disconnecting the hoses.
The instrument readings and control signals for the remote controlled valves on the LNG fuel tank container are connected to a junction box in the docking station. There is a data connection and a hard wired cable connection for increased safety.

## Preparation of the gas

The LNG is discharged from the fuel tank containers via the docking station to the evaporator skid. The evaporator skid is the module where the LNG is vaporized and heated to the conditions required by the engine (i.e. 0 – 60°C). The master gas fuel valve, which is the last safety related stop valve in the gas supply system outside the machinery spaces, is installed after the main gas evaporator on the evaporator skid.
The LNGPac™ ISO is controlled and monitored by a control and safety system. All modules, including the LNG fuel tank containers, are monitored and controlled by a single dedicated PLC-based automation system.

## Ship arrangement

The LNGPac™ ISO is intended to be located on an open deck where natural ventilation is ensured at all times. Drip trays must be installed under the skids, and also under the hose connections between the LNG fuel tank containers and the docking station. This is to prevent possible LNG leaks from damaging the deck beneath the skids.

## Design and feasibility study

A design and feasibility study has been conducted together with Germanischer Lloyd (GL) for the conversion of a RoRo vessel to gas using the LNGPac™ ISO as the fuel gas handling system. Four LNG fuel tank containers, the docking station, and the evaporator skid were located on the naturally ventilated aft deck. The LNG fuel tank containers were located on cassettes, and secured with twistlocks and lashing.
A second set of LNG fuel tank containers would be refilled in advance so as to be ready for switching with the empty LNG fuel tank containers when the ship is in port. In the area where the fuel gas handling system was located, potential existing ventilation inlets and outlets, as well as the electrical equipment, would have to be modified due to the hazardous zones around the fuel gas handling system.
For protection of the surrounding ship structures, and for weather protec-

| LNG fuel tank container | | 20 ft | 40 ft |
|---|---|---|---|
| **Frame dimensions (external)** | | | |
| Length | m | 6058 | 12,192 |
| Width | m | 2438 | 2438 |
| Height | m | 2591 | 2591 |
| **Tank** | | | |
| Geometrical volume (approx, room temp.) | $m^3$ | 20 | 40 |
| LNG volume (80 % effective volume) | $m^3$ | 16 | 32 |
| Other sizes on request. | | | |

Table 2. Typical characteristics of LNG fuel tank containers of different sizes.

tion of the equipment, the docking station and evaporator skid would be located on drip trays in naturally ventilated shelters. Escape routes were planned from all areas, especially from the docking station where the flexible hose connections to the LNG fuel tank containers were located.

As part of the study, a comprehensive risk analysis was performed of the fuel gas handling system. A risk analysis is required for a gas fuelled ship where operational risks and risks associated with physical arrangements are indentified and eliminated or mitigated. The major hazard for a fuel gas handling system on a ship is LNG leakage, and the subsequent damage to the vessel.

Where LNG leakages can occur, two important things have to be incorporated into the design. Firstly, no damage that can harm the integrity of the ship can be allowed to happen. Secondly, there has to be a way to detect and identify the leakage in order to stop and limit the leakage and the consequences. Potential leakage sources were identified for the LNGPac™ ISO modules and corrective actions were taken.

## Conclusions

Wärtsilä is today recognized as a leader in propulsion solutions for gas fuelled vessels. The company's strong and early commitment to this goal has created in depth knowledge of the use of natural gas and LNG. The Wärtsilä LNGPac™ ISO is an addition to Wärtsilä's portfolio of solutions for the LNG fuelled ship market. It represents further proof of Wärtsilä's expertise and knowledge of LNG applications, as well as its dedication to make LNG available for all ship operators and owners.

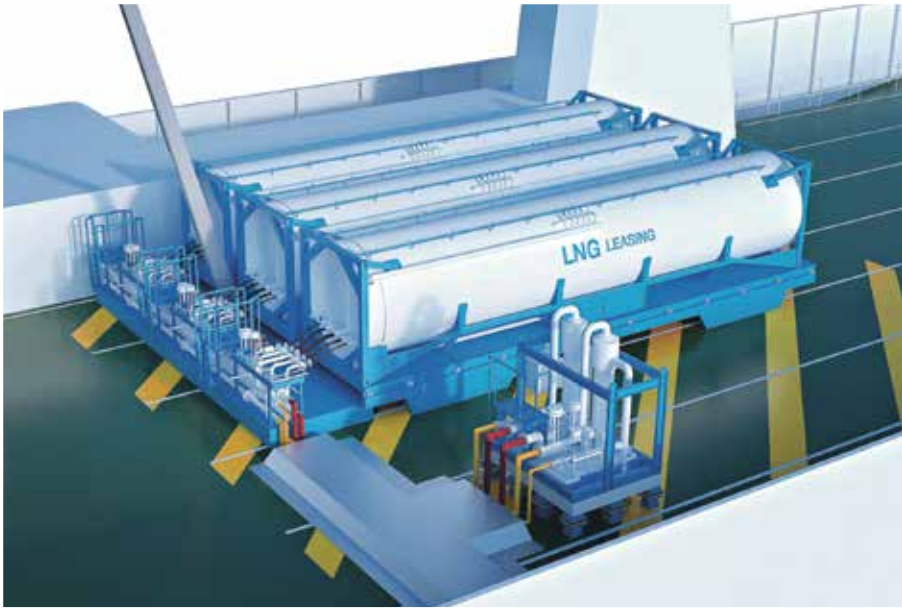


Figure 3. LNG fuel containers loaded and connected to the onboard fuel gas handling system.

Figure 4. Environmentally friendly RoRo vessel sailing on gas.

# 6TH MARITIME SECURITY MANAGEMENT

**11th & 12th May 2016, Singapore**

## Global Maritime Security Advancements & Ship Operator Risk Management Strategies

### Key Topics:

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**For registration & more information please contact:**
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# HKC

## ELECTRIC ACTUATOR QUARTER TURN

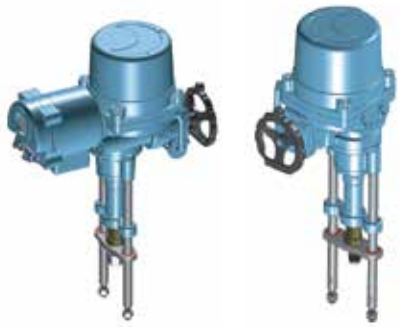
**HQ Series**

Output Torque
: 40 to 3,000 N-m

## ELECTRIC ACTUATOR LINEAR

**HL Series**

Output Force
: 5 to 25 kN



## ELECTRIC ACTUATOR MULTI TURN

**HM Series**

Output Torque
: 14 to 3,000 N-m
When combined with
gear up to 500,000 N-m

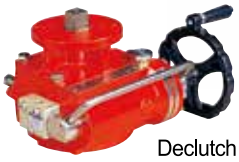
## LIMIT SWITCH BOX

**APL Series**

## PNEUMATIC ACTUATOR HEAVY DUTY

**ET Series**

Output Torque
495 to 750,000 N-m



Declutch Gear

## PNEUMATIC ACTUATOR
## RACK & PINION, SCOTCH YOKE

**HP Series**

Output Torque
: 4 to 4,373 N-m

## BUTTERFLY VALVES

**BF Series**

## CONTROL VALVES

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# HHI secured orders for 2 oil tankers

Hyundai Heavy Industries (HHI) won its first order this year. HHI announced on February 11 that it secured an order from Turkey-based Ditas Shipping for 2 units of 158,000 DWT oil tankers. The price per ship remains undisclosed. The industry estimates that these vessels would be priced at USD 120 million to 140 million apiece. Those vessels were ordered to carry crude oil produced in Iran and are scheduled for delivery to Ditas Shipping, the ship owner, in 2018.

Those 2 oil tankers, ordered to HHI by Ditas Shipping, are required to meet Tier III standard of IMO (International Maritime Organization) which comes into force this year. Tier III requires installation of pollution abatement system to mitigate emissions of environmental pollutants such as nitrogen oxides (NOx), etc.

Korea's three shipbuilding heavyweights did not win any order in January in the aftermath of global economic recession. It marks the first time that domestic three shipbuilding heavyweights did not add any vessel to their orderbooks in a month after September, 2009.

Meanwhile, HHI discontinued operation of its offshore plant II (Onsan plant) located in Ulju county, Ulsan City as the order for offshore plant dried up. Last year, HHI won orders worth USD 14.538 billion. That represents a decrease by 26% from 2014. HHI scaled back its annual new order target by 13% to USD 16.7 billion for 2016.

## 현대중공업, 유조선 2척 수주

현대중공업이 올해 들어 첫 수주에 성공했다. 현대중공업은 터키 선사인 디타스시핑으로부터 15만8000DWT급 유조선 2척을 수주했다고 지난 2월 11일 밝혔다. 척당 가격은 공개되지 않았지만, 업계에서는 1억2,000만~1억4,000만 달러 수준인 것으로 보고 있다. 이란에서 생산된 원유를 운반하기 위해 발주된 이들 선박은 2018년에 디타스시핑 측에 인도될 예정이다.

수주 금액은 공개되지 않았지만 업계에서는 1억2,000만~1억4,000만 달러(약 1,443억~1,684억원) 수준인 것으로 보고 있다. 현대중공업은 2018년에 이들 유조선을 디타스시핑 측에 인도할 계획인 것으로 알려졌다.

현대중공업이 디타스시핑으로부터 수주한 유조선 2척은 올해부터 적용되는 국제해사기구(IMO)의 새로운 규제인 '티어3(Tier3)'를 적용 받는다. '티어3' 선박은 질소산화물(NOx) 등 환경오염물질 배출을 줄이기 위해 오염물질 저감장치 탑재해야 한다.

한국 대형 조선3사는 글로벌 경기 침체의 영향으로 올해 1월 단 1건의 수주도 따내지 못했다. 대형 조선 3사가 한 달 동안 수주를 하지 못한 것은 2009년 9월 이후 처음이다.

한편 현대중공업은 해양 플랜트 발주가 끊기면서 울산시 울주군에 있는 해양 2공장(온산공장) 가동을 중단하기도 했다. 현대중공업은 작년 145억3800만 달러를 수주했다. 2014년 대비 26% 감소한 규모다. 현대중공업은 올해 수주 목표를 작년보다 13% 낮춘 167억 달러로 잡았다.

# MacGregor signs contracts to deliver Pusnes loading systems to Cosco Shipyard Group in China

By combining well-proven MacGregor Pusnes technology in bow loading and offloading systems, MacGregor, part of Cargotec, has helped to develop a solution that enables crude oil to be loaded directly from a floating production storage offloading (FPSO) facility or a floating storage offloading (FSO) unit to a conventional tanker, up to very large crude carrier (VLCC) size. The first contracts for the systems have been signed with China's Cosco Shipyard Group.

"MacGregor, and its Pusnes brand, has a long history of developing pioneering offshore loading systems within the industry," said Høye Høyesen, Vice

President, MacGregor Advanced Offshore Solutions. “Based on this legacy, MacGregor was invited by Cefront Technology, who developed the concept, to participate in the design and development of the loading systems.”

The Cosco Shipyard Group orders will see MacGregor design, manufacture, deliver and commission complete Pusnes loading systems for two cargo transfer (CTV) vessels. The vessels will be built at Cosco Nantong Shipyard and at Cosco Guangdong Shipyard. MacGregor deliveries are planned to start at the end of 2016.

Each vessel will feature MacGregor’s well-known Pusnes bow loading and offloading system, which principally comprises: two Pusnes bow loading systems, one Pusnes offloading system, including the world’s largest crude oil hose reel with offloading hose; and two sets of Pusnes-patented releasable 700-tonne hawser winches, in addition to auxiliary winches and an integrated electro/hydraulic control system.

“MacGregor is proud of its long and close relationship with Cosco shipyards in China,” he added. “The Cosco Shipyard Group is an important partner for the future and has proved to be a strong player in the merchant and offshore industries.”

MacGregor has previously delivered four sets of Pusnes bow loading systems to Cosco Nantong Shipyard and two sets to Cosco Zhoushan Shipyard, of which, one project is still ongoing. In addition to these MacGregor has delivered a range of deck machinery and steering gear to different Cosco shipyards.

# Revelin revels in dirty water with Thordon’s Compac solution keeping it clean

China’s Qingshan Shipyard has delivered AP Revelin, the second in a series of two environmentally sustainable handy-size bulk carriers, to Croatia-based shipping company Atlantska Plovidba d.d. from Dubrovnik. The 38,700 DWT ‘ecoship’ will join first of class AP Dubrava, which was delivered in July 2015.

Each 180m (591 ft) long tramp trader, built to the Green Dolphin 38 design unveiled by Shanghai Merchant Ship Design & Research Institute (SDARI) in 2012, features Thordon Bearings’ seawater-lubricated COMPAC propeller shaft bearing system and a Thordon Water Quality Package (WQP). This will provide a clean and consistent supply of seawater to the bearings even when the vessel is docked downstream of the current in shallow waters.

“These energy-efficient vessels are ocean-going but will also operate in river entrances where the seawater is highly abrasive,” said Thordon Bearings’ Business Development Manager Scott Groves. “But running Thordon’s WQP 24/7 means the propeller shaft bearings can be lubricated even when the sea chest is drawing in filthy river water.”

Explaining the reason for specifying a water-lubricated bearing system, Atlantska Plovidba’s Vice-President, Ship Management, Marin Matana, said “Our vessels trade globally, including the USA. With the Vessel General Permit in effect, we felt that the seawater-lubricated system was the perfect solution. It meets the U.S. VGP requirements and is the right choice for the environment.”

AP Dubrava, the first vessel in the series of Green Dophin 38s for Atlantska Plovidba, was delivered in July 2015.

In addition to the award-winning COMPAC bearing system and WQP, CY Engineering also supplied bronze shaft liners and a Thor-Coat corrosion protection system to both vessels.

The Green Dolphin bulk carrier concept was introduced during the Posidonia Exhibition in 2012 following a joint research project between SDARI, Det Norske Veritas (DNV) and Wärtsilä. It features a hull form and machinery configuration designed to optimise fuel consumption and reduce emissions.

# Keystone Engineering's Innovative Design Delivers the First Commercial Offshore Wind Farm in U.S.

Keystone Engineering provided an innovative jacket-type support structure design for five, 6-megawatt wind turbine generators on America's first offshore wind farm. Supplying power to Rhode Island's Block Island and the rest of New England via subsea cable, the 30-megawatt Block Island Wind Farm was chosen to kick start offshore wind farms. This location was chosen because the cost of electricity in this region is four to five times higher than in other parts of the U.S. The design was selected because it significantly reduces the cost of steel required for the wind farm, can be installed in great water depths, and can operate in a larger weather window.

For this USD 290 million project, Keystone Engineering leveraged SACS to design the composite construction and complex nodal geometry using traditional jacket foundations, leading to installed-cost savings of 20 percent and making the project economically feasible. SACS enabled the team to parallel-process multiple simulations and perform multiple design iterations in the time it would normally take to do a single iteration. This shortened the design cycle by 50 percent as compared to typical European offshore wind projects.

Addressing offshore-specific design challenges posed by extreme loading situations, such as turbine control faults and hurricanes, as well as the fatigue performance over the operating lifetime of a wind turbine structure, was crucial to project success. Keystone used the integrated SACS analysis environment to perform fully coupled hydrodynamic/aerodynamic analyses, and produced an innovative, proven concept design in a significantly shorter time that is verified against a 1000-year weather event (in other words, it is hurricane proof).

Benjamin Foley, P.E., general manager-offshore renewables, Keystone Engineering Inc., said, "The effort put in by the Bentley SACS team to couple its post-processing capabilities with the hydrodynamic/aerodynamic modeling capabilities of other software systems has allowed for the first truly useful coupled analysis in the offshore wind industry. This has resulted in significant time and cost savings for the offshore wind foundation/sub-structure engineering community."

## Keystone Engineering의 혁신적 설계로 미국 최초의 상업용 해양 풍력 발전 단지를 세우다

Keystone Engineering에서는 미국 최초의 해양 풍력 발전 단지에 있는 5기의 6메가와트 풍력 터빈 발전기를 위해 혁신적인 재킷형 지지 구조물을 제공했다. 로드 아일랜드의 블록섬 및 해저 케이블을 통해 뉴 잉글랜드의 나머지 지역에 전력을 공급하는 30메가와트의 블록섬 풍력 발전 단지가 해양 풍력 단지의 출발지로 선택되었다.

이 위치가 선택된 것은 이 지역의 전기 비용이 미국의 다른 지역보다 4–5배 정도 높기 때문이다. 이 설계가 선택된 이유는 풍력 발전 단지에 필요한 공사비용을 크게 줄일 수 있고 깊은 수심에 설치할 수 있으며 날씨의 영향을 덜 받으며 운영할 수 있기 때문이다.

2억9,000만 달러 규모의 이 프로젝트를 위해 Keystone Engineering에서는 SACS를 활용하여 전통적인 재킷 기반의 복합 구조 및 노드 형상을 설계함으로써 설치 비용을 20% 절약하고 프로젝트를 실현 가능하게 만들었다. 팀은 SACS를 사용하여 여러 시뮬레이션을 병행 처리하고 일반적으로 1회 반복에 소요되는 시간 안에 수 차례 설계 반복을 수행할 수 있었다. 설계 주기는 일반적인 유럽의 해양 풍력 프로젝트에 비해 50% 정도 단축된다.

터빈 제어 결함 및 허리케인으로 인한 극심한 하중 상황뿐만 아니라 풍력 터빈 구조물의 운영 수명 동안의 피로 성능 등 해양 분야 고유의 설계 과제를 해결하는 것이 프로젝트 성공을 위해 가장 중요했다. Keystone에서는 통합 SACS 분석 환경을 사용하여 완전히 결합된 수력학/공기역학 분석을 수행했고, 단기간에 1000년의 기후사례를 통해 허리케인에 견딜 수 있는 검증되고 혁신적인 개념 설계를 생성했다.

Keystone Engineering의 해양 재생 에너지 책임자인 벤자민 폴리(Benjamin Foley), P.E.는 "Bentley SACS 팀이 후처리 기능과 다른 소프트웨어 시스템의 수력학/공기역학 모델링 기능을 결합하려고 노력한 결과 해양 풍력 발전 산업 최초로 유용한 결합 분석이 가능해졌다. 결과적으로 해양 풍력 기초/하부 구조 엔지니어링들은 상당한 시간 및 비용 절감 효과를 얻을 수 있었다"라고 말했다.

# Statoil chooses Nexans to supply cables for the world's first floating wind farm

Statoil has awarded Nexans the contract to supply static and dynamic cabling and associated accessories for the world's first floating wind farm, following a successful demo facilitated by Nexans' cables which has been in operation since 2009. Following the initial Norway demo, Statoil has awarded Nexans a new contract worth approximately 10.2 million Euro to service the Hywind Scotland Pilot Park wind farm. Nexans will deliver cables to the site, located 30 km off the coast of Aberdeenshire.

Statoil chooses Nexans to supply cables for the world's first floating wind farm. The offshore cable systems will be tested, sealed off, prepared for pull-in and delivered in individual lengths ready for installation. The cables will be tested and manufactured at Nexans' specialized facility in Halden, Norway, before completing delivery by the end of 2017.

The pilot 30 MW floating farm will be made up of five wind turbine generators connected through an inter-array cable network before feeding into a single export cable carrying energy back to land in Peterhead, Scotland. Following the successful Norway demo, the project, assisted by Nexans, will demonstrate technological improvements, installation and operation of multiple floating wind turbines, as well as examine the cost efficiency of the park configuration.

Dirk Steinbrink, Senior Executive Vice President High Voltage & Underwater Cable Business Group at Nexans said, "This project is a great example of Nexans pioneering alternative offshore wind design, extending the options for renewable energy generation. The contract establishes Nexans as leaders in offshore wind innovation by designing specialist cables for both the initial pilot project and the Hywind Pilot Park. We are proud to be able to support Statoil as it helps the Scottish government realize its commitment to 100% renewable energy by 2020."

The Hywind project will generate green energy to power roughly 20,000 homes, and will lead the way to developing larger floating wind farms in other areas after an initial two-year testing period.

## 스타토일, 세계 최초 부유식 풍력발전단지 케이블 공급업체로 넥상스 선정

스타토일은 2009년부터 넥상스 케이블을 설치해 운영해왔던 시험가동을 성공적으로 마치고, 넥상스와 세계 최초로 부유식 풍력 발전 단지 프로젝트에 설치될 정적(static) 및 동적(dynamic) 케이블링 및 액세서리를 공급계약을 체결했다. 노르웨이에서의 성공적인 시험가동에 이어, 스타토일은 하이윈드 스코틀랜드 파일럿 파

크 풍력발전 프로젝트 관련하여 넥상스와 서비스 공급 계약을 체결 했고 계약 금액은 약 1,020만 유로이다. 넥상스는 에버딘셔 해안에서 30km 떨어진 현장에 케이블을 공급한다.

해양 케이블 시스템은 테스트를 거쳐 밀봉해 인입 준비가 완료된 후 설치에 적합한 길이로 개별 절단되어 납품된다. 이 케이블은 2017년 말 납품 완료를 목표로 노르웨이 할덴 공장에서 제조 및 테스트 한다.

시범용 30MW 부유식 풍력단지는 스코틀랜드 피터핸드 지역으로 에너지를 전송하는 단심 엑스포트 케이블에 보내기 전에 인터-어레이 케이블 네트워크를 통해 연결되는 5개의 풍력 터빈 발전기로 구성된다. 성공적인 노르웨이 시험가동에 이어, 넥상스가 지원하는 이번 프로젝트는 향상된 기술, 다중 부유식 풍력 터빈의 설치 및 가동과 파크 환경설정의 비용 효율성을 증명해 보일 것이다.

넥상스 그룹 초고압&해저케이블 사업부 총괄부사장 더크 스테인브링크(Dirk Steinbrink)는 "이 프로젝트는 넥상스가 해양 풍력 설계의 대안을 선도하며, 재생에너지 발전의 선택범위를 확장하는데 기여하는 좋은 사례다. 이번 계약으로 넥상스는 초기 데모 프로젝트와 하이윈드 파일럿 파크 시범 프로젝트에서 특수 케이블 설계를 통해 해양 풍력 혁신의 선두 위치를 확고히 하게 되었다. 또한 넥상스는 2020년까지 100% 재생에너지로의 전환 실현을 목표로 하는 스코틀랜드 정부를 돕는 작업을 스타토일과 함께 하게 되어 영광"이라고 말했다.

하이윈드 프로젝트는 약 2,000가구에 전력을 공급할 수 있는 친환경에너지를 생산하며, 향후 다른 지역에서도 초기 2년의 시험 가동기간을 거친 후 초대형 부유식 풍력발전단지를 개발하는데 기여하게 될 것이다.

# Rolls-Royce to deliver mooring system for giant crane vessel

Rolls-Royce has signed a £ 8 million contract to supply the mooring system for the world's largest semi-submersible crane vessel (SSCV), Sleipnir. The vessel will be built in Singapore by SembCorp Marine for the Dutch company Heerema Offshore Services.

Asbjørn Skaro, Rolls-Royce, Executive Vice President – Deck Machinery, said "Mooring a giant crane is a challenge we are happy to tackle, and it's a great pleasure working with SembCorp Marine on this unique project. The system to be delivered by Rolls-Royce builds on decades of experience with advanced deck machinery for both vessels and floating units."

Mooring systems from Rolls-Royce are designed to operate safely in the harshest climatic zones. For this vessel – the "Sleipnir" – Rolls-Royce will deliver a tailor made equipment package for specific operations, comprising a 12 point mooring system including electric driven winches, fairleads, wire sheaves and also a control system.

When completed the vessel will be 220 metres in length, have a width of 102 metres and a displacement of 273,700 tonnes at maximum operational draft. It will be equipped with two cranes of 10,000 tonnes lifting capacity each, providing the heavy lifting capacity to install and remove offshore facilities and install subsea structures, foundations, moorings, and floating structures in deep water. The Sleipnir will be self-propelled with a transit speed of 10 knots, and will operate on dual-fuel.

The vessel is scheduled to be delivered from the yard in the second half of 2018.

# Greenland cements Thordon's environmentally safe future

Extensive sea trials aboard Greenland, the world's first LNG-fuelled short-sea dry bulk vessel, have validated the performance of Thordon Bearings COMPAC propeller shaft solution, indicating that seawater-lubricated bearing systems are applicable to all ship types and are definitely here to stay.

Tommy Holmgren, Sales Director with the Duwel Group, Thordon Bearings' distributor in Sweden, said "Erik Thun has truly raised the standard in sustainable shipping with this vessel, pushing the boundaries of environmental possibilities to a completely new level. Greenland is a fantastic reference point not only for COMPAC in the merchant ship market, but also for the development of LNG as a ship's fuel."

Greenland, a 5800 dwt self-loading/unloading cement carrier built under the EU-TEN-T funded Pilot LNG project for the JT Cement joint venture, is the first ever LNG-fuelled dry cargo vessel in which a pressurised liquid natural gas tank is incorporated into the vessel's hull. It is also the first LNG-fuelled vessel to feature a seawater-lubricated propeller shaft bearing system.

Ola Persson, Technical Manager, Erik Thun Group, said "With environmental sustainability being the main consideration in the operation of all our vessels, equipment performance and reliability is imperative."

Thordon Bearings' Head of Marketing and Customer

JT Cement's LNG-fuelled cement carried Greenland undergoing sea trials

Service, Craig Carter, said "We are immensely proud to be associated with this ground-breaking vessel. Erik Thun and its joint venture partners have created what is probably Europe's most environmentally-friendly ship. LNG as a ship's fuel is by far the most environmental-friendly fuelling solution available today which, like the use of a seawater lubricated shaft bearings, exceeds current environmental criteria."

In addition to its COMPAC solution, Duwel supplied Thordon Bearings' grease-free ThorPlas-Blue range of polymer bearings for the vessel's deck winches and self-unloading equipment.

Erik Thun Group has a long history with Thordon products, with COMPAC and ThorPlas bearings aboard the self-unloader Vestanhev, cement carriers Gotland and Bornholm, and the dry cargo ships Alice and Helge.

"It will be Greenland, though, that shows the industry that seawater-lubricated propeller shaft bearings are the future. They're here to stay," said Holmgren.

Built by Ferus Smit's Westerbroek shipyard to Lloyd's Register Ice-class 1A and suitable for year-round service in the Baltic Sea, Greenland completed sea trials, in December, prior to taking her first operational load in Rostock, Germany.

Second of class Ireland is due for delivery within the next three months, while options for two more vessels are under consideration.

# ME-GI Reference List Adds Largest Ethane Carriers Ever Constructed

The Eco Star 85K VLECs with its overall length of 231.60 m; maximum breadth of 36.60 m; maximum deadweight of 50,000 mt; and scantling draught of 12.30 m. (Source: Hartmann)

JHW has ordered 5 × 85,000 $m^3$ Very Large Ethane Carriers (VLECs) for a JACCAR/Hartmann Reederei joint venture, called UEC (United Ethane Carriers); each vessel will be powered by a single MAN B&W 6G60ME-GI main engine. Dalian Shipbuilding Industry Offshore Co. Ltd. (DSIC) will construct the vessels in China, while Hyundai Heavy Industries (HHI) will build the engines in Korea. Delivery of the first carrier is scheduled for the middle of 2017.

Captain Ulrich Adami, Fleet Manager of Hartmann Schiffahrts GmbH & Co. KG, said "The ME-GI engine appealed to us for several reasons, not least its environmental credentials with negligible slip of gas fuel, and its robust, stable combustion

properties – even in heavy seas. We also viewed its high fuel efficiency and its flexibility of being able to run on HFO or ethane as pluses when it came to selecting main engines for our newbuildings."
The engines will meet Tier III emission requirements with the aid of MAN Diesel & Turbo's EGR (Exhaust Gas Recirculation) technique. They will feature an injection pressure of 400 bar and form the main part of a propulsion system that also features a MAN Diesel & Turbo Alpha controllable pitch propeller.

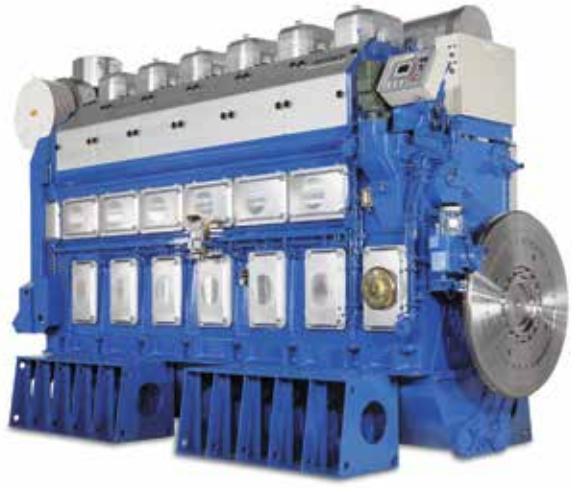
The ME-GI engines will drive VBS1810 propellers, which are the largest Mk 5 models (diameter 7.6 m) ordered from MAN Diesel & Turbo's propeller portfolio to date. To maximise efficiency, the propeller plant employs propeller blades of Kappel design, as well as a fairing cone/rudder bulb system. MAN Diesel & Turbo is also providing each vessel's shaft-alternator system.

# ABB's Azipod propulsion selected for a 100+ meter long luxury superyacht

ABB will deliver electrical propulsion and power systems to a new luxury superyacht. The 100+ meter LOA vessel, Zoza (working title), is scheduled for delivery in 2018 and will be built by Benetti shipyard in Livorno, Italy.

The owner of the ship selected ABB's Azipod propulsion at an early stage of the design process, after prioritizing energy efficiency and passenger comfort. The vessel will feature two Azipod C propulsion units which will bring maximum maneuverability whilst producing minimal noise and vibration.
"ABB was chosen because of its vast experience in the passenger vessel field and global service network. We have worked with ABB in earlier projects and have become convinced of the many benefits of Azipod propulsion and life-long support for our yacht", said Andrew North, the Owner´s Advisor.
The end result of the project is a high technology solution with six main engines and an electrical power plant, with the option to connect with a battery plant. Zoza will be one of the first yachts in the world with this solution.
"We are very proud that the owner and the yard chose ABB to deliver the electric power and propulsion systems for this yacht. We believe that Azipod C will fit perfectly for the concept of one the world´s innovative and energy efficient superyachts", said Juha Koskela, Managing Director for ABB's marine and ports business.
"We are very pleased to continue our decade long business relationship with ABB. Through the years they have provided excellent support and we are convinced this productive partnership will continue with this superyacht as well," said Vincenzo Poerio, CEO of Benetti.

# Wärtsilä fuel flexibility supporting Japan's 'gas age' shipping sector



A 6-cylinder in-line version of the Wärtsilä 50DF dual-fuel engine

A total of 16 new gas carrier ships being built in Japan for Japanese owners are to be powered by Wärtsilä dual-fuel engines capable of running on liquefied natural gas (LNG) or conventional diesel fuels. Wärtsilä's depth of experience and technological capabilities in gas fuelled propulsion solutions, were cited as being key factors in the award of these contracts. The contracts were all placed between the second half of 2014 and December 2015.

The orders specify 20 nine-cylinder, 25 six-cylinder and 16 eight-cylinder Wärtsilä 50DF dual-fuel engines. This total of 61 engines that will be running primarily on LNG represents a notable expansion of Japan's gas fuelled merchant fleet. These will be the first Wärtsilä 50DF engines delivered for Japan's LNG carrier market. The first of the Wärtsilä machinery was delivered at the end of December 2015.

"We at Wärtsilä have always been at the forefront in making it possible, through our technologies, for LNG to become a viable marine fuel. This experience, our unmatched track record in gas propulsion applications, and our well proven dual-fuel solutions are why these contracts were awarded to Wärtsilä. We are honoured and pleased to be making this contribution to Japan's ongoing shift into shipping's gas age," said Lars Anderson, Vice President, Wärtsilä Marine Solutions.

The 16 vessels have a gas cargo capacity of between 155,000 and 180,000 cubic metres. They will be employed mainly in delivering shale gas from the USA to Japan.


## Waiting For Reader's Article

Korship wait for newest articles to introduce globalized shipbuilding industry to domestic or overseas market. To enhance shipbuilding & marine related industries competitiveness and development, please send technical article, new products article, application cases, company introduction and seminar, exhibition informations, etc by e-mail or fax. The valuable articles from readers will be checked compatibility by editor and will be printed monthly Korship on free of charge. Many readers interest and participate will be appreciated.

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# Korea Shipbuiling Orders awarded to domestic shipyards in 2015~2016

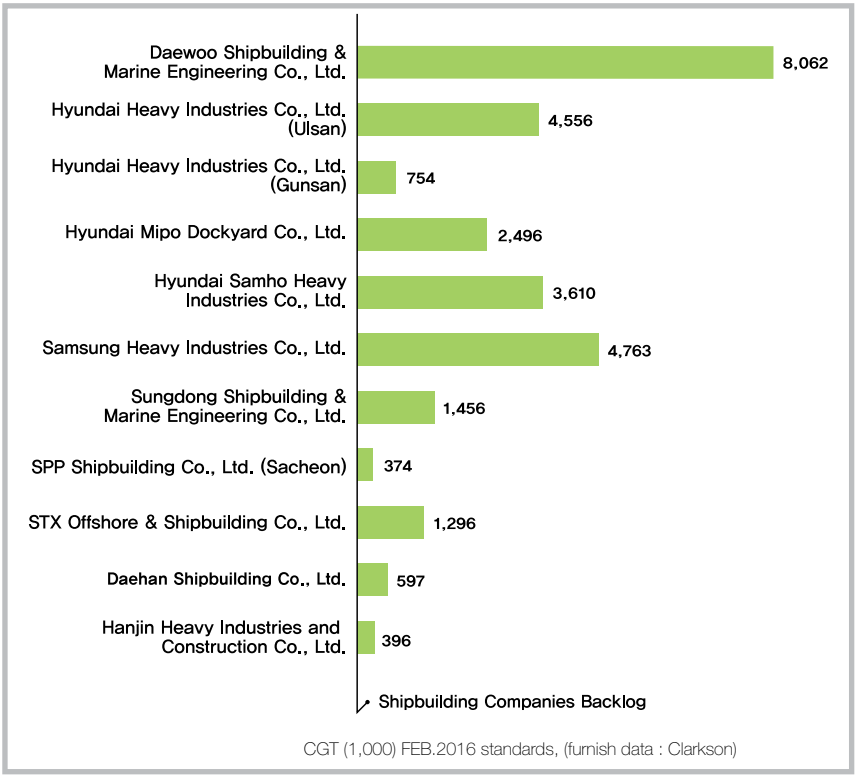
| Data | | Type | Number of vessel | Amount | Ship owner | Delivery | Shipyard |
|---|---|---|---|---|---|---|---|
| 2015 | Jan | 174,000m³ LNG carriers | 2 vessels | USD 400 million | Korea Line Corporation, Korea | The end of 2017 | Daewoo Shipbuilding & Marine Engineering |
| | | 174,000m³ LNG carriers | 2 vessels | USD 400 million | Hyundai LNG Shipping, Korea | The end of 2017 | Daewoo Shipbuilding & Marine Engineering |
| | | 19,200 TEU container ships | 3 vessels | USD 450 million | Scorpio Group, Monaco | - | Samsung Heavy Industries |
| | | LNG carriers | 2 vessels | USD 416 million | SK shipping, Korea | The end of 2017 | Samsung Heavy Industries |
| | | 319,000 DWT VLCCs | 2 vessels | USD 198 million | Maran Tankers Management, Greece | - | Daewoo Shipbuilding & Marine Engineering |
| | Feb | 158,000 tons oil tankers | 5 units (2 optional vessels) | USD 330 million | - | 2017s | Sungdong Shipbuilding & Marine Engineering |
| | | 174,000m³ LNG carriers | 1 vessel | USD 200 million | - | - | Daewoo Shipbuilding & Marine Engineering |
| | | 74,000 DWT oil products carriers | 2 units (1 optional vessels) | USD 46 million | Valles Steamship, Hong Kong | - | STX Offshore & Shipbuilding |
| | | 300,000 DWT VLCCs | 2 vessels | USD 192 million | Metrostar Management, Greece | The end of 2016 | Hyundai Heavy Industries |
| | | 1,800 TEU container ships | 4 units (2 optional vessels) | - | Cosmoship Management S.A, Greece | - | Dae Sun Shipbuilding & Engineering |
| | | 180,000m³ LNG carriers | 1 vessel | - | Mitsui O.S.K Lines, Japan | 2018s | Daewoo Shipbuilding & Marine Engineering |
| | Mar | 38,000m³ liquefied petroleum gas and ammonia carriers | 2 vessels | - | Asian ship owner | - | Hanjin Heavy Industries & Construction |
| | | 20,100TEU container ships | 4 vessels | USD 619.57 million | Mitsui O.S.K Lines, Japan | 2017. August | Samsung Heavy Industries |
| | | LR1 tankers | 2 vessels | KRW 320 billion | BW, Singapore | 2016 ~ 2017 | STX Offshore & Shipbuilding |
| | Apr | 319,000 DWT VLCCs | 2 vessels | USD 198 million | Maran Tankers Management, Greece | The end of 2016 | Daewoo Shipbuilding & Marine Engineering |
| | | 20,600 TEU container ships | 3 vessels | - | CMA CGM, France | The end of 2017 | Hanjin Heavy Industries & Construction (HHIC)-Phil's Subic Shipyard |
| | | 21,100 TEU container ships | 6 vessels | USD 950 million | OOCL, Hong Kong | The end of 2017 | Samsung Heavy Industries |
| | | 10,500 TEU container ships | 5 vessels | - | Hapag-Lloyd, Germany | - | Hyundai Samho Heavy Industries |
| | | Pure Car/Truck Carriers | 2 vessels | USD 130 million | Norwegian Car Carriers, Norway | The end of 2016 | Hyundai Samho Heavy Industries |
| | | 11,000 TEU container ships | 6 vessels | - | Asian and European ship owners | 2016 ~ 2017 | HHIC-Phil's Subic Shipyard |
| | May | 156,000 tons oil tankers | 2 vessels | - | Maran Tankers Management, Greece | - | Daewoo Shipbuilding & Marine Engineering |
| | | 5,200 ton training vessel | 1 vessel | - | - | - | Hanjin Heavy Industries & Construction |
| | | 74,000 tons LR1 tankers | 8 units (4 optional vessels) | USD 375 million | Marshall Islands-based ship owners | The end of 2016 | STX Offshore & Shipbuilding |
| | Jun | 300,000 DWT VLCCs | 10 units (5 optional vessels) | USD 1 billion | The National Shipping Company of Saudi Arabia | 2017s | Hyundai Samho Heavy Industries |
| | | 19,630 TEU container ships | 11 vessels | USD 1.1 billion | Maersk Line A/S, Denmark | 2018s | Daewoo Shipbuilding & Marine Engineering |
| | | Tankers | 2 vessels | - | Arcadia Shipmanagement, Greece | - | Hyundai Heavy Industries |
| | | 300,000 DWT VLCCs | 6 units (4 optional vessels) | USD 540 million | John Fredriksen | - | STX Offshore & Shipbuilding |
| | | 174,000 CBM LNG carriers | 3 units (1 optional vessels) | - | Teekay LNG Partners, Canada | First quarter of 2019 | Hyundai Samho Heavy Industries |
| | | 155,000 DWT tankers | 3 vessels | USD 330 million | - | 2018. February | Samsung Heavy Industries |
| | | 84,000m³ VLGCs | 4 vessels | USD 320 million | China Peace, China | - | Daewoo Shipbuilding & Marine Engineering |
| | Jul | 173,400m³ LNG Carriers | 1 vessel | USD 195 million | Chandris, Greece | The end of 2018 | Daewoo Shipbuilding & Marine Engineering |
| | | 14,000 TEU container ships | 9 vessels | USD 1.1 billion | Maersk Line A/S, Denmark | 2017 | Hyundai Heavy Industries |
| | Aug | Product Carriers | 4 vessels | USD 144 million | Scorpio Tankers, U.S.A | The first of 2017 | Hyundai Mipo Dockyard |
| | Sep | 84,000m³ LPG Carriers | 2 vessels | - | Asia ship owner | 2017s | Daewoo Shipbuilding & Marine Engineering |
| | | 74,000 tons LR1 tankers | 4 units (2 optional vessels) | - | Greece ship owner | The second half of 2017 | STX Offshore & Shipbuilding |
| | Oct | 173,400m³ LNG Carriers | 2 vessels | USD 400 million | BW Group, Singapore | The first half of 2019 | Daewoo Shipbuilding & Marine Engineering |
| | | 84,000m³ LPG carriers | 2 vessels | - | Asia ship owner | 2017s | Daewoo Shipbuilding & Marine Engineering |
| | Nov | 319,000 tons VLCCs | 2 vessels | - | Maran Tankers Management, Greece | 2017s | Daewoo Shipbuilding & Marine Engineering |
| | Dec | 114,000 tons products carriers | 2 vessels | - | Sea Tankers Group | 2017. September | Daehan Shipbuilding |
| 2016 | Feb | 158,000 DWT oil products carriers | 2 vessels | - | Ditas Shipping, Turkey | 2018s | Hyundai Heavy Industries |

*Note : Based on the press release and public announcements of each shipyards, internal estimation of Monthly KORSHIP (estimation until Feb 15, 2016)

Korean shipyards won new orders amounting to 10.15 million CGT (with 262 vessels) last year, taking the second spot worldwide for 4 consecutive years, according to the data published by Clarkson. Chinese shipyards took the first spot for 2 consecutive years, registering 10.25 million CGT (with 452 vessels) in new orders. Meanwhile, Japanese shipyards won new orders amounting to 9.14 million CGT, trailing close behind Korean shipyards.

Although Korean shipyards received new orders amounting to 10.04 million CGT from January to November last year, outstripping Chinese shipyards that registered 9.25 million CGT, new orders at Korean shipyards in December alone stood at only 110,000 CGT with 4 vessels.

In the meantime, Chinese shipyards clinched new orders amounting to 1 million CGT with 38 vessels in the same period, successfully overtaking Korean shipyards at the last moment in terms of annual new order intake. Chinese shipyards have maintained top spot globally for 4 consecutive years in terms of new order intake since 2012.




Japanese shipyards saw a decline in new orders last year compared to 2014 (9.63 million CGT), but expanded market share to 27.1%, an increase by 5.5%P from 2014 (21.6%). After all, new orders at the three Asian countries did not show significant difference as they carved out similar chunk of the market: 30.3% share was captured by Chinese shipyards while 30.0% share and 27.1% share were garnered by Korean shipyards and Japanese shipyards, respectively.

Strong performance of Japanese shipyards is driven by strong cost-competitiveness on the back of weak yen, shipping companies' placement of shipbuilding orders at domestic shipyards, aggressive target marketing to win orders for ultra-large containerships, etc.

Global order backlog stood at 192.9 million CGT as of the end of 2015, which represents a decrease by about 980,000 CGT recorded in last month. By country, China claimed top spot worldwide with 39.87 million CGT, followed by Korean shipyards with 30.52 million CGT and Japanese shipyard with 23.14 million CGT.

Here, we take a close look at the performance of major domestic shipyards, the world's leading players with strong growth in new orders as shown currently in the Clarkson data, such as Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME), Samsung Heavy Industries (SHI) and others based on the order backlog data.

Photo: Daewoo Shipbuilding & Marine Engineering Co., Ltd.

# Offshore plant orders awarded to domestic shipyards in 2011-2016

| Data | | Type | Number of vessel | Amount | Ship owner | Delivery | Shipyard |
|---|---|---|---|---|---|---|---|
| 2011 | Jul | Drillship | 2 vessels | USD 1.1225 billion | Maersk, Denmark | July 2014 | Samsung Heavy Industries |
| | Aug | LNG-FSRU | 1 vessel | USD 280 million | Excelerate Energy, U.S.A | First quarter of 2014 | Daewoo Shipbuilding & Marine Engineering |
| | Sep | 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 vessel | KRW 600 billion | Noble Drilling, U.S.A | Second half of 2014 | Hyundai Heavy Industries |
| | Oct | Fixed Offshore Platform | - | USD 1.4 billion | Chevron, U.S.A | Second half of 2014 | Daewoo Shipbuilding & Marine Engineering |
| | | Drillship | 1 unit | 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 | - | - | From 2013 to 2014 | STX OSV |
| | | Platform Supply Vessel | 4 units | KRW 2 trillion | Island Offshore, Norway | Consecutively from the 3rd quarter | of 2013 to the 1st quarter of 2014 |
| | Nov | Pipe Laying Support Vessel | 2 units | USD 500 million | Odebrecht, Brazil | August of 2014 | Daewoo Shipbuilding & Marine Engineering |
| | Dec | Offshore facilities (Gas platform and various facilities) | - | USD 900 million | Major multinational oil companies | 2nd half of 2014 | Hyundai Heavy Industries |
| 2012 | Jan | CPF (Central Processing Facility) | - | KRW 2.6 trillion | INPEX, Australia | 4th quarter of 2015 | Samsung Heavy Industries |
| | | Semi-submersible rig | 1 unit | USD 620 million | Odfjell, Norway | by mid 2014 | Daewoo Shipbuilding & Marine Engineering |
| | Feb | LNG-FSRU | - | - | Hoegh, Norway | - | Hyundai Heavy Industries |
| | Mar | Offshore Platform | 1 unit | USD 560 million | DONG E&P A/S, Danish | April 2015 | Daewoo Shipbuilding & Marine Engineering |
| | | FPSO | 1 unit | USD 2.0 billion | INPEX, Australia | April 2016 | Daewoo Shipbuilding & Marine Engineering |
| | Apr | Drillship | 1 vessel | USD 645 million | Ensco plc | Third quarter 2014 | Samsung Heavy Industries |
| | May | Semi-submersible Drilling Rig | 2 units | USD 1.1 billion | Songa Offshore, Norway | Mid 2015 | Daewoo Shipbuilding & Marine Engineering |
| | | Drillship | 1 vessel | USD 600 million | Seadrill, Norway | Second half of 2014 | Samsung Heavy Industries |
| | | Drillship | 1 vessel | USD 655 million | Diamond Offshore Drilling Limited., U.S.A | 4th quarter of 2014 | Hyundai Heavy Industries |
| | Jun | Semi-submersible drilling rig | 1 unit | USD 700 million | Fred Olsen Energy, Norway | March 2015 | Hyundai Heavy Industries |
| | | LNG-FPSO | 1 unit | - | Petroliam Nasional Berhad, Malaysia | June 2015 | Daewoo Shipbuilding & Marine Engineering |
| | Jul | Drillship | 1 vessel | USD 645 million | Ensco plc | - | Samsung Heavy Industries |
| | | Gas Compression Platform | 1 unit | USD 420 million | (Letter of Award) | Second half of 2015 | Hyundai Heavy Industries |
| | Aug | LNG-FSRU | 8 vessels | - | Excelerate, U.S.A | Between early 2015~2017 | Daewoo Shipbuilding & Marine Engineering |
| | Sep | Drillship | 1 vessel | USD 620 million | Rowan, U.S.A | First half of 2015 | Hyundai Heavy Industries |
| | | Drillship | 1 vessel | USD 623 million | - | - | Samsung Heavy Industries |
| | Oct | Drillship | 4 vessels | USD 2.06 billion | Transocean, U.S.A | One-by-one from mid 2015 | Daewoo Shipbuilding & Marine Engineering |
| | | Drillship | 1 vessel | USD 560 million | Atwood Oceanics, U.S.A | - | Daewoo Shipbuilding & Marine Engineering |
| | | LNG-FSRU | 1 vessel | USD 270 million | Hoegh LNG, Norway | First half of 2015 | Hyundai Heavy Industries |
| | Nov | Drillship | 1 vessel | USD 700 million | - | 2nd half of 2015 | STX Offshore & Shipbuilding |
| | Dec | offshore platform (Top side) | 1 unit | USD 1.77 billion | Statoil, Norway | The end of 2016 | Daewoo Shipbuilding & Marine Engineering |
| 2013 | Jan | Gas Production Platform (topside) | 1 unit | USD 1.1 billion | Statoil, Norway | Mar 2016 | Hyundai Heavy Industries |
| | | LNG-FSRU | 1 vessel | - | BW Maritime, Singapore | 2015 | Samsung Heavy Industries |
| | Mar | Floating Production Unit (FPU) | 1 unit | USD 1.3 billion | Total, France | First half of 2016 | Hyundai Heavy Industries |
| | | Tension Leg Platform (TLP) | 1 unit | USD 700 million | Total, France | First half of 2015 | Hyundai Heavy Industries |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Apr | FPSO | 1 unit | USD 1.9 billion | Chevron, U.S.A | - | Hyundai Heavy Industries |
| | May | Semi-Submersible Drilling Rig | 1 unit | USD 750 million | Diamond Offshore, U.S.A | Nov of 2015 | Hyundai Heavy Industries |
| | Jun | Ultra-deepwater Drillship | 1 unit | USD 515 million | Ensco, United Kingdom | Third quarter of 2015 | Samsung Heavy Industries |
| | | FPSO | 1 unit | USD 3.0 billion | Nigeria | Second half of 2017 | Samsung Heavy Industries |
| | | Jack-up Rig | 2 units | USD 1.3 billion | Statoil, Norway | - | Samsung Heavy Industries |
| | Jul | Ultra-deepwater Drillship | 2 units | USD 600 million | Seadrill, Norway | Second half of 2015 | Samsung Heavy Industries |
| | | Semi-Submersible Rig | 1 vessel | USD 718 million | Stena, Sweden | First half of 2016 | Samsung Heavy Industries |
| | | Ultra-deepwater Drillship | 1 unit | USD 570 million | Atwood Oceanics, U.S.A | The end of 2015 | Daewoo Shipbuilding & Marine Engineering |
| | Sep | Drillship | 1 unit | USD 550 million | - | Dec of 2015 | Samsung Heavy Industries |
| | | Ultra-deepwater Drillship | 1 unit | USD 600 million | Ocean Rig, Greece | Dec of 2015 | Samsung Heavy Industries |
| | | Jack-up Rig | 1 unit | USD 530 million | Maersk Drilling, Denmark | The middle of 2016 | Daewoo Shipbuilding & Marine Engineering |
| | Oct | Drillship | 2 vessels | USD 1.24 billion | - | Second half of 2015 | Daewoo Shipbuilding & Marine Engineering |
| | | Drillship | 1 vessel | USD 520 million | Transocean, U.S.A | The middle of 2016 | Daewoo Shipbuilding & Marine Engineering |
| | | LNG-FSRU | 1 unit | - | Gas Sayago (Joint venture) | Sep of 2016 | Daewoo Shipbuilding & Marine Engineering |
| | Dec | LNG-FSRU | 1 unit | - | BW Maritime, Singapore | Early 2016 | Samsung Heavy Industries |
| | | LNG-FSRU | 1 unit | - | Mitsui OSK Line, Japan | The middle of 2016 | Daewoo Shipbuilding & Marine Engineering |
| 2014 | Feb | LNG-FPSO | 1 unit | USD 1.45 billion | Petroliam Nasional Berhad, Malaysia | 2018 | Samsung Heavy Industries |
| | Apr | Drillship | 2 vessels | USD 1.29 billion | Oceania | First half of 2017 | Samsung Heavy Industries |
| | Jul | Central Processing Platform | 2 units | USD 700 million | Hess E&P Malaysia, Malaysia | The end of 2016 | Hyundai Heavy Industries |
| | | Fixed offshore platform | 4 units | USD 1.94 billion | ADMA-OPCO, UAE | The end of 2019 | Hyundai Heavy Industries |
| | Nov | Fixed Offshore Platform & Submarine Cable | 4 units | USD 1.9 billion | ADMA-OPCO | Second half of 2019 | Hyundai Heavy Industries |
| | | Offshore Platform | 1 unit | USD 700 Million | Royal Dutch Shell | _ | Samsung Heavy Industries |
| | | FPU | 1 unit | | _ | _ | |
| 2015 | Jun | Offshore Platform | 2 unit | USD 1.06 billion | Statoil, Norway | The end of 2018 | Samsung Heavy Industries |
| | Jul | FLNG | 3 unit | USD 4.7 billion | Royal Dutch-Shell | _ | Samsung Heavy Industries |

* Note : Based on the press release and public announcements of each shipyards, internal estimation of Monthly KORSHIP (estimation until Feb 15, 2016)

# The power of Korea as global shipbuilding leader

## - FLNG and FPSO opening up future of shipbuilding industry

Although offshore plant industry is confronted with crisis amid sustained low oil prices, the enthusiasm for offshore resource exploitation has not faded away completely. Offshore plant still remains a new growth engine for the next century in global shipbuilding and offshore industries.

Related industries are pessimistic over the outlook of offshore plant market this year. However, offshore plant projects of various scale, which have been pushed forward for several years around the globe, are not expected to be scrapped in one moment.

Korea's three shipbuilding heavyweights, such as Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME), and Samsung Heavy Industries (SHI), have seen their offshore plant business overshadowed for several years by persistent low oil prices.

Nonetheless, there would be silver lining peeking around the corner as some offshore plant projects are expected to be on track this year, including FLNG project in Mozambique, Bonga FPSO project in Nigeria, Ubon oil production platform project in Thailand, etc., raising the expectations for order-taking.

The world's largest cylindrical FPSO 'Goliat' by Hyundai Heavy Industries (HHI).

FPSO with a capacity of 2 million barrels, built by Samsung Heavy Industries (SHI).

'Agbami FPSO' ordered by Chevron and built by Daewoo Shipbuilding & Marine Engineering (DSME)

DSME successfully launched the FLNG out of the floating dock

This FPSO, ordered by French oil giant Total S.A. in December 2007, was christened 'Pazflor FPSO' after the name of the crude oil field in Angola where the facility will be finally installed.

The world's first newbuilding LNG-FSRU by Hyundai Heavy Industries.

FSRU built and delivered by DSME is supplying the natural gas from the sea off the coast of Brazil.

Noble Seillean FPSO in Brazil.

'USAN FPSO', built by HHI in November 2010.

The world's first and largest FLNG (Floating Liquefied Natural Gas) facility, being built by Samsung Heavy Industries (SHI).

New Product

# Long-awaited high grade pure epoxy tank coating

*Hempel*

Highly anticipated as a replacement to its world-renowned Hempadur 15400 tank coating, leading marine paints manufacturer Hempel announced the launch of Hempadur 15460.
This high-grade product has been specifically designed as a tank coating for chemical vessels and is based on amine adduct cured epoxy technology. This delivers outstanding resistance to continuous immersion in a range of chemicals, including crude oil up to temperatures of 80°C/176°F.
Hempadur 15460 delivers a range of benefits for shipowners including:

- *A two coat system, which reduces expensive application times*
- *Higher volume solids with reduced solvent emissions*
- *Low cargo absorption and retention meaning quicker cargo turnaround and greater flexibility*
- *Higher cross-linking density giving improved chemical resistance.*

Developed specifically with customer requirements in mind, Hempadur 15460 incorporates a high cross-link density technology, which creates an internal matrix giving added advanced chemical resistance and low cargo absorption and retention.
In addition, this new pure epoxy tank coating exhibits a high glass transition temperature (known asTg) that provides high temperature resistance, improved abrasion resistance, extended maximum recoating intervals and a hard, smooth and glossy surface for easy cleaning.
Hempadur 15460 uses no toxic products and can be used to coat all liquid cargo tanks. It is also suitable for grey and black water tanks, mud and brine tanks, refrigerated seawater fish tanks and other vessel tanks.

-TEL: +82-51-679-9300
-http://www.hempel.com

# Stay ahead with preventative maintenance by using Portamonitor™ Bearing Indicator

*Coltraco Ultrasonics Limited*

Coltraco Ultrasonics has introduced the Portamonitor® Bearing Indicator. This effective kit provides insight into planning of future repairs. It identifies sites which are contaminated or lacking lubrication so they can be easily fixed before any further damage occurs. Above and beyond that, the Portamonitor® identifies varying levels of damage to prevent excessive and extremely dangerous damage.

The miniature Portamonitor® has been designed to test bearings and rotating machinery on board ships and Naval vessels. Trials are being conducted with a leading Navy shortly. Portamonitor® aids in the identification of mechanically deteriorated bearings and bearings with inadequate/contaminated lubricant. It does this by detecting high frequency (ultrasonic) stress waves associated with friction and other faults with machinery in poor condition (impacts etc.). It can be used to monitor bearings in motors, pumps, fans, gearboxes and other rotating machinery applications. It has two outputs – a decibel (dB) reading and a Distress® level which are both measured and displayed simultaneously by the Portamonitor®.

It is extremely sensitive to detecting faults and is easy to use: measurements can be taken both for land-based applications as well as offshore on vessels and platforms. It is quick and reliable, allowing for problem bearings to be checked quickly if damage is suspected. The repeatable results allow the operator to compare logs of past measurements which can help identify even small changes in the functioning of the bearing. The non-destructive and non-intrusive technology will not affect the function of the bearing.

-TEL: +44-20-7629-8475
-http://www.coltraco.co.uk

New Product

# New Smart 3D imager arrays

*FARO Technologies, Inc.*

FARO Technologies announced highly adaptable 3D imager arrays that promise to drive automated industrial manufacturing metrology processes to the next level.

The new FARO Cobalt 3D Imager is equipped with dedicated on-board processors – an industry first. The smart sensor allows unique multi-imager array configurations enabling industrial manufacturers to significantly improve productivity and operations in a way never before possible. An unlimited number of 3D imagers can be placed in array configurations virtually anywhere in a manufacturing process – all scanning simultaneously and controlled by a single computer.

Ideal for integration within the production environment, Cobalt can also be installed in more conventional ways, such as in conjunction with a rotary table, robot, or industrial inspection cell. Combining blue light projection, stereo cameras and powerful on-board processing, Cobalt captures and processes millions of 3D data points in seconds. With high resolution, automatic exposure and high dynamic range, Cobalt expertly handles complex parts with fine details, varying colors, textures and reflectivity. Cobalt delivers fast and consistent measurements, independent of the operator, for quality inspection and reverse engineering applications on parts, assemblies, and tools.

The FARO Cobalt 3D Imager is designed for quick and easy integration onto the production floor, and seamlessly connects with the full-featured FARO CAM2 Measure 10 metrology software.

-TEL: +82-51-662-3412
-http://www.faro.com

# ControlAir Achieves Safety Integrity Level (SIL 3) Certification for Volume Boosters

*Control Air Inc. / YTEC Co., Ltd.*

ControlAir, a leading manufacturer of precision pneumatic and electro-pneumatic controls, is pleased to announce that its Type-6500 Aluminum and Type-6600 Stainless Steel Large Flow Capacity Volume Boosters were awarded a Certificate of Compliance to IEC 61508 for a SIL 3 safety rating.

SIL is an industry measure of safety system performance and reliability, and is used as part of the Functional Safety Standard IEC 61508 to calculate risk protection in a system. When a company is using the IEC 61508 standard for safety, SIL components are required in system design.

The IEC 61508 standard defines the requirements to ensure products have a high level of resistance to random hardware and systematic design failures. ControlAir's Type-6500/6600 Large Flow Capacity Volume Boosters were evaluated by a qualified third party certification agency, Factory Mutual (FM), which assessed and certified that the Type-6500/6600 Volume Boosters had been designed and developed in accordance with the IEC 61508 standard. FM followed a rigorous process that verified the Safety Integrity Level (SIL) for the Type-6500/6600 series hardware design, as well as its manufacturing and quality control procedures.

The Type-6500/6600 Large Flow Capacity Volume Boosters are ideal for any application that requires high flow capacity or remote pressure control. Typically they are used to increase throttling speed of large volume control valve actuators. When used in a safety system, the volume boosters are used in conjunction with a valve actuator, to perform a safety-related function. The greater air flow provided by the Type-6500/6600 units allows a valve to actuate more rapidly, which would then allow a safety shut-off system to reach a safe state quicker.

The Large Flow Boosters handle up to 250 psig (17.0 BAR) supply pressure and deliver an output pressure up to 150 psig (10.0 BAR). The units provide a flow capacity of up to 400 SCFM (11,320 Nl/min). Units are rated to a wide operating temperature range of -40° to 200°F (-40° to 93°C). Exhaust capacity is 100 scfm (2,830 Nl/min). The Type-6500/6600 are available in 3/4″ and 1″ NPT porting.

-TEL: +82-31-777-8200
-http://www.ytec.net

# BMEA (Busan Marine Equipment Association)
# Member List

**ANSWER CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.answerclear.com
Main Products : CO2 Extinguishing Sys. External Fire Fighting Sys.
TEL : +82-51-831-3691

**BANDO MARINE.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.bando.info
Main Products : Life Boat
TEL : +82-51-831-1950

**BERM YOUNG VALVE.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.byvalve.com
Main Products : Quick Closing Valve, Ball Valve, Bellows, Beal Valve
TEL : +82-51-311-2511

**B-I INDUSTRIAL CO., LTD.**
Head Office : Gangseo-gu, Busan
Homepage Add : www.b-i.co.kr
Main Products : Fire & gas detection system, smoke, heat & flame detector.
TEL : +82-51-441-5670

**BMT CO., LTD.**
Head Office : Yangsan Gyeongsangnam-do
Homepage Add. : www.superlok.com/
Main Products : Fitting & Valve, Vacuum Clamp
TEL : +82-55-783-1000

**BO KYOUNG IND., CO.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : O-ring, Sealing, Gasket
TEL : +82-51-831-4615

**BOKYUNGTL CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Rudder Body, Winch, Crane
TEL : +82-51-832-0801

**BO MYUNG METAL CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Copper Tube & Pipe, Cupro-Nikel Pipe, Copper Fitting
TEL : +82-51-266-4101

**BOYANG HARDWARE CO., LTD.**
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.byhd.co.kr
Main Products : Stairway Body, Ladder, Hardware
TEL : +82-55-345-1951

**BUSAN INDUSTRY CO.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Powder Coating
TEL : +82-51-831-4810

**BUSUNG PLANT CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Cargo Reducer Piece
TEL : +82-51-831-1784

**CEPHAS PIPELINES CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Butterfly Valve
TEL : +82-51-263-3661

**CHK CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.chkj.co.kr
Main Products : Telephone Booth, Work Shop, Cable Box, Spare Box
TEL : +82-51-831-9500

**CHWANG HYEOP INSTRUMENTS.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.chkj.co.kr
Main Products : Telephone Booth, Work Shop, Cable Box, Spare Box
TEL : +82-51-831-3607

**CHANG WON ENVIRONMENT IND CO., LTD.**
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.seaclean.kr
Main Products : Sewage Tredtment Plant
TEL : +82-55-342-5545

**CMR KOREA CO., LTD.**
Head Office : Kumjung-gu Busan
Homepage Add. : www.cmkkorea.com
Main Products : Temperature & Press Sensor, Alarm Monitoring Sys.
TEL : +82-51-521-2883

**DAECHANG METAL CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Main Bearing support, Chain Wheel, Gear Wheel
TEL : +82-51-264-0831

**DAE-DONG ENTEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.ddentec.com/
Main Products : Air Cooler, Oil Cooler, Oil Tank, Air Tank, Oil Heater
TEL : +82-51-832-1123

**DAE HAN HEAT ELECTRIC MACHINERY IND.,CO.**
Head Office : Kijang-kun Busan
Homepage Add. :
Main Products : $CO_2$ Welder, DC Tig, Welder, AC ARC Welder
TEL : +82-51-724-6777

**DAEHEUNG IND. CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.daeheungind.kr/kr/
Main Products : Forged Flanges, Nozzel & Forged Neck, Forged Items for ship
TEL : +82-51-831-6635

**AQ TECK CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Flower Meter, Viscometer, Control Valve
TEL : +82-51-831-3720

**DAEHWA TECHNICAL CO., LTD.**
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. :
Main Products : Shot & Blast, Painting, Painting's Manufacture
TEL : +82-55-329-5705

**DAEJUNG SPECIAL STEEL CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Winch, Shaft, Gear Cluch
TEL : +82-51-831-1133

**DAEKYUNG CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. : www.dkhoist.com
Main Products : Chain Block, Lever Block Trelley
TEL : +82-51-264-6611

**DAERIM MACHINERY CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dae-rim.kr
Main Products : Head, Air Receiver Tank, Pressure Vessel, Reactor
TEL : +82-51-831-1456

**DAESAN ENGINEERING CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.daesan-eng.com
Main Products : E/R Package unit, Pipe Group Unit
TEL : +82-51-831-0090

**DAE SEONG MARINE TEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.ds-frp.com/
Main Products : Pipe Insulation System, FRP Weather Door
TEL : +82-51-832-2071

**DAESUNG IND CO.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : VENT SYS, OIL TANK, Out Fitting
TEL : +82-51-831-7427

**DAE WON HEAVY INDUSTRIES CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.daewonindustry.co.kr/
Main Products : Deck Machinery, Deck Equipments, OffShore
TEL : +82-51-831-5215

**DAEWON METAL IND. CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.galvanizing.co.kr/
Main Products : Hot Dip Galvanizing, Pipe for Shipbuilding
TEL : +82-51-831-2541

**DAEYANG ELECTRIC CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. : www.daeyang.co.kr
Main Products : Precision Instrument
TEL : +82-51-200-5331

**DAEYANG INSTRUMENT CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. : www.daeyang.co.kr
Main Products : Precision Instrument
TEL : +82-51-200-5331

**DAEYANG SP CO., LTD.**
Head Office : Yangsan Gyeongsangnam-do
Homepage Add. :
Main Products : Welding machine
TEL : +82-55-388-3800

**DA HEUNG ENG. CO., LTD.**
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Marine valves
TEL : +82-51-311-1882

**DAOM METAL.**
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Sus plate, Flange, Pipe sleeve
TEL : +82-51-315-1347

**DEAIL MACHINERY.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Piston Rod, Cross headpin, Propeller Shaft
TEL : +82-51-832-1119

**DECKWIN CO., LTD.**
Head Office : Youngdo-gu Busan
Homepage Add. : www.deckwin.com
Main Products : Winch
TEL : +82-51-413-1193

**DH-M CO., LTD.**
Head Office : Seo-gu Incheon
Homepage Add. : www.dhm.co.kr
Main Products : High Pressure Blower, High Pressure Washer
TEL : +82-32-527-5782

**DHP ENGINEERING CO., LTD.**
Head Office : Dongnae-gu Busan
Homepage Add. : www.dhpeng.com
Main Products : Plate Type heat Exchanger, Disk & Shell type heat Exchanger
TEL : +82-51-556-4200

**DINES CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Provision Crane, Tilting Radar Post
TEL : +82-51-971-0972

**DK INDUSTRIAL CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. : www.dk-ind.com/
Main Products : Silencer, Fire Damper, Lashing Bridge, Rudder
TEL : +82-51-832-1436

**DK TECH CORPORATION CO., LTD.**
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.dklok.com
Main Products : Instrument TuBe Fitting, Instrument Valve
TEL : +82-55-338-0114

**DNP CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dnpco.kr
Main Products : Fire & Gas Damper, Galley Equipment, AL, Steel Furniture
TEL : +82-51-831-4551

**DOLIM PRECISION.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Cross Head Pin, Main Journal, Crank Shaft
TEL : +82-51-831-8861

**DONG-A VALVE IND.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Marine Offshore valve, Strainer
TEL : _+82-51-831-1500

**DONGBANG SHIP MACHINERY CO., LTD.**
Head Office : Jinhae Gyeongsangnam-do
Homepage Add. : www.dongbangsm.co.kr
Main Products : General Steel Poping, Framo & Hydro Piping, Module Unit
TEL : +82-55-545-0882

**DONGHAE INTEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dhintec.co.kr
Main Products : Sleeve, Scupper, Suction Bell Mouth
TEL : +82-51-831-2565

**DONG HUN ENTERPRISE CO.**
Head Office : Sasang-gu Busan
Homepage Add. :
Main Products : Ball Valve
TEL : +82-51-314-2610

**DONGHWA ENTEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dh.co.kr
Main Products : E/R Heater & Cooler, Copt, Condenser, Plate Heat Exchanger
TEL : +82-51-970-1000

**DONGHWA M&E CO., LTD.**
Head Office : Gangseo-gu, Busan
Homepage Add. : www.donghwame.com
Main Products : Heat Exchanger
TEL : +82-51-971-3455

**DONGHWA PNEUTEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Air Comfressor, Cylinder, Cylinder, Head, Piston
TEL : +82-51-974-4800

**DONGIL SHIPYARD CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. :www.dongilshipyard.co.kr
Main Products : Rescue Boat Davit & Winch, Assembly, Line Hauler
TEL : +82-51-200-1211

**DONGKYUNG INDUSTRY CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dki21.co.kr
Main Products : Reducer, Gear
TEL : +82-51-832-1602

**DONG NAM ENGINEERING CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. : www.dongnam-eng.com
Main Products : Electric Control Panel
TEL : +82-51-204-3984

**DONGNAM PRECISION IND. CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Multi Core Tube, Sus Cable Tray & Cover, LNG Line Out Fitting
TEL : +82-51-831-3500

**DONG SUNG HIGHTECH.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dshitech.com
Main Products : Shutter Grill, P-Chamber, Diffuser, Frie Damper, Volume Damper
TEL : +82-51-831-9561

**DONGYANG G.T.S.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Compresed Centellen Board, Metal Inserting Gasket
TEL : +82-51-831-6505

**DONGYANG HYDTEC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dongyang-hyd.com
Main Products : Rudder & propeller Truck, Block lifter, Gripper Jack System
TEL : +82-51-831-6185

**DONGYANG METAL CO., LTD.**
Head Office : Sasang-gu Busan
Homepage Add. : www.dy-metal.co.kr
Main Products : Swing bolt a' ssy, Fittings
TEL : +82-51-814-5157

**DONGYOUNG ELECTRIC CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dyelectric.com
Main Products : Main Switchboard, Emergency Switchboard
TEL : +82-51-261-9800

**DSB ENGINEERING CO., LTD.**
Head Office : Youngdo-gu Busan
Homepage Add. : www.dseng.com
Main Products : Totally Enclosed, Lifeboat, Herged Qrarity Davit
TEL : +82-51-412-5937

**DSE BEARING CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.dsebearing.com
Main Products : Metal Bearing
TEL : +82-51-831-2046

**DSK CO., LTD.**
Head Office : Youngdo-gu Busan
Homepage Add. : www.dskworld.com
Main Products : Piston Crown
TEL : +82-51-417-7800

**DUYOUNG INDUSTRIAL MACHINES CO., LTD.**
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 Outffittings
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 : I.C.C.P. System, M.G.P.S, Shaft Earthing Device
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
Homepage Add. : www.cuniship.com
Main Products : W-NT 90/10 Flange, Elbow, Tee
TEL : +82-51-266-6655

**SAMYOUNG FITTING.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Elbow, Tee, Coupling
TEL : +82-51-832-0211

**SDK CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Winch, Hatch
TEL : +82-51-832-1882

**SEAPLUS CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.sea-plus.co.kr
Main Products : Low Pressure CO2, Fire Extinguishing Sys
TEL : +82-51-831-0119

**SEBO METAL CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.sebometal.co.kr
Main Products : Pump Tower for LNG, Vent Mast
TEL : +82-51-970-0200

**SEBO TECH CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Windwall, Heat Shield, Manual Hatch
TEL : +82-51-831-4171

**SEIL SERES CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. : www.seilseres.com
Main Products : VRC system, ODME
TEL : +82-51-831-1858

**SEJIN BOLT CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Bolt, Nut & Be, Double Nut, Chard Nut, Hinge Bog
TEL : +82-51-831-9832

**SEUNG JIN E.N.G.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Pipe Spool (Steel)
TEL : +82-51-831-9050

**SEUN STEEL CO., LTD.**
Head Office : Jin-gu Busan
Homepage Add. : www.seunsteel.co.kr
Main Products : CR, HGL, CGL, EGL
TEL : +82-51-639-3200

**SEWOONG PRECISION MACHINERY CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products :
TEL : +82-51-831-0595

**SEYANG HIGH-TECH**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Water & Oil Strainer, Condensate Chlorination Tank
TEL : +82-51-831-9125

**SHILLA E&T CO., LTD.**
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Spot Cooler, Heat Exchanger, Pressure Yeses
TEL : +82-51-831-7705

**SHINDONG DIGITECH CO., LTD.**
Head Office : Dong-gu Busan
Homepage Add. : www.shindong.com
Main Products : Navigation Communication, Satellite Communication
TEL : +82-51-461-5000

**SHINHWA INTERIOR & TECHNOLOGY CO., LTD.**
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Marine Furniture
TEL : +82-51-441-1294

**SHINKWANG ACE ELECTRIC CO., LTD.**
Head Office : Kimhae Gyeongsangnam-do
Homepage Add. : www.skace.com
Main Products : Cable Tray, Accessories
TEL : +82-55-332-3315

**SHINMYUNG INDUSTRIAL CO., LTD.**
Head Office : Gangseo-gu Busan

Homepage Add. :
Main Products : Cable Tray Joint, Hanger
TEL : +82-51-831-5061

### SHIN SHIN HEAVY INDUSTRIES CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Deck Machinery, Hydraulic system, Serface Treatment
TEL : +82-51-832-0734

### SHIN SHIN MACHINERY CO., LTD.
Head Office : Kijang-kun Busan
Homepage Add. : www.sspump.com
Main Products : Centrifugal Pumps, Gear Pumps, Screw Pumps
TEL : +82-51-727-5300

### SHINWOO METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.shinwoometal.net
Main Products : Flange, Forging
TEL : +82-51-831-2830

### SHIN YOUNG AIR CLUTCH.
Head Office : Gangseo-gu Busan
Homepage Add. : www.airclutch.co.kr
Main Products : SY-CB Type, SY-VC Type, SY-E Type
TEL : +82-51-831-7072

### SILLA METAL CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.sillametal.com
Main Products : PROPELLER(F.P.P), C.PPROPELLER Blade & Hub
TEL : +82-51-831-5991

### SIN HUENG FLANGE CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Flange for ship
TEL : +82-51-831-6167

### SINWEOL GRATING CO., LTD.
Head Office : Sasang-gu Busan
Homepage Add. : www.steelgrating.net
Main Products : Steel Grating for Ship
TEL : +82-51-323-7000

### SMS CO., LTD.
head office : Saha Gu Busan
homepage add : www.sms-marinesystem.com
main products : hatch-pontoon type, folding type, side rolling type, etc. lashing equipment-2/3tier
TEL : +82 51-290-1000

### SM POWER TEC CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.smpt.co.kr
Main Products : Vacuum Pump for Shipping Bldc, AC,DC Motor & Generator
TEL : +82-51-973-0267

### SNP CO., LTD.
Head Office : Saha-gu Busan
Homepage Add. :
Main Products : Galley Equipment, Cold Chamber, Catering Furniture
TEL : +82-51-261-7711

### STACO CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.staco.co.kr
Main Products : Wall Panel, Celing Panel, Unit Toilet, Marin Door
TEL : +82-51-831-7000

### STA-JH CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. :
Main Products : Welding Fittings (Butt Welding)
TEL : +82-51-831-1274

### STASB CO., LTD.
Head Office : Jinhae Gyeongsangnam-do
Homepage Add. :
Main Products : Marine Furniture, Door
TEL : +82-55-544-8070

### STAUFF KOREA LTD.
Head Office : Saha-gu Busan
Homepage Add. : www.stauff.co.kr
Main Products : Hyd' System & Engineering, Hyd' Clamp & Test
TEL : +82-51-266-6666

### STBEND CO., LTD.
Head Office : Gangseo-gu Busan
Homepage Add. : www.stbend.co.kr
Main Products : SUS Pipe Fitting, SUS Bend
TEL : +82-51-831-5131

### STEEL KOREA CO., LTD.
Head Office : Jinhae Gyeongsangnam-do
Homepage Add. :
Main Products :
TEL : +82-55-541-2212

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Until : Send to head office by 15nd every month.

KORSHIP
Shipbuilding
Offshore
Oil & Gas
Offshore wind

Registration No. : Youngdungpo Ra 00220
Published on Mar. 5. 2016
Publisher Yoseob Choi
Editor-in-Chief Chunghoon Lee
Senior Editor Chanyoung Choi
Designer MiHwa Choi
Marketing Manager Sungsu Park
Kijong Seo
Jongki Hong
Deoki Lee (Busan Office)
Printed by Hyung-Je Art Printing
Printed (CTP) by Hyung-Je Art Printing
Published by PROCON

Address: Room. 708 ACE Techno Tower, 12, Dangsan-ro 2-gil, Yeongdeungpo-gu, Seoul, Korea (Postcode: 07299)
Tel : +82-2-2168-8898
Fax : +82-2-6442-2168
International : +82-10-5604-7311 (Chanyoung Choi)

www.korship.co.kr www.procon.co.kr
E-mail : korshipeditor@gmail.com
Price per Copy : ₩10,000
Annual Subscription Fee : ₩100,000

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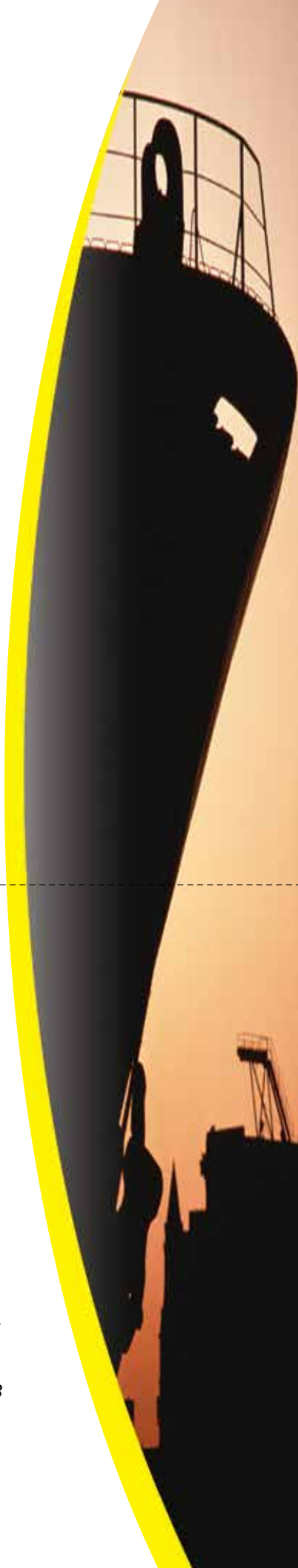

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