

# KORSHIP

Korea monthly shipbuilding magazine

Shipbuilding · Offshore · Oil & Gas · Offshore wind

2017. 5

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Official Magazine

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2016년 개정판

조선 & 해양 총람

# Guide Offshore & Shipbuilding

## 조선&해양 총람 '2016년 개정판' 발행

월간 KORSHIP은 지난 2013년 조선해양 관련업계의 관심과 협조에 힘입어 국내 처음으로 '조선&해양 기업총람(Offshore & Shipbuilding Guide)'을 제작해 발행했습니다.

이번에 월간 KORSHIP은 국내 조선업계의 요구에 따라 '2016년 개정판'을 새롭게 발행하게 되었습니다. 2016년 개정판은 기존 2013년 총람 (1,008개 업체)에 비해 50% 이상 업체가 추가되어 총 1,600여 곳의 조선&해양 업체 정보가 수록되어 있습니다.

발행사: 프로콘 (Procon) / 월간 KORSHIP

발행일: 2016년 7월 20일

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& 2016년 개정판 조선해양 총람 구매와 관련해 기타 자세한 사항은 전화문의(02-2168-8896) 또는 본사 홈페이지([www.korship.co.kr](http://www.korship.co.kr))를 참조해 주십시오.





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#### E-MAIL

wts21c@chol.com

#### MOBLE

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- 1991** Established Pukyong Water Purification Engineering Co.,Ltd
- 1992** Started development of the wastewater reclamation and reusing system
- 1993** Development of the Clear Water Supply System
- 1997** Established the 21st Century Water Purification Engineering Co.,Ltd
- 1998** Applied practical new design to refine a centralized water purification system  
Registered the factory of the 21st Century Water Purification Engineering Co.,Ltd. (No.98-3)  
Patented an advanced water purification device(invention patent)
- 1999** Acquired a license for specialized construction business and machine and equipment work business(Busan 99-12-03)
- 2000** Certified ISO 9000.  
Registered practical new design (Registration No. 0205625)
- 2001** Applied domestic patent of wastewater reclamation and reusing supply system.  
Applied Chinese patent of wastewater reclamation and reusing supply system.  
Increase of capital (0.1 billion won to 0.3 billion won)
- 2002** Changed company name from the 21st Century Water Purification Engineering Co.,Ltd. to ONELINE TECH., Ltd.
- 2004** Approved special engineering method by the Ministry of Government Administrations and Home Affairs.  
Registered patent of wastewater reclamation and reusing and supply system(Patent No.0430071)
- 2005** Certified venture company by the Small and Medium Business Administration.  
Made an Industry Academy Cooperative Agreement with Pohang University of Science and Technology.  
Successful completion of strategy and innovation project by the Small and Medium Business Administration.
- 2006** Established R&D Dept.(Korea Industrial Technology Association).  
Made an Industry Academy Cooperative Agreement with the Pusan National University.  
Certified a patent innovative type promising company (Busan Techno Park)  
Awarded a good small and medium businessmen (Busan and Ulsan Small and Medium Administration)
- 2007** Increase of capital (0.3 billion won to 0.5 billion won)  
Certified Innobiz company (Small and Medium Business Administration)
- 2009** Awarded 'Citizen Inventor' in the 44th invention Day by Busan Mayor Busan City's Certification of a Leading Enterprise.
- 2010** Republic of Korea naval vessel and desalination facilities designated defense contractor with a submarine.
- 2013** American 'Shock, Vibration, Noise' submarine with equipment certification and specifications stipulated a naval vessel acquisition.



# 최고의 나노기술 아크릴계 수성 나노페인트

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- 다양한 용도(방오, 방청, 선저방조, 내후성, 내열, 차열)
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gear up to 500,000 N-m



## LIMIT SWITCH BOX

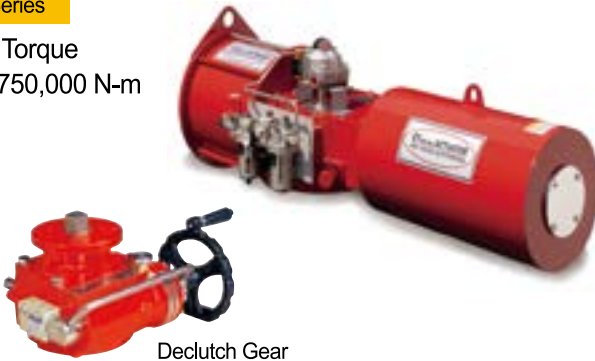
### APL Series



## PNEUMATIC ACTUATOR **HEAVY DUTY**

### ET Series

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Declutch Gear

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

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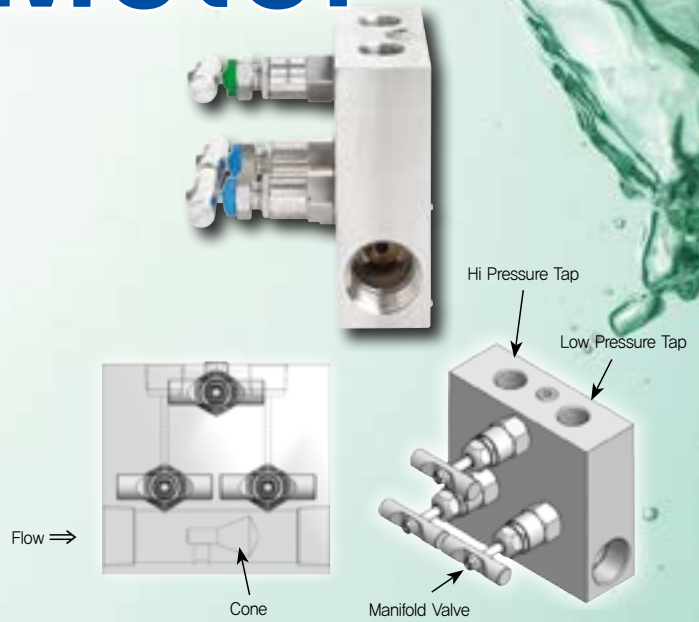
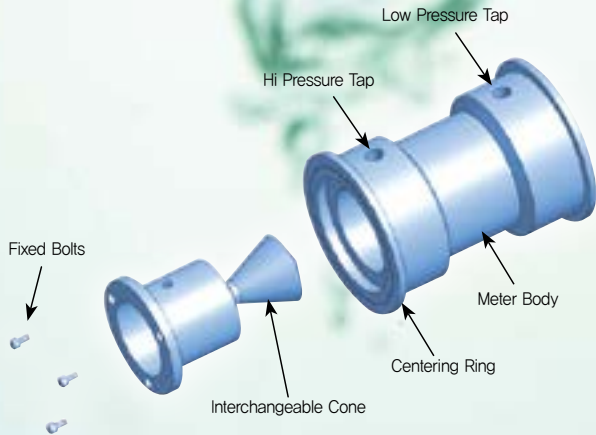


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# Cone Meter



## HFV-WM (Wafer type Cone Meter)

## IVCM (Integral Valve Cone Meter)

# DP HiCone Meter

DP HiCone Meter는 일반적인 차압유량계의 일종이며 차압유량계와 같은 물리적 원리에 따라 유량을 측정합니다. 조임부 역할을 하는 Cone은 Meter body 중앙에 위치하여 유체의 흐름에 따라 유속을 증가시키고 차압을 발생시킵니다. 두 개의 검출 Tap은 High 와 Low pressure를 DP 전송기로 보내 유량을 지시합니다.

**70%** 전단 3D 후단 1D의 짧은 직관부를 가짐에 따라 플랜트 건설에 최대 70%까지 원가를 절감하는 효과를 가집니다. (미국 CEESI에서 API 22.2 TESTING)

**±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 교정시스템에 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 문치의 충격으로 인한 Cone의 변형에 쉽게 교체 사용할 수 있는 특징을 가지고 있다. 또한, Water형태로 설치가 용이하고 모든 구성품이 정밀 기계가공되어 측정정확도가 우수하며, 용접부가 없어 압력부의 건전성이 확보 되었다.



(특 허 : 제 10-0915088호)

## IVCM

IVCM은 차압식 유량계의 필연적 구성품인 Manifold Valve를 Meter body와 일체형으로 제작하여 공정시 발생할 수 있는 연결부의 Leak를 최소화 하고, 설치 공사 비용 및 시간을 줄이는 장점을 가진다.



(특 허 : 제 10-0915089호)



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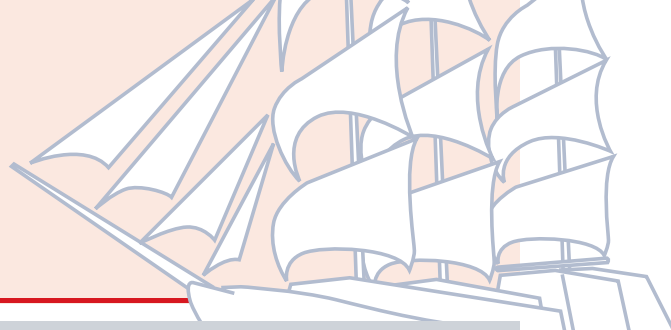
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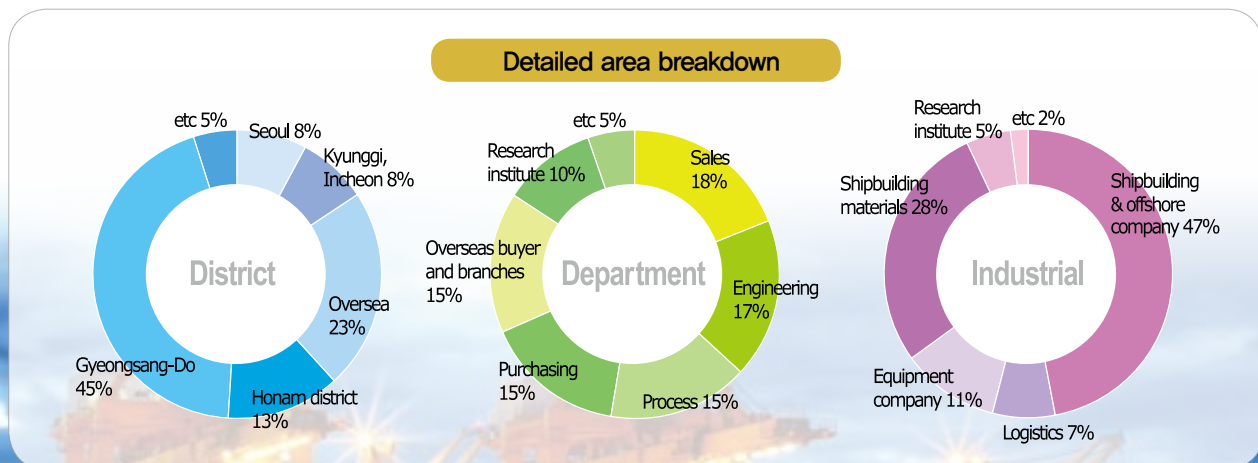
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## Hyundai Heavy Industries Group Posts Largest Ship Orders in 3 Years

Hyundai Heavy Industries (HHI) Group announced on April 26 that it won 39 ships worth \$2.3 billion for January-April period, which is the largest ship orders for the comparable period in three years.

HHI Group won 18 ships worth \$900 million in April alone. Since the orders include options exercisable by owners to order additional same or similar class vessels, the total orders in April will be amounted to 31 ships worth \$1.5 billion.

Considering HHI is now in the final negotiating stage for additional three ships and

Hyundai Mipo Dockyard (HMD) for two more vessels, and an array of other shipbuilding inquiries HHI Group is receiving lately, HHI Group expects more orders to come in May and afterwards.

Despite a dearth of new orders in the global shipbuilding market, HHI Group was capable of winning the huge orders on the back of its competitive edge on eco-friendly shipbuilding capabilities and comprehensive restructuring efforts resulting in healthier fiscal soundness over its competitors.

With uncertainties in the shipbuilding linger-

ing on, it seems natural that shipowners prefer to placing order to HHI Group that has a stronger financial status and proven track records of delivering thousands of ships on time.

An official from HHI said, "With our new orders improving this year, we are receiving shipbuilding inquiries doubled over the last year's comparable period. With our competitive edge on green shipbuilding technology and fiscal health, we will continue to exert efforts to win more orders."

### 현대중공업 그룹 올해 수주 실적 3년 만에 최대치

현대중공업 그룹은 올해 들어 현대중공업, 현대삼호중공업, 현대미포조선 3사가 총 39척 23억 달러의 수주고를 기록하며, 2014년 이후 최대 실적을 기록했다고 발표했다. 올해 4월 한 달 동안에만 18척 9억 달러의 계약을 체결하며 수주실적이 가파른 상승세를 보이고 있다.

올해 수주한 선박을 선종별로 살펴보면, 현대중공업(현대삼호중공업 포함)은 탱커 13척, 가스선 2척 등

총 15척 14억 달러, 현대미포조선은 PC선 18척, 기타 선종 6척 등 총 24척 9억 달러를 수주했다.

조선업계 전반적으로 불황을 겪고 있는 가운데, 현대중공업 그룹이 대규모 수주실적을 거둔 주요 원인으로 친환경 선박에 대한 기술력과 조선업계 중에서 선제적으로 경영개선계획을 수행함으로써 눈에 띄는 안정적인 재무 건전성을 갖추게 된 점이 꼽히고 있다. 최근 유럽 선주사들은 선박연비와 품질에만 중점을 두고 발주하는 것에 벗어나 선박을 적기에 인도받기 위해 한국 조선업체들의 재무상태를 최우선적으

로 살피는 것으로 알려졌다. 몇몇 선주사들은 현대중공업의 재무상태에 높은 평가를 내린 한편, 현대글로벌서비스를 통해 인도받은 선박을 지속적으로 A/S받을 수 있다는 점에서 큰 만족을 표하기도 했다. 현대중공업 관계자는 "올해 들어 수주실적이 호조를 보이고 있는 가운데 수주관련 문의도 지난해 같은 기간에 비해 2배 이상 늘어났다"며 "친환경 기술력과 안정적인 재무건전성을 바탕으로 영업활동에 적극 나섬으로써 수주 소식을 이어갈 수 있도록 최선을 다하겠다"고 밝혔다.

## Nexans celebrates 40 years since commissioning of the Skagerrak interconnector submarine link

For decades, high-voltage direct current (HVDC) mass impregnated (MI) cables have been the preferred solution for long-distance submarine transmission. This year, Nexans is celebrating 40 years since its HVDC MI cables were first put into commercial service at the Skagerrak Interconnector submarine HVDC link between Denmark and Norway. In 1977, the Skagerrak link, which is owned and operated by Energinet.dk in Denmark and Statnett SF in Norway, represented the first time high-voltage cables were installed for such a long distance sea crossing (130 kilometers) at a water depth of 550 meters.

Nexans celebrates 40 years since commis-

sioning of the Skagerrak interconnector submarine link. In operation, the links of the Skagerrak Interconnector enable additional renewable energy to be integrated into the power mix and more efficient use of electricity by connecting the Norwegian grid, which is largely hydroelectric based, with the Danish grid, which is primarily thermal and wind power based. With 40 years of service and counting, the Skagerrak Interconnector's



HVDC MI cable systems from Nexans have definitely proven their strong reliability and longevity.



Nexans' Skagerrak 1 and 2 HVDC MI cables are operating at 250 kilovolts, and each cable has a power rating of 250 megawatts (MW). As the demand for energy between the countries increased, additional power transmission has been installed. Today, four cables have a total power rating of 1,700 MW, which represents the energy needs of nearly 25 000 typical Scandinavian households. HVDC MI cables from Nexans are used for transmission links worldwide including the Skagerrak line and other interconnectors

such as Sweden-Finland (Fenno-Skan) and Estonia-Finland (EstLink 2). They also are being used for the upcoming HVDC links between Italy and Montenegro (Mon. Ita), Norway and Germany (NordLink) and Norway and the United Kingdom (NSL). "Through decades of research and development in design, materials, testing, manufacturing processes and installation techniques, Nexans has been able to push the limits for voltage levels, power transmission capacity and installation depth for MI cable systems. Ongoing research and develop-

ment activities for MI cable systems focus on even higher voltage levels and increased transmission capacity, resulting in new possibilities for bulk transmission of vast amounts of electrical energy over long distances," said Vegar Syrtveit Larsen, Technical Director Nexans Norway. "We are proud to say that as of today, Nexans has more than 2,600 kilometers of MI cables in service, and with the upcoming links, this figure will be almost doubled by the end of 2021."

### 넥상스, 40년간 성공적으로 스카게락 인터커넥터 해저 링크 운영

지난 수 십년간 초고압 직류(HVDC) MI(Mass Impregnated) 케이블은 장거리 해저 송전분야에서 선호되는 솔루션이다. 넥상스는 덴마크와 노르웨이를 잇는 스카게락 인터커넥터 해저 HVDC 링크에 사용된 HVDC MI 케이블이 상용화 이후 올해로 40주년을 맞았다. 1977년에 덴마크 Energinet.dk와 노르웨이 Statnett SF가 상용화한 스카게락 해저 케이블은 해저 550m, 총 길이 130km에 달하는 장거리를 연결하는 세계 최초의 초고압 케이블링크다.

스카게락 인터커넥터 링크는 재생에너지 부분을 전력 믹스에 통합되게 하고, 이를 주로 수력발전으로 가동되는 노르웨이 그리드와 열과 풍력 기반의 덴마크 그리드와 함께 연결해 더욱 효율적인 전기 사

용을 가능하게 한다. 40여년간의 서비스 제공으로 넥상스의 스카게락 인터커넥터 HVDC MI 케이블 시스템은 고객에게 제품에 대한 높은 신뢰와 긴 수명을 증명했다.

스카게락 1, 2에 사용되는 넥상스 HVDC MI 케이블은 250kV에서 작동되며, 각 케이블은 250MW 전압이다. 국가간 에너지 수요가 증가함에 따라 추가적인 송전 시스템이 설치되었다. 현재 4개의 케이블이 총 1,700MW의 정격 용량을 보유하고 있으며, 이는 약 25,000 스칸디나비아 가정의 에너지 수요량이다. 넥상스 HVDC MI 케이블은 스카게락 라인 및 스웨덴-핀란드(Fenno-Skan) 및 에스토니아 핀란드(EstLink 2) 등 기타 인터커넥터를 포함한 전세계 송전 링크에 사용된다. 또한, 이탈리아와 몬테네그로를 연결하는 HVDC 링크(MonIta), 노르웨이 및 독일

(NordLink), 그리고 노르웨이와 영국(NSL)을 잇는 링크에도 사용되고 있다.

넥상스 노르웨이 기술팀 이사 비가 솔베트 라센(Vegar Syrtveit Larsen)은 "수 십년간의 연구 및 설계, 재료, 시험, 제조 공정, 설치 기술 개발을 통해 넥상스는 전압, 송전 용량, 설치 깊이에 있어 MI 케이블의 한계를 뛰어넘었다. MI 케이블 시스템에 대한 현재 진행중인 연구 및 개발 활동은 더욱 높은 전압과 송전 용량 증대에 초점을 두고 있으며, 이를 통해 막대한 양의 전력 에너지를 장거리로 보내는 벌크 송전에 대한 새로운 가능성을 발견했다"면서, "우리는 현재까지 2,600km가 넘는 MI 케이블을 공급했다는 사실을 자랑스럽게 생각하며, 앞으로 설치 예정인 링크까지 포함하면 2021년 말에는 현재 수치의 약 두 배가 될 것으로 전망된다"고 말했다.

## Korea Eximbank injects USD 1 billion into Kuwait's CFP

The Export-import Bank of Korea (Korea Eximbank) announced that it would inject USD 1 billion directly into Kuwait's CFP (Clean Fuels Project) which was jointly awarded with domestic construction companies. This project valued at 14.5 billion is an ultra-large project aiming to modernize 2 refining facilities currently operated by KNPC (Kuwait National Petroleum Corporation) so as to ensure production of high-quality light-oil products.

An official from Korea Eximbank said, "Plants worth USD 6 billion are being built

by 5 large domestic construction companies while more than 150 domestic small and medium-sized plant equipment manufacturers are exporting their equipment as partners of KNPC. The funding worth KRW 1 billion in whole will be provided in direct loans by Korea Eximbank alone to ensure expeditious funding and successful financing of Kuwait's clients for the project that has made 70-80% progress thus far."

Korea Eximbank signed a business agreement worth USD 5 billion with KPC (Kuwait Petroleum Corporation) in late 2015 to cre-

ate a platform for domestic companies to participate actively in Kuwait's large-scale plant projects. In addition, Korea Eximbank played a key role in helping domestic companies win contracts for 4 packages in Al-Zour Refinery Project valued at USD 16 billion in late 2015 and another contract for LNG import terminal project worth USD 3 billion in early 2016. Additional contracts are expected to be awarded to domestic companies, including the contract for 8 units of VLGCs (Very Large Gas Carriers) in the period ahead.

## 한국수출입은행, 쿠웨이트 정유플랜트사업에 10억 달러 지원

한국수출입은행은 국내 건설사들과 공동 수주한 쿠웨이트 CFP(Clean Fuels Project) 사업에 10억 달러를 직접 제공한다고 밝혔다. 이 사업은 쿠웨이트 정유공사(KNPC)가 운영 중인 정유설비 2기를 현대화해 고품질의 경질유 제품을 생산하는 145억 달러 규모의 초대형 프로젝트이다. 한국수출입은행 관계자는 “국내 대형 건설사 5곳이

60억달러 규모의 플랜트를 건설하고, 150개 이상의 국내 중소·중견 플랜트 기자재업체가 KNPC의 협력사로 기자재수출을 맡고 있다”면서 “우리가 단독으로 10억 달러 전액을 직접대출 형태로 제공하는 것은 이번 사업이 70~80% 진행된 상황에서 신속한 자금 투입을 통해 쿠웨이트 발주처의 성공적 금융조달을 촉진하기 위한 것”이라고 말했다. 한국수출입은행은 쿠웨이트의 대규모 플랜트 발주에 국내 기업이 적극 참여할 수 있는 플랫폼을 마련

하기 위해 2015년말 쿠웨이트 석유공사(KPC)와 50억 달러 규모의 업무협약을 체결한 바 있다. 한편 한국수출입은행은 지난 2015년말 160억 달러 규모의 알주르 정유공장 중 4개 패키지와 2016년 초 30억 달러 규모의 LNG 수입터미널 사업을 수주하는데 견인차 역할을 담당했으며, 향후 초대형가스선(VLGC) 8척을 포함해 쿠웨이트 신규 사업에서 한국 기업들의 추가 수주까지 기대되고 있다.



## DSME commenced construction of a large-scale onshore oil production plant

Daewoo Shipbuilding & Marine Engineering (DSME) held a steel-cutting ceremony on March 28 at Okpo Shipyard on Geoje Island to mark the start of construction of an onshore oil production plant project worth USD 2.7 billion which was awarded to it in 2014 by Tengizchevroil LLP (TCO), the operator of Tengiz Field in Kazakhstan, thus launching production of modules in full scale. TCO is a joint venture formed by Chevron and ExxonMobil, etc., the global oil giants.

This onshore oil production plant consists of 89 production modules including oil well control and crude oil processing facilities for expansion of Tengiz oil field and its total production volume reaches approximately 180,000 tons. DSME will build them at Okpo shipyard and its subsidiary Shinhan Heavy Industries, etc., which are scheduled for delivery from April 2018 to 2020 on a stag-

gered basis. This project will be carried out on AFC (Approved for Construction) basis where detail design, large-scale equipment procurement, and local installation works, etc., will be undertaken at the responsibility of client while DSME will undertake only production of modules.

An official from DSME said, “This project will bring significant respite to domestic equipment manufacturers and subcontractors mired in difficulties arising from reduction of volumes due to contraction of offshore plant market, such as recent drop in oil prices. With thorough preparation and implementation, we will dispel concerns



about our company in the market and take another giant leap forward.”

Once this project is completed, daily crude oil production from Tengiz oil field will more than double from current 500,000 barrels to about 750,000 barrels. TCO and Chevron expect the first oil production to start in 2022 after completion of construction.

## 대우조선해양, 대형 육상 원유생산 플랜트 건조 시작

대우조선해양은 지난 2014년 카자흐스탄 텡기즈 유전(Tengiz Field)을 운영하는 텡기즈셰브로일(Tengizchevroil LLP, 이하 TCO)로부터 수주한 27억 달러 규모의 육상 원유생산 플랜트의 건조 시작을 알리는 강재절단식(Out Steel Ceremony)을 지난 3월 28일 거제 옥포조선소에서 갖고 본격적인 모듈 생산에 들어갔다. TCO는 세계적인 석유회사인 셰브론(Chevron)과 엑스모빌(ExxonMobil) 등으로 구성된 조인트벤처이다.

이 육상 원유생산 플랜트는 텡기즈 유전 확장을 위한 유정제어 및 원유처리시설 등 생산모듈 89기로 구성되어 있고, 총 제작 물량만 약 18만톤에 달한다. 대우조선해양은 이들 물량을 옥포조선소와 자회사인 신한중공업 등에서 제작해 2018년 4월부터 2020년까지 순차적으로 인도할 예정이다. 특히 이 프로젝트의 특징은 상세설계와 대형장비 구매, 현지 설치공사 등은 선주 측 책임하에 진행되며, 대우조선해양은 모듈 제작만 담당하게 되는 AFC(Approved for Construction) 방식 계약이다.

대우조선해양 관계자는 “이 프로젝트는 최근 유가

하락 등 위축된 해양플랜트 시장으로 인해 물량 감소로 어려움을 겪고 있는 국내 기자재 업체와 협력사에 큰 도움이 될 것”이라며, “철저한 준비와 실행을 통해 회사에 대한 시장의 우려를 불식시키고 재도약의 기회로 만들겠다”고 말했다.

한편 이 프로젝트가 완료되면 텡기즈 유전은 현재 약 50만 배럴 수준인 하루 원유생산량이 75만 배럴로 약 50% 가량 늘어나게 된다. TCO와 셰브론 측은 공사 완료 이후 첫 원유생산(First Oil) 시점을 2022년으로 예상하고 있다.



## HHI strengthens its position in large-scale engine sector with technological collaboration

Hyundai Heavy Industries (HHI) announced on April 11 that it has signed a long-term partnership agreement with MAN Diesel & Turbo and Winterthur Gas & Diesel, respectively. MAN Diesel & Turbo and Winterthur Gas & Diesel are the leading engineering companies in possession of original design technologies for 2-stroke large-scale engine with over 6,000 horsepower.

Under this agreement, HHI can tap into original technologies of both companies for 2-stroke large engines, such as gas-powered and dual-fuel engines, including electronically controlled diesel engines. Moreover, HHI will launch EcoShip package products combining those engine technologies of both companies with eco-friendly technologies developed independently by HHI in tandem with research and development which aim to improve engine performance in the period ahead.

For that, HHI will complete establishment of a gas engine demonstration facility at its Ulsan headquarters by the first half of 2018 and is poised to develop new products in collaboration with MAN Diesel & Turbo. Recently, HHI is broadening the area of cooperation in the large-sized engine sec-

tor as an eco-friendly engine partner of MAN Diesel & Turbo and Winterthur Gas & Diesel, going beyond the license contract.

In particular, HHI commercialized eco-friendly auxiliary engine devices built with its independent technologies, such as the LNG carrier fuel gas supply system (FGSS) developed in 2015 and NOx (Nitrogen

Oxide) reduction system developed last year, thus meeting the requirements set forth by Tier III, the highest standard environmental regulation which its engines alone could not comply with previously.

An official from HHI said, "These two major global engine makers recognized the excellence of HHI's eco-friendly engine



Executive Senior Vice President, K.D. Lee, pictured signing for HHI-EMD at the ceremony in Copenhagen. Also pictured are: (left) Klaus Engberg, Senior Vice President – Head of Two-Stroke Licensing; and (right) Thomas Knudsen, Senior Vice President – Head of Low-Speed. Standing (from left): W. S. Jeong (Hyundai), Head of Marine Engine & Machinery Sales Dept.; Søren H. Jensen, Vice President, R&D; Bjarne Foldager, Vice President – Sales & Promotion, Two-Stroke Business; and J. D. Yu (Hyundai) Senior Engineer

technology which would also create momentum of co-growth, finally leading to conclusion of this long-term partnership agreement spanning more than 10 years which is unprecedented even in large-scale engine industry."

### 현대중공업, 기술 협력 통해 대형엔진 분야 강화

현대중공업은 만 디젤&터보(MAN Diesel&Turbo), 빈터투어 가스&디젤(Winterthur Gas&Diesel)과 장기 파트너십 계약을 잇달아 체결했다고 지난 4월 11일 밝혔다. 이들은 6,000마력급 이상의 2행정(2-Stroke) 대형엔진에 대한 원천 설계기술을 독점하고 있는 엔지니어링 회사다.

이번 계약에 따라, 현대중공업은 양사와 전자제어식 디젤 엔진을 비롯해 가스 및 이중연료 엔진 등 2행정 대형엔진에 대한 원천기술을 제휴받아 제품을 생산하게 된다. 또한 현대중공업이 독자 개발한 친환경 기술들을 이들 엔진과 접목하는 에코십(EcoShip) 패키지제품을 출시하고, 향후 엔진의 성능 향상을 위한 연구 개발도 함께 진행할 예정이다. 이를 위해 오는 2018년 상반기까지 현대중공업 울산

본사에 가스엔진 실증설비를 구축하고, 만 디젤&터보사와 함께 신제품 개발에 나서기로 했다.

최근 들어 현대중공업은 대형엔진 분야에서 만 디젤&터보, 빈터투어 가스&디젤과 라이선스 계약 관계에 머물지 않고, 친환경 엔진 파트너로서 협력 범위를 넓히고 있다. 특히, 현대중공업은 2015년 LNG 운반선 연료공급시스템(FGSS), 지난해 질소산화물 저감장치(NOx SCR) 등 독자 개발한 친환경 엔진 부

가장치를 상용화함으로써 엔진 자체적으로 충족시키지 못했던 최고 등급의 환경 규제(Tier III)를 만족시키고 있다.

현대중공업 관계자는 "글로벌 메이저 엔진 메이커인 이들 양사도 현대중공업의 우수한 친환경 기술을 기반으로 동반 성장할 수 있다고 평가해, 대형엔진 업계에서 유례없는 10년 이상의 장기 파트너십 계약을 맺게 됐다"고 말했다.

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## KR releases the 15th version of KR-CON

Korean Register (KR) has announced the release of its latest KR-CON software on Apr 3.

The 15th edition of KR-CON has been developed in-house, and offers a comprehensive electronic database program containing the latest IMO conventions, codes, resolutions and circulars, in either English, Korean or Chinese.

KR-CON users include shipping companies, shipyards, design houses, surveyors, and Port Control Inspectors, the popular software allows them to quickly pull up the regulations relevant to any individual ship by simply inputting its details.

KR-CON, is easily accessed via the KR-CON website, on a USB stick and via a mobile app. This edition offers a new cloud

function which is a significant enhancement, allowing users around the world quick and easy access to the most up-to-date information on the IMO convention database. The cloud function will be supported by new cloud network servers across six continents including the U.S. and Europe, which will be operational by mid-2017.

The 15th edition of KR-CON also includes a new Flag Administration Marine Notice Browser function. It provides users with full details of any relevant local rules and offers specific detailed information from the major flag states, including Panama, Liberia and the Marshall Islands.

Lee Jeong-kie, Chairman and CEO of KR said "We are proud to launch the 15th version of KR-CON, our latest version offers



even better functionality and data access to its users. Equipped with cloud network support and the new flag administration marine notice browser, our customers around the world will be able to access KR-CON's database quickly and accurately to find the information they need. We will continue to develop our user-friendly software, with new functions based on users' feedback to ensure that we meet all of our customers' needs."

## HHI installs regasification System Using Glycol at newbuilding LNG-FSRU

Hyundai Heavy Industries (HHI) announced on Mar 31, it held a demonstration ceremony for the installation of LNG regasification system using glycol at a 170,000 cbm LNG-FSRU with the attendance of shipowners from home and abroad and major classification societies at its Ulsan shipyard.

Since the glycol regasification process is free from saltiness unlike a system that uses seawater, it can minimize corrosion in major equipment including heat exchangers, and it can also lower the risk of explosion that a system using propane may be exposed to.

Regasification is a process of converting cooled natural gas back to natural gas at atmospheric temperature. Regasification system is a key facility for an LNG FSRU (floating storage regasification unit) that receives liquefied natural gas from offloading LNG carriers and provides gas send-out through pipelines to shore. LNG-FSRU

takes a year less and costs half as much as an onshore LNG terminal to complete. The facility, better known as 'the LNG plant on the ocean', can also move from place to place where the energy demand is in growth as it has its own propulsion system, a feature making it an economical and reliable option for operators.

After being granted AIP from Lloyd's Register last month and internationally and domestically patented recently, HHI is also in the process of receiving the recognition for the system from other major classification societies as well.

An official from HHI said, "The recent development of even more evolved regasification system will further sharpen our technological



The world's first newbuilding 170,000 cbm LNG-FSRU that HHI built for Hoegh in 2014.

competitive edge in LNG-FSRU market which has witnessed a rising demand. We will keep developing high efficiency eco-friendly technologies to respond quickly to the requirements in the market."

HHI, as the world's largest shipbuilder, has completed the world's first newbuilding LNG-FSRU in 2014. It is also the only Korean shipbuilder that can both build membrane and moss-type LNG carriers.

## 현대중공업, 신개념 LNG 재기화시스템 독자 개발

현대중공업은 자체 개발한 '글리콜(Glycol) 간접 가열 LNG 재기화시스템'을 건조 중인 170,000m<sup>3</sup>급 LNG-FSRU에 탑재하기로 하고, 지난 3월 31일 국내·외 선사 및 선급을 초청해 실증설비 시연회를 개최했다.

LNG 재기화시스템은 저장된 액화천연가스(LNG)를 기체 상태로 바꾸어 육상에 공급하는 LNG-FSRU의 핵심 설비로, 기존에는 해수나 프로판(Propane) 가스를 통해 LNG를 가열하는 방식을 사용해왔다.

현대중공업이 이번에 개발한 신개념 재기화시스템은 응고점을 낮춘 글리콜 혼합액을 열 매개체로 사

용해 기존 방식보다 내구성 및 안전성을 크게 높인 것으로 평가 받고 있다. 특히, 글리콜을 통한 가열 방식은 해수와 달리 소금기 등 불순물이 없어 열 교환기를 비롯한 주요 장치의 부식을 최소화 할 수 있으며, 프로판 가스 가열 방식이 가진 폭발 위험성도 낮출 수 있다.

현대중공업은 이 기술에 대해 지난달 영국 로이드(Lloyd) 선급의 실용인증(API)을 획득한데 이어 전 세계 주요 선급을 대상으로 추가 인증을 추진하고 있으며, 국내·외 특허출원도 완료했다. 이 재기화시스템이 처음 탑재된 LNG-FSRU는 오는 2019년 초 인도될 예정이다.

현대중공업 관계자는 "한 단계 진보한 재기화시스템을 개발함으로써 수요가 증가하고 있는 LNG-FSRU 시장에서 기술 경쟁력을 높일 수 있게 됐다"며, "앞으로도 고효율·친환경 기술 개발을 통해 시장의 요구에 신속히 대응해 나갈 계획"이라고 말했다.

한편, 현대중공업은 지난 1994년 국내 최초로 모스(Moss)형 LNG선을 건조하는 등 국내에서 유일하게 모스형 LNG선과 멤브레인(Membrane)형 LNG선을 모두 건조할 수 있으며, 2014년에는 세계 최초로 LNG-FSRU를 건조하는 등 활발한 수주활동과 기술 개발을 통해 LNG선 시장을 선도하고 있다.



## Increasing interest in ballast water treatment and Alfa Laval PureBallast for high flow capacities

With the IMO Ballast Water Management (BWM) Convention taking effect in September, customer interest in ballast water treatment systems and in Alfa Laval PureBallast has been growing. Of particular note is interest in PureBallast systems with high flow capacities.

While interest for high flow PureBallast systems has increased, Alfa Laval is prepared to support vessels with these needs. The IMO and U.S. Coast Guard (USCG) type-approved PureBallast 3.1 features a unique single-filter solution, which enables higher capacities - up to 6000 m<sup>3</sup>/h - with a small footprint. Alfa Laval has recently signed a deal to supply two LNG carriers, Korean newbuilds, with installations comprised of two parallel 3000 m<sup>3</sup>/h systems.

"Traditionally, many have operated under the assumption that high flows require chemical treatment systems," noted Kristina Effler, Global Business Manager for Alfa Laval PureBallast. "But today, more ship owners and operators are seeing the benefits of PureBallast's enhanced UV dis-

infection technology, which can handle a much broader range of flows than other UV systems."

The benefits include reduced installation costs and a lower OPEX, meaning substantial savings over vessel life cycle. In addition, Alfa Laval PureBallast has a decade-long record of ensuring compliance that is unmatched by any chemical disinfection system.

"The high interest in Alfa Laval PureBallast provides clear evidence of growth in the retrofit market, and there are many reasons this is happening right now," said Anders Lindmark, Head of Alfa Laval PureBallast, Alfa Laval Marine Division. "We have received lots of interest directly tied to our recent USCG type approval, and we're also seeing greater numbers of ship owners preparing for the IMO convention."

For ship owners who put off selecting a ballast water treatment system during the lengthy ratification process for the BWM Convention, the global requirements taking effect in September leave little time to make



a decision.

"Alfa Laval is well prepared to guide customers who are only now entering the market," said Lindmark. "We've developed a wealth of knowledge in more than a decade of experience with ballast water treatment, and we're providing resources to help ship owners understand their options."

Those resources include a new white paper on ballast water management, as well as a comprehensive book that explores the legal, technical and business implications of different compliance alternatives.

## 선박평형수 처리와 대유량 알파리발 PureBallast에 대한 관심 증가

오는 9월 국제해사기구(IMO)의 국제선박평형수관리 협약(BWM)의 발효를 앞두고 선박평형수 처리 시

스템과 알파리발 PureBallast에 대한 관심이 증가하고 있다. 특히, 대유량 용량의 PureBallast 시스템에 관심이 집중되고 있다.

알파리발은 대유량 PureBallast 시스템을 필요로 하는

선박들을 지원할 만반의 준비를 갖추고 있다. IMO 및 미국해안경비대(USCG)에서 승인한 PureBallast 3.1은 최대 6000m<sup>3</sup>/h의 높은 용량을 구현하는 독창적인 단일 필터 솔루션을 특징으로 하며 작은 설치 면적을

자랑한다. 최근 알파라발은 한국의 신조선박 2척 (LNG선에 3000m³/h 2대의 병렬 시스템으로 구성된 설비를 공급하는 계약을 체결했다.

알파라발 PureBallast의 글로벌 비즈니스 매니저인 크리스티나 에플러(Kristina Effler)는 “그 동안 유량이 높으면 화학 처리 시스템이 적합하다는 가정 하에 운영이 이루어져 왔다”며 “그러나 오늘날에는 점점 더 많은 선주와 운영자가 PureBallast의 향상된 UV 살균 기술의 이점을 활용하고 있다. 이 기술은 기존 UV 시스템보다 훨씬 넓은 유량의 범위를 처리할 수 있다”고 말했다.

설치 비용 및 운용 비용 절감에 도움을 주는 PureBallast는 선박의 수명 주기를 통틀어 상당한 비용 절감에 기여하며, 다른 화학 살균 시스템이 따라올 수 없는 10년여의 컴플라이언스 보장 경력을 자랑한다. 알파라발 PureBallast 총괄 책임자인 앤더스 린드마크(Anders Lindmark)는 “알파라발 PureBallast에 대한 높은 관심은 retrofit 시장의 성장을 입증하며, 여러 이유가 있다”며 “최근 USCG 승인과 관련해서 알파라발이 많은 관심을 받고 있고 또한 IMO 협약에 대비하는 선주의 수가 늘어나고 있다”고 밝혔다. BWM 협약의 장기 기준 기간 내 선박평형수 처리 시

스템 선택을 완료하지 않을 경우, 9월부터 시행되는 관련 규정들에 즉각적으로 대응하는 것이 어렵다.

“알파라발은 현재 시장에 진입하는 고객을 안내할 만반의 준비를 갖추었다”고 린드마크는 말했다. 그는 “우리는 10년 이상의 선박평형수 처리 경험을 통해 풍부한 지식을 축적해 왔으며 선주의 선택을 돕기 위한 다양한 자료를 제공하고 있다”고 강조했다. 이러한 자료에는 평형수 관리에 대한 관한 새로운 백서를 비롯하여 다양한 규정에 대한 대안을 법적, 기술적, 비즈니스 측면에서 검토한 포괄적인 내용의 책자도 포함되어 있다.



## The MOF supports construction of large-scale car ferry and passenger ships

The Ministry of Oceans and Fisheries (MOF) will receive applications for participation in the project, titled ‘Coastal Passenger Ship Modernization Fund Project for the First Half of 2017’, in a bid to support construction of newbuild passenger ships that replace old fleets.

The types of vessels to be built in this project are car ferries and swift ships. Operators (shipping companies) of inner harbor passenger transportation business are eligible for financial support. The government will pay 50% of shipbuilding price

through funding, while ship lease companies organized separately will take on the role of ship owners. Shipping companies that participate in project are required to pay only a part of ship price (10% to 20%) to charter vessels (30-40% of ship price can be financed by financial institutions through mortgage on vessel as security).

The MOF provided support for construction of large-scale car ferry with a capacity of 19,000 tons through this project last year and plans to support construction of at least 2 passenger ships this year. In addition,

the MOF plans to increase the funding to approximately KRW 100 billion by 2019 from current KRW 35 billion.

An official from the MOF said, “We anticipate much attention from ship owners to this project designed to underpin ship modernization efforts of cash-strapped shipping companies and to revitalize domestic shipbuilding industry currently gripped by recession. We will press ahead with modernization of coastal passenger ships to ensure better services to passengers.”

### 해양수산부, 대형 카페리 여객선 건조 지원

해양수산부는 노후화된 국내 연안여객선의 신규 건조를 지원하는 ‘2017년 상반기 연안여객선 현대화 펀드 사업’의 사업 대상자를 모집한다.

이 사업을 통해 건조를 지원하는 선박은 카페리 및 쾌속선이며, 내항여객운송사업자(선사)가 신청 대상이다. 정부가 펀드를 통해 선박건조가격의 50%를 지

원하고 별도 설립한 ‘선박대여회사’가 선주가 되며, 사업에 참여한 선사는 선박 가격의 일부(10%~20%)만을 부담하고 선박을 용선에 사용할 수 있다.(선가의 30~40%는 선박을 담보로 금융기관 대출)

한편, 지난해 해양수산부는 이 사업을 통해 19,000톤급 대형 카페리 여객선 건조를 지원했으며, 올해도 2척 이상의 여객선 건조를 지원할 예정이다. 또한 이 사업을 위해 올해까지 350억원의 펀드를 조

성한 해양수산부는 2019년까지 약 1,000억원으로 펀드 규모로 확대할 계획이다.

해양수산부 관계자는 “영세한 선사의 선박 현대화를 지원하고 침체된 국내 조선산업을 활성화하기 위한 이번 사업에 많은 선사들이 관심을 가져 주시기 바란다”며, “연안여객선 현대화를 차질 없이 추진해 국민 여러분께 더 나은 여객 서비스를 제공할 수 있도록 노력하겠다”고 말했다.



## HHI solidifies cooperation with 3 countries of the Middle East

Hyundai Heavy Industries (HHI) announced that the ambassadors from the 3 countries of Middle East to Korea visited its Ulsan headquarters on April 6. On the same day, a lun-

cheon was held, attended by Riyadh bin Ahmed Almubarak, Saudi Arabian Ambassador to Korea, Mohamed Al-Dehaimi, Qatar's Ambassador to Korea, Mohamed

Salim Alharthy, Oman's Ambassador to Korea, along with executives of HHI, including Chairman Choi Kil-Seon, Vice Chairman Kwon Oh-Gap, etc., offering a platform to discuss

measures for reinforcing cooperation among respective countries in shipbuilding and onshore/offshore plant sectors.

HHI entered into strategic alliance with Saudi Arabia's state-owned oil company ARAMCO in November 2015 and is pushing forward many joint ventures, including establishment of shipyards in Saudi Arabia. Construction of joint shipyards has been thrust into limelight as national project of Saudi Arabia. That was illustrated by a ceremony held in the presence of Saudi Arabia's King Salman bin Abdulaziz Al Saud in December last year to announce

establishment of King Salman Shipbuilding Industrial Complex at the sites selected for joint shipyard project of HHI and ARAMCO.

HHI has carried out many onshore and offshore plant projects in Middle Eastern countries, including Saudi Arabia, and has delivered VLCCs (Very Large Crude Carriers), LNG carriers, LPG carriers, etc., to national shipping companies



in the Middle East, solidifying cooperative relationship with them.

### 현대중공업, 중동 3개국과 협력 강화

현대중공업은 지난 4월 6일 중동 3개국 주한대사 일행이 함께 현대중공업 울산 본사를 방문했다고 밝혔다. 이날 리야드 빈 아흐메드 알무바라키(Riyad bin Ahmed Almubarak) 주한 사우디 대사, 모하메드 알-데하이미(Mohamed Al-Dehaimi) 주한 카타르 대사, 모하메드 살림 알하르시(Mohamed Salim Alharthy) 주한 오만 대사 일행은 최길선 회장, 권오갑 부회장 등 현대중공업 경영진과 오찬을 하며 조

선 및 육·해상플랜트 분야에서 각국 간의 협력 강화방안 등에 대해 의견을 나눴다.

현대중공업은 지난 2015년 11월 사우디아라비아의 국영 석유기업인 아람코(ARAMCO)와 전략적 제휴를 맺고, 사우디 현지 조선소 건립 등 다수의 합작 사업을 추진하고 있다.

지난해 12월에는 살만 빈 압둘아지즈 알사우드(Salman bin Abdulaziz Al Saud) 사우디아라비아 국왕이 참석한 가운데 현대중공업과 아람코의 합작조

선소 건설 예정지에서 'King Salman 조선산업단지 선포 행사'가 열리는 등 합작조선소 건설은 사우디의 국가적 사업으로 주목받고 있다.

현대중공업은 사우디아라비아를 비롯한 중동 국가에서 다수의 육·해상플랜트 공사를 수행했으며, 중동 국적 선사들에 초대형 원유운반선(VLCC), LNG선, LPG선 등을 인도하며 긴밀한 협력관계를 이어 오고 있다.



## KOGAS injects momentum into development of marine engines for LNG-fuelled vessels

Korea Gas Corporation (KOGAS) signed an MOU (Memorandum of Understanding) with Doosan Infracore and Samjin Yard to develop 'marine LNG engine' at Incheon Gas Research Institute on March 27. Under this MOU, the 3 companies will develop and disseminate the technology for LNG engines for small and medium-sized vessels and generators.

KOGAS is currently developing technologies for newbuilding and remodeling of small-sized LNG-fuelled vessels in collaboration with Busan Metropolitan City and Yeongdo District Office. This MOU will allow KOGAS to target the LNG-fuelled vessels even more actively.

LNG-fuelled vessels provide excellent environmental protection effects, including

100% reduction in emissions of fine particulate matter and SOx (Sulfur Oxides) and 20% reduction in emissions of CO<sub>2</sub> (Carbon Dioxide) which are discharged in large quantities from diesel engines outfitted mostly to small-sized vessels.

Moreover, LNG-fuelled vessels are expected to help create new momentum of growth based on stronger technological capabilities and robust job creation for domestic shipbuilding and offshore industries likely to be gripped by low growth.

An official from KOGAS said, "LNG-fuelled vessel will be groundbreaking solution to



meet ever more rigorous requirements of international environment regulations on vessels. We will do our best to ensure that this blue ocean in shipbuilding and offshore industries can be unlocked through concerted efforts of public corporations and private-sector companies."

## 한국가스공사, LNG추진선 엔진 개발 협력

한국가스공사는 지난 3월 27일 인천 가스연구원에서 두산인프라코어, 삼진야드와 '선박용 LNG 엔진 개발'을 위한 MOU를 체결했다. 이번 MOU를 통해 3사는 중소형급 선박 및 발전기용 LNG 엔진에 대한 기술개발 및 보급에 나서게 된다. 현재 부산광역시, 영도구청과 소형 LNG추진선의 신

조 및 개조에 관한 기술개발을 진행하고 있는 한국 가스공사는 LNG추진선 시장에 보다 적극적으로 참여하게 됐다.

LNG 추진선은 소형 선박의 대부분을 차지하는 디젤 엔진이 다량 배출하는 미세먼지와 황산화물을 100%, 이산화탄소를 20% 저감시키는 등 환경보호 효과가 탁월하다. 또한 저성장이 우려되고 있는 국내 조선 및 해양 산업에 기술력 확보 및 일자리 창

출을 통해 새로운 성장 모멘텀 역할을 할 것으로 기대된다.

한국가스공사 관계자는 "LNG추진선은 엄격해지는 국제 환경 규제 분위기 속에서 기존 선박에 대한 획기적인 대안으로 자리 잡을 것으로 생각한다"며, "이와 같은 조선해양산업의 블루오션에서 공기업과 민간기업이 힘을 모아 좋은 성과를 거둘 수 있도록 최선을 다하겠다"고 말했다.

## 5.36 Million Convertible Preferred Shares of HSHI Acquired by IMM Private Equity for KRW 300 billion via pre-IPO

Hyundai Samho Heavy Industries (HSHI), a shipbuilding affiliate of Hyundai Heavy Industries (HHI), announced on Apr 24 it attracted 300 billion won investment via pre-IPO. Under the agreement HSHI signed with IMM Private Equity, a leading Korean private equity firm, HSHI will issue 5.36 million new convertible preferred shares and IMM PE will pay 300 billion won in total to acquire the shares at 56,000 won per share.

That deal brings HSHI's total market value at 2.5 trillion won. IMM PE's investment in HSHI will also serve as an opportunity to re-evaluate the corporate value of HHI that takes up 83.7% of HSHI.

The investment of IMM PE that has been in active in investing in shipping and shipbuilding sectors including Hanjin Newport and Hyundai Merchant Marine's LNG business shows its confidence in the recovery of shipbuilding industry for years to come.

An official from HSHI said, "IMM PE's investment puts more favorable valuation on HSHI than HSHI's competitors, which tells that IMM PE is confident that the market is likely to bounce back and the investment reflects the true valuation of HSHI's competitive edge."

Even in 2016 when market conditions were adverse with a dearth of orders, HSHI turned a profit with 3.8686 trillion won in sales and 171.5 billion won in operating profits with new orders of 15 ships valued at \$1.1 billion in total. Moreover in March this year, HSHI won \$240 million order to build four units of the world's first LNG-fueled Ice-Class IA Aframax tankers from Sovcomflot, the Russia's state-owned shipping company.

Shareholders	Before pre-IPO		After pre-IPO	
	Number of Shares	Share Ratio	Number of Shares	Share Ratio
HHI	37,967,000	94.9%	37,967,000	83.7%
IMM PE	-	-	5,357,143	11.8%
Employee Stock Ownership Association	705,699	1.8%	705,699	1.6%
Other Shareholders	1,327,301	3.3%	1,327,301	2.9%
Total	40,000,000	100.0%	45,357,143	100.0%

HSHI share ratio changes before and after pre-IPO

HSHI plans to finalize the approval of the deal early June this year through the meeting of Board of Directors, and to use the investment to lower its debt-to-equity ratio to 78.1% from current 96.4%.

IMM PE is a leading Korean private equity firm that was established in 2006. IMM PE has currently \$2.5 billion worth asset under management and has been investing in sectors including consumer/industrial goods and health care.

## 현대삼호중공업, IMM PE로부터 주당 56,000원 총 3,000억원 투자유치

현대중공업의 조선 자회사인 현대삼호중공업이 프리-IPO(상장 전 투자유치)를 통해 3,000억원 규모의 자금을 조달하는데 성공했다. 현대삼호중공업은 국내 톱티어(Top-tier) 사모펀드인 IMM PE와 3,000억원 규모의 프리-IPO에 관한 주요사항합의서를 체결했다고 지난 4월 24일 밝혔다.

이번 계약에 따라 현대삼호중공업은 전환우선주 536만주를 신주 발행하고, 이를 주당 56,000원에 IMM PE가 모두 인수하게 된다. 이에 따라 현대삼호

중공업의 시장가치는 2.5조원에 달해 이 회사의 지분 83.7%를 보유한 현대중공업의 기업가치 또한 재평가 받을 것으로 기대된다.

IMM PE는 조선·해운 산업에 지속적인 관심을 가지고 그동안 한진해운 신항만, 현대상선 LNG사업부 등 관련 분야에 다양한 투자를 집행해왔다. 이러한 조선·해운 분야의 전문성을 바탕으로 IMM PE는 향후 조선업황 회복을 확신하며 업계 선도기업으로서 높은 경쟁력을 보유한 현대삼호중공업 프리-IPO에 참여한 것으로 알려졌다.

현대중공업그룹 관계자는 "현대삼호중공업이 비상

장사임에도 불구하고, 이번 프리-IPO에서 동종업계 상장사보다 높은 수준의 가치평가를 받았다"며, "이는 향후 조선업황 회복에 대한 기대감과 현대삼호중공업의 사업 경쟁력이 충분히 반영된 결과"라고 밝혔다. 실제로 현대삼호중공업은 어려운 시황에도 불구하고, 지난해 매출 3조 8,686억원 영업이익 1,715억원으로 흑자전환에 성공했다. 또한 수주 가뭄 속에서도 지난해 15척 11억불을 수주했으며, 올해도 러시아 소브콤플로트(Sovcomflot)로부터 세계 최초 LNG추진 대형 유조선 수주하며 업계 선도 기업으로서 차별화된 면모를 보이고 있다. 현대삼호중공업은 6월



초 이사회에서 이번 프라-PO를 최종 승인하고 본 계약을 체결할 예정이다. 조달한 자금은 재무구조 개선을 위해 활용, 부채비율을 96.4%에서 78.1%로 획기적으로 개선한다는 계획이다. 현대중공업그룹 관계자는 “이번 프라-PO는 구조매

출 대신 신주발행 방식을 택해 현대삼호중공업이 투자금 3,000억을 모두 확보하는 구조”라며, “지난 분할을 통해 현대중공업의 재무구조가 충분히 개선된 것에 이어, 이번 투자유치로 자회사인 현대삼호중공업의 재무건전성 또한 크게 강화될 것”이라고 밝혔다.

한편 IMM PE는 2006년 설립돼 현재 운용자산이 3조원에 달하는 국내 최대 사모펀드 운용사 중 하나로, 지금까지 소비재, 헬스케어, 산업재, 유통 등 다양한 업종에서 투자를 진행하며 시장 입지를 공고히 하고 있다.

## LNG-fuelled VLOC joint design programme announced

Woodside Energy Ltd., Anangel Maritime Services Inc., Hyundai Heavy Industries Co., Ltd., General Electric Company and Lloyd's Register set out their intention to commence work on a joint project with an announcement at Gastech 2017 on 6 Apr.

The joint design programme is aimed at exploring the suitability of technologies for large ships, such as VLOC. Since the introduction of IMO nitrogen oxide and sulphur oxide emission limitations, and the increased developments in the global supply of gas, there is a continued need for ship designs to evolve to provide further alternatives to traditional oil-fuelled designs.

In this regard, the novel ship propulsion design burning natural gas is considered as the most favourable option and the adoption of novel gas storage, supply and propulsion

technologies are not only environmentally-friendly but also provide a wealth of possibilities for cost-efficient design and operation.

The next generation of cost efficient and environmentally-friendly large ships are best defined by the design development of an alternative propulsion system, improved asset safety and reliability. The agreement outlines the joint design project for a conventional dual-fuel powered VLOC incorporating proved technologies. The next stage of the joint design programme will then investigate the design and benefits of highly efficient next-generation LNG fuelled propulsion systems.



A photograph of the ceremony to announce the JDP, from left to right: Stavros Hatzigrigoris, MD, Maran Gas Maritime Warwick Pointon, VP Shipping, Woodside Energy Kisun Chung, Executive VP, Corporate Planning Office, HHI Jim Smith, North Asia Area Manager, Marine & Offshore, Lloyd's Register David Nelson, Director, Sales & Business Development, Marine, GE Aviation

A programme of work has been agreed by the joint parties to address design, construction and operational aspects including LNG bunkering, with the aim to create a new generation of cost efficient, safe, reliable and above all, environmentally-optimised design for large ore carriers.

## ABB's Marine Academy gains certification from DNV GL

ABB's Marine Academy has been recognized by classification society DNV GL for meeting its standards for maritime training. Operating in six locations around the globe, ABB's Marine Academy aims to reduce vessel downtime and improve safety through education. ABB was awarded the DNV GL SeaSkill certificate following an extensive audit by the classification society and it will be valid for the next five years.

With electrical systems playing a greater role onboard, ABB is seeing a strong demand from the maritime sector to ensure the skills

of crew members remain up-to-date. “The Marine Academy is a vital link between ABB and the maritime industry,” said Klaus Moldskred, Sales & Marketing Manager, ABB Marine Academy. “Our commitment to improving safety onboard does not stop with our equipment or service agreements; proper training of the crew is also vital.”

A study by DNV GL indicates that up to 90% of accident at sea are caused by human error and ABB's courses are aimed at addressing this problem.

“We are delighted our Marine Academy has



been recognized by DNV GL as a provider of high quality maritime education. ABB is not just a provider of electrical systems; we also prioritize the training of the crew who use our equipment,” said Moldskred.

## Seaspan trusts MacGregor for a series of container stowage system upgrades

Seaspan Corporation has placed an order with MacGregor for cargo system update of its eleven 10,000 TEU container vessels. Seven of the ships were returned to Seaspan from the bankrupt South Korean container carrier Hanjin Shipping and four of the ships are in final stage at the shipyard.

The work will be carried out under a MacGregor Cargo Boost service, which is designed to improve cargo carrying efficiency and the earning potential of existing container vessels. The upgrades include an individual plan for these vessels with focus on improving the vessel's earning potential resulting in efficient, modern and attractive fleet for today's challenging market. In addition to cargo efficiency upgrades, Seaspan also implemented other structural changes

to improve the fuel efficiency as well.

The works on the ex-Hanjin vessels were started 20th January 2017 at three repair yards in Zhoushan area and the last vessel will be completed by the end of March 2017. The remaining four ships will be upgraded within April 2017. Some of the vessels have already returned to service.

"Market conditions and technology are always evolving; in this fleet upgrade program, we have taken advantage of the latest technology to deliver more competitive ships for our clients. We trusted MacGregor because of our long co-operation and their ability deliver the overall cargo system upgrade from design and hardware to training and the software in form of Interschalt MACS3 loading computer," said

Peter Jackson, Vice President, Projects and Technology of Seaspan.

"The configuration for each upgrade case may be different, but all are designed to maximise the vessel's earning potential and bringing those to par with newer vessels. It is a combination of mechanical and engineering solutions together with software and trainings. The main target is to deliver greater cargo system flexibility to allow a wider range of containerised cargoes," said Leif Byström, Senior Vice President, Cargo Handling Division at MacGregor.

The contracts were signed in December 2016 and January 2017 and reported accordingly.

## DSME and DNV GL partner for efficient LNG carrier design

At the Gastech 2017 conference in Tokyo, Japan, Daewoo Shipbuilding & Marine Engineering (DSME) and DNV GL presented the results of a joint development project (JDP) for the design of an innovative, efficient LNG carrier based on today's technology. The project focused on delivering a design which an owner can take straight to the yard and is ready for upcoming market trends and incoming regulations, with an optimal size, hull form, and machinery and electrical systems.

"When we look at today's LNG market we predict that in the years to come we will see the rise of post-Panamax LNG carrier designs which are dimensioned to fit of the new Panama Canal. Capacities of over 175,000 m<sup>3</sup> are feasible given the new restrictions," said Johan Petter Tuttoren, DNV GL – Maritime Business Director Gas Carriers.

An important consideration for the design is

the shift towards lower, more energy-efficient transit speeds. The hull and propulsion system have been optimized for three different operating profiles on a standard transpacific route (19.5, 16 and 12 knots). Calm water optimization resulted in gains of 6%, 2% and 5% over the reference design at each of the three operating profiles. The optimization calculations were performed using the DNV GL hydrodynamic analysis software Wasim as well as statistics and Reynolds-averaged Navier-Stokes (RANS) simulations for determining wave resistance.

The design uses direct-coupled, two-stroke dual-fuel (DF) main engines and DF auxiliary engines, with LNG as the primary fuel. A combined gas turbine, electric and steam (COGES) propulsion system was chosen for the optimized machinery.

For the portion of the boil-off gas used as LNG fuel a "High Manganese Steel Cargo Tank Independent Type B" was chosen and



DSME's new efficient LNG carrier design

underwent closed mock-up testing using liquid nitrogen (LN<sub>2</sub>). This was selected for its excellent tensile properties, high performance and product capacity at low cost, and allows flexible tank shapes while being slosh-free without imposing any filling limitations.

The design also incorporates DSME's SloT<sup>®</sup> (Ship Internet of Things) technology and their wireless computer network and integration system Smartship 4.0. In addition, the entire on-board computer environment underwent thorough testing to improve its cybersecurity.



## HMD and DNV GL present world's first double side-hull LPG carrier

DNV GL presented Hyundai Mipo Dockyard (HMD) with an approval in principle (AIP) certificate for a new double side-hull LPG carrier design - LPG SAFE (Structural Advances for the Environment) on Apr 7.

The result of a development project conducted by HMD working closely together with DNV GL, the AIP certificate confirms that the design complies with the new DNV GL rules for the classification of ships. The innovative LPG SAFE design is the first 38K LPG carrier design to provide the safety benefit of a double side-hull, while offering the same cargo carrying capacity and the same construction cost as a conventional design.

"We have been able to maintain the same cargo capacity as the single side-hull

design by optimising the structural configuration of the no. 1 and no. 3 cargo tanks design, in combination with finite element (FE) analysis and using the DNV GL rules to optimize the scantlings, weight and hull strength," said Dug Ki Min, Vice President, HMD Seoul. "Furthermore, the new design with its simple hull shape and double hull construction could offer our employees an improved working environment during production of the vessel, resulting in higher quality deliveries."

LPG carriers are designed to carry liquefied gases such as propane or butane in bulk. The ships are normally equipped with cargo tanks inside the hold, with Type A independent cargo tanks arranged inside the hold,

supported on insulation-bearing blocks which typically consist of wooden chocks installed on the inner bottom structure. The double side-hull design of LPG SAFE offers a significant increase in protection for these tanks, especially in the event of a collision.

"It has been a great pleasure for us to work with HMD throughout their design and analysis process and our verification and review of this concept," said Hwa Lyong Lee, Regional Business Development Manager, DNV GL - Maritime. "The LPG SAFE design has shown a measurable improvement in safety, while retaining capacity, strength and cost, and we are very honoured that HMD selected us to work with them to realize this extremely interesting and exciting concept."



## 현대일렉트릭, 에너지 관리 신사업 본격화

현대중공업에서 분리된 현대일렉트릭이 신사업으로 추진 중인 에너지 솔루션 브랜드 '인티그릭(INTEGRIC)'을 국제산업박람회인 '하노버 메세(Hannover Messe) 2017'에서 처음으로 공개했다.

'인티그릭'이란 정보통신기술(CT)을 활용해 빌딩과 공장, 선박의 전력기기를 원격 제어하고 가동 정보를 분석해 에너지 효율 향상과 유지·보수를 지원하며, 전기·열·가스 등 각종 에너지 시설을 하나의 체계로 통합 관리해 최적의 상태로 운영하는 지능형 솔루션을 말한다.

현대일렉트릭은 약 33평(110㎡) 규모의 전시 부스를 마련하고, 빌딩·공장의 에너지 사용을 최적화하는 '에너지 관리 솔루션(Energy Management Solution)'과 선박기관 및 전력 계통을 원격으로 관리하며 경제운항을 지원하는 '스마트십 솔루션(Smart Ship Solution)' 등 인티그릭 관련 기술을 홍보했다.

또한 스마트폰과 태블릿PC로 전력 소비량과 온도 등 기기의 가동 정보와 유지·보수 매뉴얼을 한눈에 확인할 수 있는 증강현실(AR) 부스를 운영하는 등 다양한 체험 행사를 통해 현지 고객들의 관심을 끌고 있다.

앞서, 현대일렉트릭은 올해 340억 달러에서 2020년 500억 달러까지 성장이 예상되는 에너지 솔루션 시장을 공략하기 위해 미국 디지털 기업인 PTC사와 함께 산업용 사물인터넷(IoT) 플랫폼을 출시하고, 이를 적용한 전력기기 제품과 관련 기술 서비스를 '인티그릭'이란 브랜드로 통합했다.

현대일렉트릭은 최근 강릉 씨마크(Seamarc) 호텔에 '에너지 관리 솔루션'을 적용해 한국에너지공단으로부터 에너지 저감 효과와 신뢰성 등을 인정받아 국내 상업시설로는 처음으로 '건물 에너지 관리 시스템 설치 확인' 1등급을 획득했으며, 이달 말 '스마트십 솔루션'을 6,500대급 자동차운반선에 설치한다.

현대일렉트릭 관계자는 "제조업을 뛰어넘어 빅데이터 등 최신 정보통신기술을 적용한 스마트 서비스로 새로운 활로를 개척하고 있다"



며, "다양한 전력설비들을 편리하게 관리하고 유지·보수할 수 있는 인티그릭을 통해 자산관리 분야에 획기적인 변화를 이끌어낼 것"이라고 말했다.

전기전자 전문기업 기업인 현대일렉트릭은 지난 4월 초 새롭게 출범한 이후, 기존 전력설비의 생산은 물론 컨설팅, 시공까지 고객의 효율적인 에너지 관리를 지원하는 '에너지 솔루션 사업'을 강화하며 미래 성장 동력을 확보하는데 박차를 가하고 있다.



# Bright outlook for LNG fuelled vessel orders

- Korean shipyards with leading technologies are more likely to take benefit
- LNG-fuelled vessel orders on the rise amid more stringent environmental regulations



Global oil giant Shell published its outlook on LNG for this year with a prediction that LNG demand would rise by 4-5% annually. Global LNG market has witnessed growth of demand amid the rising demand for LNG power generation in countries including India and China. LNG, an eco-friendly fuel, has been touted as the solution to cope with rigorous environmental regulations designed to curb emissions even in ship market. LNG-fuelled vessels have come into the spotlight as one of future growth engines in the midst of enforcement of ever more stringent environmental regulations around the globe. The number of LNG-fuelled vessel market is expected to reach at least 300 units, comprising 10% of

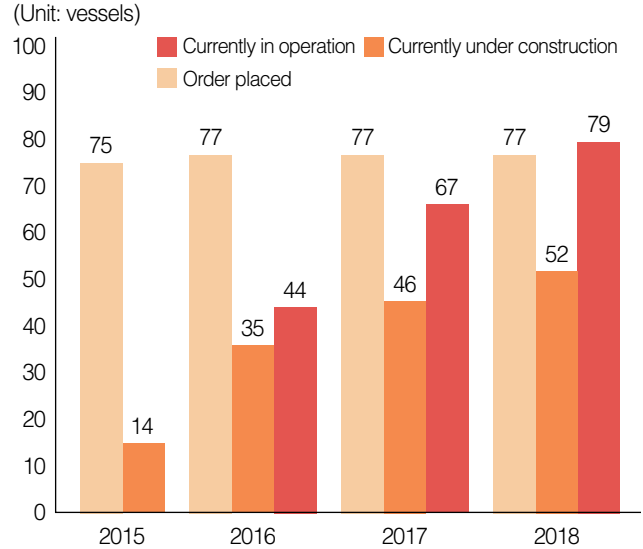
newbuild vessels by 2020. Europe, China, Japan, etc., including Korea which have leading technologies, are scrambling to build LNG-fuelled vessels and develop related equipments, thus adding vitality to shipbuilding industry plagued by order drought.

Korea's 3 shipbuilding heavyweights are the only companies capable of medium and large-sized LNG-fuelled vessels in global market. There is a mounting expectation that LNG-fuelled vessel order placement, driven by the need to comply with environmental regulations, may bring much-needed respite to Korean shipbuilding industry in the grip of order drought.



**T**here has been a heightened interest in the trend of order placements for LNG-fueled vessel, an eco-friendly type, amid enforcement by the IMO (International Maritime Organization) of ever more stringent regulations on emissions from ships which have been blamed for air pollution. According to DNV-GL, the LNG-fueled vessel market is expected to expand and be worth USD 100 billion by 2025.

The IMO has already set up and operated the emission control area (ECA). The access to the ECA, including the Baltic Sea and the seas of the United States, has been limited to the vessels using the fuel oil with sulfur content below 1.0%



Status of global LNG-fueled vessels (Source: DNV-GL)

since July 2010. The cap on sulfur content in marine fuel was further reduced to below 0.1% after January 2015. For vessels operating outside the ECA, the cap on sulfur content in marine fuel has been limited to 3.5% since 2012. In October last year, the IMO adopted an even more rigorous environmental regulation that lowered the global cap on sulfur content in marine fuel to 0.5% by 2020. As a result, even vessels powered by MGO (Marine Gas Oil), as well as most vessels using HFO (Heavy Fuel Oil) as fuel, are subject to this environmental regulation set forth by the IMO. In that regard, marine fuel is expected to be replaced by eco-friendly fuels such as LNG, LPG, etc., which emit less amount of sulfur oxides, nitrogen oxides, and carbon dioxide, instead of bunker C-oil.

### Hot issues

Global shipbuilding industry is anticipating a turnaround in the newbuilding market this year in the wake of adoption of SOx regulations. A realistic solution would be the ship replacement or LNG-fueled vessel. According to Clarkson, the number of vessels aged 20 years or older will reach 46,000 by 2020 which represents a half of the existing 92,000 vessel. Out of them, 10% or approximately 8,000 to 9,000 units are expected to be replaced.

Korea has unique technologies for construction of vessels that use LNG as fuel. Small-size LNG carriers can be also built by foreign shipbuilders, but mid and large-sized LNG

carriers can be built only by about 3 Korean shipbuilders such as Hyundai Heavy Industries (HHI), Daewoo Shipbuilding & Marine Engineering (DSME), and Samsung Heavy Industries (SHI).

There are currently more than 80 LNG-fuelled vessels operating worldwide, and more than 80 units are under construction. National flag carriers, such as those of the U.S., Canada, U.K., Germany, etc., are already pressing ahead with construction of various commercial vessels including containerships. The number of LNG-fuelled vessels is expected to reach about 300 units, comprising 10% of total newbuilding market, by 2020. Furthermore, experts predict that most of world's vessels will use LNG as fuel by 2050.

Meanwhile, China recently announced that it would convert ordinary vessels using bunker C oil into LNG-fuelled vessels by next year. Total number of these vessels currently stands at about 1,000 units and China has already designated 3 regions as ECA (Emission Control Area), responding vigorously to SOx regulations.

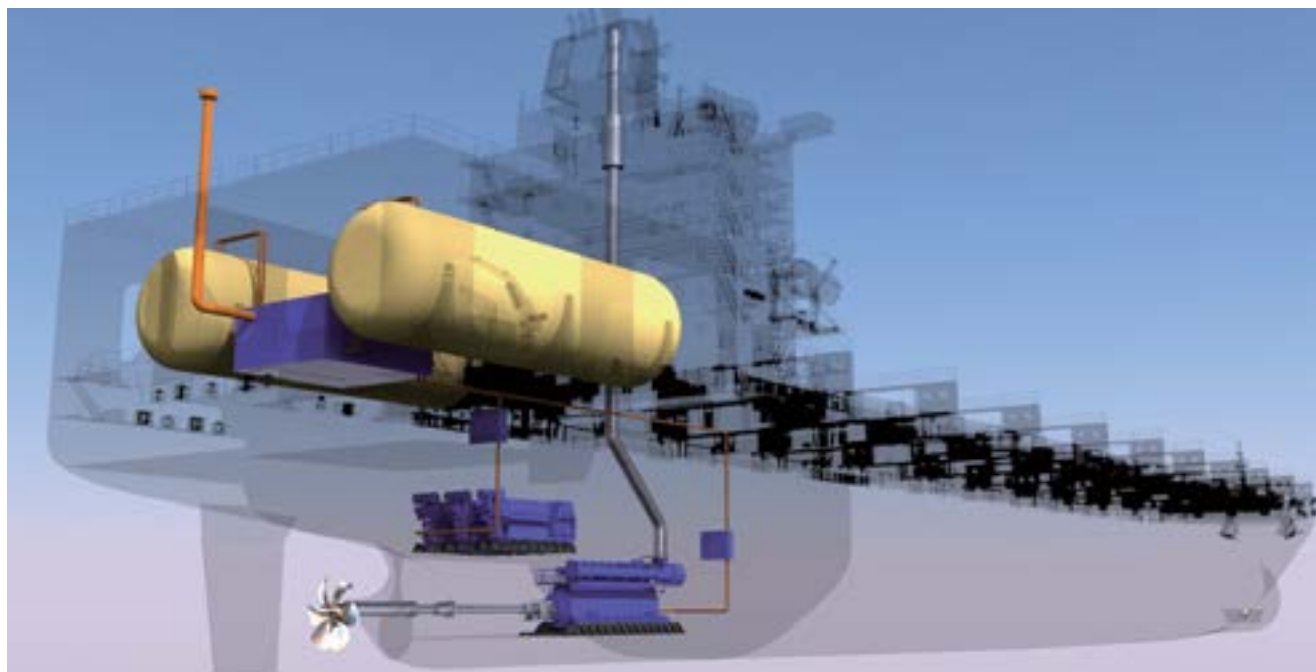
### Vigorous technology development for LNG-fuelled vessels

A shift in marine fuel has been spurred by the rising global LNG demand and resultant increase in LNG shipbuilding orders and ship replacement demand. Russia's SCF

(Sovcomflot), which ordered LNG-fuelled Aframax tanker for the first time in the world, announced that it would replace about 60 LNG carriers mostly with LNG-fuelled vessels within the next 5-6 years. Last month, Hyundai Heavy Industries (HHI) secured an order worth about USD 240 million from SCF for 4 units of oil tankers using the LNG as marine fuel. In 2015, Daewoo Shipbuilding & Marine Engineering (DSME) became the first shipyard to apply LNG propulsion fuel technology to a 3,100 TEU container ship built at NASCO Shipyard in the United States.

In some cases, shipping companies convert vessels powered by bunker-C oil into LNG-fuelled vessels to meet ever more stringent global environmental regulations. Samsung Heavy Industries (SHI) recently revised a contract so as to convert 2 oil tankers, out of the 4 units ordered by Malaysia-based AET (American Eagle Tanker) in 2015, into LNG-fuelled vessels at the request of ship owner.

As the need for LNG vessels increases, Korean shipyards have increased expectations for new order intakes. Korea's 3 shipbuilding heavyweights, such as Hyundai Heavy Industries (HHI), Samsung Heavy Industries (SHI), and Daewoo Shipbuilding & Marine Engineering (DSME), have the world's strongest technology competitiveness and unrivalled shipbuilding technologies in LNG carrier and LNG-fuelled vessel sectors. Particularly, these shipyards have



shown strong performance in the fields of LNG carriers and LNG-FSRU.

Korean shipyards are also actively developing technologies related to LNG-fuelled vessels. Hyundai Heavy Industries (HHI) announced that it would install the LNG-FSRU, developed with its proprietary technology, for the first time on board the 170,000m<sup>3</sup> LNG-FSRU ordered by an European ship owner this year for delivery in 2019. In addition, the existing containerships are being designed in such a way so as to ensure compatibility with LNG-fuelled vessels, targeting the LNG-fuelled vessel remodeling market.

DSME already developed and commercialized a high-pressure natural gas fuel supply system (HiVAR-FGSS) in 2011 which increased LNG fuel efficiency. Sungdong Shipbuilding & Marine Engineering (SSME) also obtained certification from Lloyd's Register for practical application of LNG fuel propulsion technology for 11,000 TEU class containership last year, targeting the LNG-fuelled vessel market.

### LNG with high fuel efficiency

According to the Korean Register of Shipping (KR), ship owners need to use LSFO (Low Sulfur Fuel Oil) or LNG (Liquefied Natural Gas) as marine fuel or to install SOx (Sulfur Oxides) reducing system in order to meet ever more rigorous regulations that aim to curb emissions of pollutants from ships. If vessels are equipped with emission reduction systems, fuels with high sulfur content can be still used which will however result in initial facility investment cost as high as USD 2-5 million per unit of vessel. Furthermore, consideration needs to be given to arrangement of exhaust pipes and equipment that controls back pressure increase in exhaust pipes when emission reduction systems are installed. The use of LSFO (Low Sulfur Fuel Oil) is the simplest way to meet requirements of environmental regulations without the hassle of installing additional equipment, but that requires care to be taken due to the contents which can cause wear or clogging of internal parts of engine in addition to high prices. By contrast, LNG, if used as marine fuel, is eco-friendly and provides over 20% higher heat output, compared to fuel with high sulfur content, thus reducing ship operation costs.

Currently, LNG is more cost-effective marine fuel. The price of fuel oil per ton is about USD 280 for HFO (Heavy Fuel Oil) with 3.5% sulfur content, approximately USD 400 for LSFO (Low Sulfur Fuel Oil) with 0.5% sulfur content, and USD 430 for LSFO with 0.1% sulfur content.



5 million btu (MMBtu) equivalent to 1 ton of liquefied natural gas (LNG) is traded at the price of USD 238. MGO with sulfur content of 0.1% is priced at USD 460 per ton which is twice more expensive compared to LNG.

LNG-fuelled vessels still has technical limitation which has been pointed out as disadvantage. When LNG is used as marine fuel, installation costs will be incurred from storage tank, double pipe facility, etc., which are needed for safe supply of LNG to engine while the space for cargo is reduced. Although bunkering facilities used to supply LNG to vessels are still limited to Europe, the newbuilding market is expected to heat up with LNG-fuelled vessels in hot issue due to enforcement of ever more stringent environmental regulations.

### Expansion of LNG-fuelled vessel market

A total of 80 LNG-fuelled vessels are currently operational, which are mostly small and medium-sized vessels. That is a small number, considering that the number of internationally operating vessels exceeds 60,000 units. However, LNG-



fuelled vessels are expected to find broader range of applications, such as containerships, etc., in the wake of enforcement of environmental regulations.

By ship type, the proportion of car ferry is still high, but 2 containerships are still operating. As 80 units of LNG-fuelled vessels are currently under construction, LNG-fuelled vessels are undergoing diversification into various types such as LNG carriers, oil tankers, containerships, etc., and scaling up from small-sized vessels to large-sized vessels.

New order placement for LNG-fuelled vessels, mostly small and medium-sized units, has been led by ship owners of Europe and the United States due to technological constraints. However, there has been a heightened interest in LNG-fuelled vessels among ship owners of Asia, including China, Japan and Singapore. In global shipbuilding market, the replacement cycle of old vessels was expected to be hastened due to adoption of SOx regulation and BWMS (Ballast Water Management System) regulation. Industry experts agree that the switch to LNG-fuelled system is unavoidable, given that most existing vessels currently in operation use mechanical engines which cannot cope with the SOx regulations slated to take effect. Ship replacement demand is expected to soar to an extent that vessels to be replaced with LNG-fuelled vessels will outnumber the tankers (5,000 units) replaced entirely with double hull vessels over the period of 8 years in early 2000s.

### LNG price competitiveness holds the key

The greatest stumbling block hindering the spread of LNG-

### Eco-friendly LPG-fuelled vessel

LPG-fuelled vessels have been thrust into limelight as another solution to meet environmental regulations on emissions from ships. Japan-based Astomos Energy recently pointed to the potential of LPG-fuelled vessels. LPG is an eco-friendly fuel that emits 99.9% less SOx (Sulfur Oxides) and 15-20% less NOx (Nitrogen Oxides), compared to existing marine oils. Additionally, LPG can reduce fine particulate matters by 0.3% and carbon dioxide emissions by more than 30%, compared to conventional diesel-powered vessels. Moreover, LPG-fuelled vessel enables easy transportation and supply of fuel, thus increasing the ease of bunkering, and has the advantage of reducing initial facility investment cost incurred from installation of fuel tanks, etc., compared to LNG-fuelled vessels. LPG, if used to power the vessels, has less price competitiveness in comparison to LNG.

In the meantime, GE signed an MOU (Memorandum of Understanding) with Korean companies last year for cooperation in development of LPG-fuelled ferries, thus embarking upon full-scale development of vessels. Specifically, GE set a goal of completing development of the world's first of LPG-fuelled ferries outfitted with 'COGES (Combined Gas turbine Electric & Steam)', a ship propulsion system in the next 2 to 3 years.

fuelled vessels is the issue of economic efficiency. Currently, natural gas fuel is more expensive than conventional bunker C oil. Since 2020, global cap on sulfur content in marine fuel will be reduced to 0.5% from 2020, but it is not necessary to use LNG in all cases. In that regard, experts agree that dual fuel engines operating on both natural gas and bunker C-oil are likely to be adopted. For ship owners, fuel prices are directly linked to sales revenue. It is not an easy decision to use expensive fuel.

In fact, price of LNG fuel is higher than that of bunker C oil. The impact of sustained low oil prices has also been a factor. Experts indicate that 20% or more price reduction is necessary to ensure competitiveness. This sector is dictated by the trends of international oil prices. Eventually, the spread of LNG-fuelled vessels is unlikely without price competitiveness. ⚓



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# ABB to acquire B&R - Shaping leadership in industrial automation

Acquisition of B&R will close ABB's historic gap in machine and factory automation, also creating a uniquely comprehensive automation portfolio for customers globally.

ABB announced the acquisition of B&R (Bernecker + Rainer Industrie-Elektronik GmbH) on 4 Apr, the largest independent provider focused on product- and software-based, open-architecture solutions for machine and factory automation worldwide. B&R, founded in 1979 by Erwin Bernecker and Josef Rainer is headquartered in Eggelsberg, Austria, employs more than 3,000 people, including about 1,000 R&D and application engineers. It operates across 70 countries, generating sales of more than \$600 million (2015/16) in the \$20 billion machine and factory automation market segment. The combination will result in an unmatched, comprehensive offering for customers of industrial automation, by pairing B&R's innovative products, software and solutions for modern machine and factory automation with ABB's world-leading offering in robotics, process automation, digitalization and electrification.

Through the acquisition, ABB expands its leadership in industrial automation and will be uniquely positioned to seize growth opportunities resulting from the Fourth Industrial Revolution. In addition, ABB takes a major step in expanding its digital offering by combining its industry-leading portfolio of digital solutions, ABB Ability, with B&R's strong application and software



platforms, its large installed base, customer access and tailored automation solutions.

"B&R is a gem in the world of machine and factory automation and this combination is a once-in-a-lifetime opportunity. This transaction marks a true milestone for ABB, as B&R will close the historic gap within ABB's automation offering. This is a perfect fit and will make us the only industrial automation provider offering customers the entire spectrum of technology and software solutions around measurement, control, actuation, robotics, digitalization and electrification," said ABB CEO Ulrich Spiesshofer. "This acquisition perfectly delivers on our Next Level strategy. With our unique digital offering and our installed base of more than 70 million connected devices,

70,000 control systems and now more than 3 million automated machines and 27,000 factory installations around the world, we enable our combined global customer base to seize the huge opportunities of the Fourth Industrial Revolution."

"This combination offers fantastic opportunities for B&R, its customers and employees. We are convinced that ABB offers the best platform for the next chapter of our growth story. ABB's global presence, digital offering and complementary portfolio will be key for us to further accelerate our pace of innovation and growth," said Josef Rainer, co-founder of B&R.

"This is a strong signal for our employees as our operations in Eggelsberg will become ABB's global center for machine and factory automation," said

Erwin Bernecker, co-founder of B&R.

### Complementary strengths

With the acquisition, ABB will expand its industrial automation offering by integrating B&R's innovative products in PLC, Industrial PCs and servo motion as well as its software and solution suite. ABB will offer its customers a uniquely comprehensive, open-architecture automation portfolio. B&R has grown successfully with a revenue CAGR of 11 % over the last two decades. Revenues more than quintupled since 2000 to more than \$600 million (2015/16). The company has a rapidly growing global customer base of more than 4,000 machine manufacturers, a proven track record in automation software and solutions and unrivaled application expertise for customers in the machine and factory automation market segment.

Both companies have complementary portfolios. ABB is a leading provider of solutions serving customers in utilities, industry and transport & infrastructure. B&R is a leading solution provider in the automation of machines and factories for industries such as plastics, packaging, food and beverage. The joint commitment to open architecture increases customer choice and flexibility facilitating connectivity in increasingly digitalized industries.

### Substantial investments in innovation

Innovation is at the heart of both companies. B&R invests more than 10 percent of its sales in R&D and employs more than 1,000 people in R&D and application engineering. ABB spends \$1.5 billion annually on R&D and employs some 30,000 technologists



ABB Group Headquarters, Zurich, Switzerland

and engineering specialists. Going forward, ABB and B&R will continue to invest considerably in R&D.

Automation of machines and factories is a key driver of the Fourth Industrial Revolution and the IoT. ABB will continue B&R's strong solution-based business model and build on its deep domain expertise to develop new software-based services and solutions for end-to-end digitalization. ABB's industry-leading digital offering, ABB Ability, will now capitalize on the large installed base, application and solution know-how, simulation software expertise and advanced engineering tools of B&R.

### Proven integration approach

On closing of the transaction, B&R will become part of ABB's Industrial Automation division as a new global business unit - Machine & Factory Automation - headed by the current Managing Director, Hans Wimmer. Both companies consider B&R's management and employees as a key driver of future growth and the business integration together with their counterparts from ABB. The co-founders of B&R, Erwin Bernecker and Josef

Rainer, will act as advisors during the integration phase to ensure continuity.

The integration will be growth-focused and live by the "best-of-both-worlds" principle, with ABB adding its own PLC and servo drive activities to the offering of the new business unit in a phased approach. ABB underlines its clear commitment to continuing the B&R growth story by articulating a mid-term sales ambition to exceed \$1 billion.

ABB is committed to further investing in the expansion of B&R's operations and to building on the company's successful business model and brand. B&R's headquarters in Eggelsberg will become ABB's global center for machine and factory automation.

With this acquisition, ABB becomes the largest industrial automation player in Austria. ABB has operated in Austria for more than 100 years. With the strong future role, B&R and its headquarters in Austria will play as part of ABB, Austria, particularly Upper Austria, will benefit. The planned expansion of the R&D and production activities in Eggelsberg and Gilgenberg will strengthen Austria's high-tech industrial landscape. 

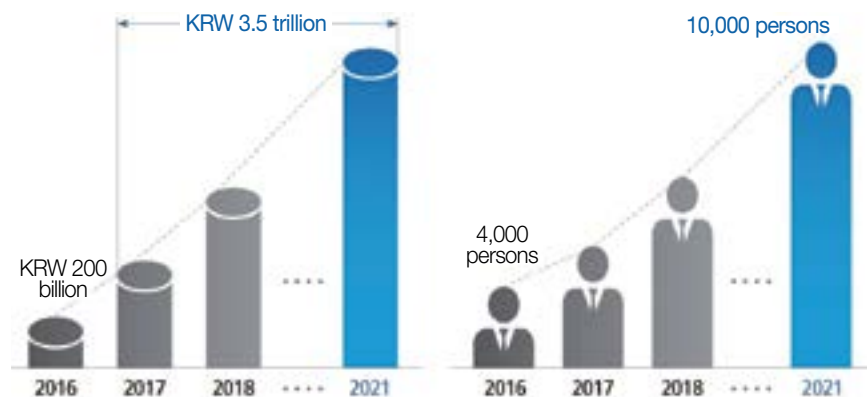
# HHI Group set to invest KRW 3.5 trillion in technology development by 2021

Hyundai Heavy Industries Group, split into 4 independent entities, made a fresh start on April 1 with high expectations from the market and investors.

Hyundai Heavy Industries Group, split into 4 entities (Hyundai Heavy Industries, Hyundai Electric & Energy Systems, Hyundai Construction Equipment, and Hyundai Robotics), held a tree-planting ceremony in front of the main building of its Ulsan Headquarters on April to announce the vision of second leap forward, attended by major officials including HHI Chairman Choi Kil-seon, HHI Vice-Chairman Kwon Oh-Gap, and presidents from 6 member companies of the Group.

On the same day, the 4 independent entities of Hyundai Heavy Industries Group unveiled the technology and quality-focused management strategy centered around the plan to invest KRW 3.5 trillion in technology development, secure 10,000 design and R&D (research and development) personnel, and introduce new HR management system by 2014.

This represents an aggressive effort of Hyundai Heavy Industries Group to identify new growth engines through bold investment in technological development and quality improvement even in the midst of unstable business environment such as sluggish market conditions of shipbuilding and offshore sector, the key area of the Group's business, and persistent global recession. For quality enhancement of its products and services, HHI will set up les-




sons-learned database by accumulating engineering failure cases while HEES, HCE, and HR will further accelerate technology development drives to secure competitive product lineup. Moreover, the four companies will appoint chief technology officers in charge of driving product development, drafting technology strategy, and nurturing human resources, and expand numbers of researchers to 10,000 from current 4,000.

HHI Group also introduces new HR management system that simplifies current 5-tier ranking system to 3-tier one to build up horizontal and creative organization culture and to liven up communications among employees. The companies also introduce performance-based pay system marking the departure from current seniority-based one.

At a tree planting ceremony at HHI's

Ulsan shipyard to commemorate HHI Group's rebirth, vice chairman & CEO of HHI Kwon Oh-gap remarked, "As today marks new chapter in our history, the three newly established companies will make utmost efforts to rank the global top 5 in their respective fields by making quality and technology top priorities."

Under the plan, the new HHI will invest USD 1.8 billion in developing eco-friendly and smart ships, enhancing offshore engineering capability, and establishing smart ship yard. Hyundai Electric & Energy Systems (HEES), Hyundai Construction Equipment (HCE) and Hyundai Robotics (HR) will also make an investment of USD 640 million, 620 million and 90 million for technological innovation respectively. In the longer-term, HHI Group plans to spend 6-7% as a percentage of annual sales in R&D. 

# Inmarsat FleetBroadband takes major step toward formal GMDSS approval

The role of Inmarsat as the sole provider of satellite technology performing to GMDSS standards is set for advancement, after an IMO Sub Committee decided to greenlight consideration of both FleetBroadband and Fleet One for formal approval.

On 5 April, Inmarsat is the only company which has received approval from the IMO (International Maritime Organization) to provide the Global Maritime Distress and Safety System (GMDSS) data and messaging communications on which mariners rely in the last resort, currently via Inmarsat C and Fleet 77 services.

IMO delegates tasked with modernising GMDSS at a Navigation, Communications and Search and Rescue (NCSR) Sub-Committee meeting in March agreed that FleetBroadband should undergo the necessary and technical assessment by IMSO (International Mobile Satellite Organization), with a report provided for consideration by the next NCSR in 2018. According to an assessment offered by the IMO's UK delegation, FleetBroadband has achieved availability surpassing the 99.9 per cent required for GMDSS by IMO in every year since January 2010.

Operating on L-Band via the Inmarsat fleet of four I-4 satellites, Inmarsat FleetBroadband terminals are equipped with the same GMDSS functionality as Inmarsat-C. Today, around 160,000 Inmarsat-C terminals are installed on ships operating worldwide.


"Given that most of FleetBroadband's components already meet IMO performance standards, the service is on course for a formal approval, and this is

very much in line with the agreed timetable for the modernisation of GMDSS," said Peter Broadhurst, Inmarsat Maritime Senior Vice President, Safety and Security. "Our continuing commitment to investment in L-Band includes the development of a new Maritime Safety Terminal (MST) to enable easier functionality, standardised interface and information rich safety data."

GMDSS capabilities have been supported solely by Inmarsat since its inception from the 1st February 1999, ensuring that thousands of lives have been saved. "Safety is a cornerstone of all Inmarsat services to the maritime community," said Broadhurst. "It's in our DNA."

He added that an information paper provided to IMO by the UK delegation had noted that FleetBroadband effectively complies with GMDSS while offering enhanced safety and distress features. NCSR was satisfied that

Inmarsat had met the last Maritime Safety Committee's request to offer detail of outstanding matters to IMSO. This had opened the way for FleetBroadband's approval to progress, Broadhurst said.

FleetBroadband has been Inmarsat's flagship maritime service for a decade and currently supports connectivity onboard 45,000 vessels. Offering dependable, seamless coverage, it was the first maritime communications service to deliver cost-effective, broadband data and voice simultaneously through a compact antenna. The L-band service is far less susceptible to rain fade than VSAT, Ku-band or C Band systems. FleetBroadband also provides continuous back-up for the Ka-band connectivity offered through Fleet Xpress, the Inmarsat service launched in March 2016 that takes maritime communications to the next level. 



# SCF Group chooses WinGD's X-DF for the first ever gas-powered Aframax tanker

Extending the benefits of its dual-fuel technology beyond LNG carriers with a world premiere, Winterthur Gas & Diesel (WinGD) has announced that its low-speed dual-fuel engines with X-DF low-pressure gas admission will propel the first ever gas-fuelled Aframax crude oil tankers.

Under a contract signed in March 2017, SCF Group, Russia's largest shipping company, has chosen seven-cylinder, 62 cm bore type 7X62DF engines from WinGD's X-generation to propel a series of four LNG-fuelled Aframax-class tankers. The ships will be built by Hyundai Heavy Industries (HHI) of South Korea at its shipyard in Samho, while the 7X62DF engines will be built by HHI's Engine & Machinery Division (HHI-EMD) in Ulsan, South Korea.

The 7X62DF engines are rated 13,800 kW at 86 rpm and designed to operate on a choice of LNG, HFO, distillate or hybrid liquid fuels. The engines comply with IMO Tier III limits for oxides of nitrogen (NOx) in their gas fuel mode, and with IMO Tier II when burning liquid fuel. To enable IMO Tier III compliance on liquid fuel operating mode, the contract also specifies the supply of low-pressure selective catalytic reduction (SCR) after treatment systems for the 7X62DF engine.

As well as the engine designs, WinGD will also supply its Engine Diagnostic System which targets increased availability via monitoring, lower fuel costs via engine performance optimising and extension of predicted Times Between Overhaul (TBO) of components.

## Vessel details

The LNG-fuelled Aframax crude oil



The X62DF dual-fuel engines with X-DF low-pressure gas injection technology designed by WinGD will power four ice class 1A, 114,000 DWT Aframax tankers of SCF Group.

tankers have a capacity of 114,000 DWT. The vessels are designed to ice-class 1A and are scheduled to operate primarily in the Baltic and North Seas. With the ability of the 7X62DF engines to meet IMO Tier III limitations on NOx and SOx in Emission Control Areas (ECAs) when operating on gas without after treatment, and when burning low sulphur liquid fuel with low-pressure SCR, the tankers are designed for worldwide trade, including ECAs.

SCF anticipates that the WinGD X-DF

engines will deliver substantial emissions benefits as well as excellent total cost of ownership (TCO). To exceed rather than meet emissions legislation in the environmentally sensitive regions in which its fleet operates, SCF notes that marine engines running on LNG release over 90% less SOx, over 80% less NOx, 15% less CO<sub>2</sub> than those burning standard marine fuels. The ships' auxiliaries and boilers will also be equipped for operation on gas fuel. On the TCO side, SCF acknowledges the benefits of the 7X62DF with low-

pressure gas admission in terms of both capital expenditure (CAPEX) and operating expenditure (OPEX). As confirmed during their development programme, the X-DF engines employ a lean air-gas mixture ignited by injection of a small amount of liquid fuel to achieve high fuel efficiency, very stable combustion and inherently low formation of NOx, allowing IMO Tier III compliance in ECAs without exhaust after treatment.

Reducing both CAPEX and OPEX, the low-pressure gas admission technology means that in contrast to engines with high-pressure gas injection, the gas fuelling system on the X-DF engines does not require high-pressure electrically-driven cryogenic pumps. This considerably reduces both the purchase and installation cost of the fuelling system and the consumption of electricity needed for injection of gas into the combustion chamber. As a result, there is also the

potential to dimension a ship's auxiliary plant smaller for further CAPEX and OPEX savings.

#### **Affirmation of X-DF**

As well as being a source of pride, this contract for WinGD engines to power the first Aframax crude oil tankers with dual-fuel engines is affirmation of the WinGD X-DF low-pressure gas admission technology.

"This order represents a vote of confidence in X-DF and a recognition from SCF Group and its partners of the benefits of low-pressure X-DF technology to both their business and the environment," noted Martin Wernli, WinGD CEO. "Further, with this project the SCF Group has raised the bar for environmentally-friendly Aframax tankers. Overall the order for the 7X62DF for the gas-fuelled Aframax tankers is a very clear message that our low-pressure lean burn technology is becoming the industry standard for all LNG-fuelled

vessels, and not just LNG carriers." Additionally, the WX72DF also successfully passed the Type Approval Test (TAT) on 22 March. To date, already seven engines have been built, all completing the respective shop tests (FAT). All X-DF engines are meeting and exceeding by far the requirements for Tier III NOx emissions. WinGD's X-DF concept with its low-pressure gas system provides advantages in terms of lower investment and operating cost. It allows also compact installation of a fuel gas handling system which convinces with its simplicity hence lower CAPEX and OPEX, thanks to the low gas pressure requirement. The measured NOx emissions are far below the required Tier III limit.

The X62DF dual-fuel engines with X-DF low-pressure gas injection technology designed by Winterthur Gas & Diesel will power four ice class 1A, 114,000 DWT Aframax tankers of SCF Group. ⚓

### **Rolls-Royce to provide mooring system for Statoil's oil platform Njord A**

Rolls-Royce has been chosen by Norway-based engineering and construction services firm Kvaerner to provide a mooring system for Norwegian oil and gas company Statoil's oil platform, Njord A. Njord A is being upgraded by Kvaerner and Rolls-Royce has been chosen to provide an upgrade to its mooring system. The contract has a value of about £15 million.

Njord A is a semisubmersible floating steel platform, with an integrated deck with drilling and processing facilities, as well as living quarters. It is normally located in the Njord oilfield, around 130 km northwest of the city Kristiansund and 30 km west of the Draugen field.

Today Njord A has a 12-point mooring system which will be upgraded to a modern 17-point system. Rolls-Royce will supply low pressure hydraulic driven winches, fairleads and a control system. The semisubmersible four-column production platform will be moored at about 330m water depth.

The delivery from Rolls-Royce is scheduled for 2018. The platform is planned to be back in operation offshore in 2020 and to operate for another 20 years.

The platform upgrade is part of a project Statoil has named "Njord Future," intended to prolong the lifespan of the Njord field.

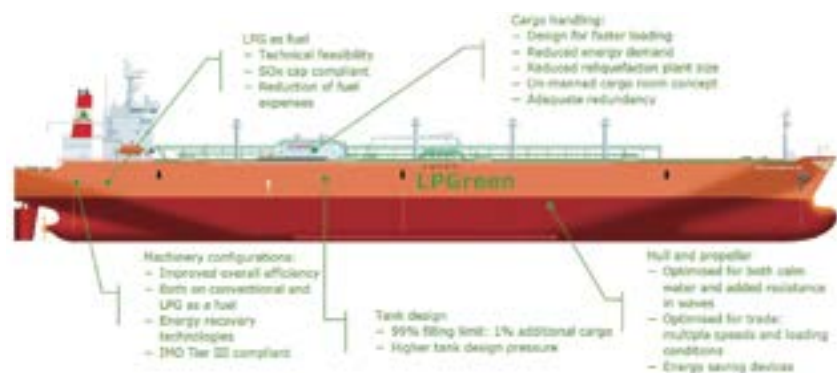


# CMM, HHI, Wärtsilä and DNV GL reveal LPGreen concept design

DNV GL introduced the next-gen LPG fuelled carrier design at Gastech 2017 on 5 April.

In connection with the Gastech 2017 conference and exhibition in Tokyo, project partners Consolidated Marine Management (CMM), Hyundai Heavy Industries (HHI), Wärtsilä Oil & Gas, and DNV GL presented the results of a joint industry project (JIP) to develop a new LPG fuelled carrier design – LPGreen. Launched at the Posidonia trade fair in 2016, the JIP sought to develop a more energy efficient, environmentally friendly, and safer vessel for the transportation of LPG products. “In order to increase the competitiveness of modern LPG carriers, novel ship designs need to simultaneously account for the market and trade route characteristics; excellent safety and ease of operation; cargo and fuel flexibility; and, overall energy efficiency combined with economic viability,” said Nikolaos Kakalis, DNV GL’s Manager for R&D and Advisory Services in South East Europe and Middle East. “Therefore, a holistic approach to the design of modern LPG carriers is required, taking into advantage market insight, technology innovation, advanced computer tools and industry-wide collaboration with strong partnerships.”

The JIP has resulted in a new concept design that achieves state of the art performance on several fronts. Compared to the reference vessel, which is a high-quality vessel built to a standard design




## LPGreen concept design

in 2016, there is an overall improvement of 6-9% in energy efficiency, depending on machinery configuration and fuel used. A redesign of the tank allows for a filling limit of 99% - a 1% increase in overall carrying capacity. Loading duration has been decreased by 30%, while the newly designed cargo handling system concept results in a 5% reduction in energy demand. “Perhaps most importantly, LPGreen has demonstrated the technical feasibility of a LPG fuelled propulsion concept, which, depending on fuel prices and the development of a commercial and chartering framework, could result in a cut of up to 30% in fuel expenses” said George Dimopoulos, Principal Specialist in DNV GL and project manager for LPGreen.

To realise these gains, the partners utilised advanced computer analysis tools. Hull form optimisation both in calm water

and waves was conducted using HHI’s and DNV GL’s CFD hydrodynamic optimisation codes. The overall concept system evaluation and optimisation was conducted using DNV GL’s COSSMOS modelling framework, which allowed for an integrated analytical approach to the evaluation of all machinery technology options and design improvements considered. Finally, every technology feature was compared against the performance of an existing, new (2016), and very modern LPG carrier from CMM’s fleet, which gave a solid basis for documenting improvements.

“Above all, the LPGreen concept design demonstrates that the partnership and close collaboration of industry leaders coupled with advanced analysis methodologies and computer tools can lead to efficiency improvements and innovation in practice, available today,” said Nikolaos Kakalis. 



# SHI Builds World's Largest Containership with Intergraph Smart® 3D

Successful construction of the MOL Triumph cements partnership of technological excellence

Samsung Heavy Industries (SHI), one of the world's leading shipbuilders, has used Intergraph Smart® 3D to design the world's largest containership for Mitsui O.S.K Lines, Ltd. (MOL), surpassing 20,000 Twenty-foot Equivalent Units (TEU).

With a length of 400 meters, breadth of 58.8 meters and draft of 32.8 meters, the vessel is classified as an Ultra Large Containership that can transport 20,150 containers. It was christened the MOL Triumph and delivered to the owner on March 27, 2017. The MOL Triumph is the first of four 20,150 TEU vessels SHI is building for MOL.

Smart 3D was used to execute the detailed and production design of the Triumph, as well as to produce installation and fabrication drawings, and Bills of Materials for SHI's procurement team. Smart 3D's Top-down Planning & Estimation and Assembly Planning & Simulation modules were also employed on this project.

SHI has enjoyed the benefits of Smart 3D since 2004, recording schedule reductions of up to three months on major shipbuilding projects, thanks to the solution's intelligent early design features.

"Successful construction of the MOL Triumph is further evidence of SHI's technological excellence and our long-




MOL TRIUMPH, the world's largest containership (20,150 TEU) built by SHI

standing partnership with Intergraph PP&M," said Mun-Keun Ha, vice president at SHI. "Furthermore, we were able to complete construction on-time and with zero incidents, thanks to Smart 3D's optimized design features." Mattias Stenberg, president of Intergraph PP&M, said, "SHI has been leading the market with optimized hull and outfitting design and record-breaking containership size. Intergraph is proud to be a technological partner in this journey."

Smart 3D is a 3D design solution that lowers risk on today's tight project schedules by offering high-quality designs to support the fabrication, construction and operational phases. The built-in engineering rules enable

project stakeholders to make critical design decisions early on, freeing up time for real engineering work by automating design functions, enforcing design consistency through the different disciplines and all related, automatically produced deliverables. Smart 3D also minimizes costly rework by managing the changes that inevitably occur throughout design.

The ARC Advisory Group, a leading industry analyst firm, ranked Intergraph as the No. 1 overall worldwide provider of engineering solutions for plant design (process, power and marine), according to its "Engineering Design Tools for Plants & Infrastructure Global Market Research Study Market Analysis and Forecast Through 2020." 

# ABB, B&R 인수로 산업 자동화 리더십 구축

ABB는 B&R 인수로 기계 및 공장 자동화 부문에서의 오랜 격차를 해소할 수 있게 됐으며, 종합적인 자동화 포트폴리오 갖춘 세계 유일의 기업이 됐다.

ABB는 지난 4월 4일 B&R(Bernecker + Rainer Industrie-Elektronik GmbH) 인수를 발표했다. B&R은 기계 및 공장 자동화 부문 세계적인 기업으로, 제품과 소프트웨어 기반, 개방형 아키텍처 솔루션을 공급해왔다. 에르윈 베르네커(Erwin Bernecker)와 조셉 라이너(Josef Rainer)가 1979년 설립한 B&R은 오스트리아 에겔스버그에 본사가 위치하고 있으며, 1000명의 R&D 및 어플리케이션 엔지니어를 포함해 3,000명 가량 직원이 근무 중이다. 전세계 70개 국가에서 운영 중이며, 연간 200억 달러 규모의 기계 및 공장 자동화 시장에서 지난해 B&R은 약 6억 달러의 매출을 달성했다.

이번 인수로 B&R의 최신 기계 및 공장 자동화 관련 혁신적인 제품이 세계시장을 선도하고 있는 ABB의 소프트웨어 및 솔루션을 비롯해 로봇, 공정 자동화, 디지털화 및 전기 제품과 결합됨으로써 산업 자동화 고객에게 비교 불가한 종합적인 솔루션을 제공하게 됐다.

ABB는 산업 자동화 리더십을 확대하는 동시에 4차 산업혁명에서 기인한 성장 기회를 얻게 됐다. 추가적으로 산업 선두의 디지털 솔루션인 'ABB Ability'와 강력한 B&R 어플리케이션 및 소프트웨어 플랫폼, 폭넓은 설치 기반, 고객 접근성, 맞춤형 자동화 솔루션이 통합됨으로써, ABB는 디지털 제품을 확대하는 중요한 진전을 이루내었다



는 평가다.

ABB 울리히 스피스호퍼(Ulrich Spiesshofer) CEO는 “B&R은 기계 및 공장 자동화 분야에서 보석과 같은 기업이기 때문에 이번 인수는 일생 단 한번의 기회였다. 우리는 B&R를 통해 기존 자동화 제품군의 격차를 줄일 수 있게 되었으며, 산업 자동화 분야에서 획기적인 한 획을 긋게 됐다. 이 조합으로 ABB는 계측, 제어, 구동, 산업로봇, 디지털화, 전기 관련 기술과 소프트웨어 솔루션에 대한 모든 분야를 제공할 수 있는 유일한 산업 자동화 공급업체가 될 것”이라고 말했다. 덧붙여 그는 “이번 인수는 차세대 전략을 완벽하게 이행하고 있습니다. 유일무이한 디지털 제품들, 7,000만개 이상 연결된 디바이스 설치 기반, 70,000대의 제어 시스템, 그리고 이제는 300만대 이상의 자동화 기

계와 전세계 27,000개 공장, 그리고 전세계 고객들이 4차 산업 혁명의 무수한 기회를 잡을 수 있도록 지원할 것”이라고 밝혔다.

B&R 공동 창업자인 조세프 라이너(Josef Rainer)는 “B&R 고객 및 직원 모두에게 환상적으로 좋은 기회를 제공하게 되었다. 우리는 ABB가 성장 스토리의 다음 장을 써 내려 갈 최고의 플랫폼을 제공할 수 있을 것으로 확신한다. ABB의 글로벌 입지, 디지털 제품, 보완적인 포트폴리오는 혁신과 성장 속도를 더욱 가속화하는데 핵심적인 역할을 할 것”이라고 말했다.

B&R 공동창업자 에르윈 베르네커(Erwin Bernecker)는 “오스트리아 에겔스버그(Eggelsberg)는 기계 및 공장 자동화 분야와 관련한 ABB의 글로벌 센터가 될 것이므로, 우리 직원들에게 확고한 시그널이 될

것으로 생각한다”고 말했다.

### 상호 보완적인 장점

ABB는 산업 자동화 관련 제품군을 확장시키는 효과를 얻게 되었는데, 이는 B&R의 혁신적인 제품인 PLC, 산업용 PC 및 서버 모션과 소프트웨어, 그리고 솔루션 제품군 등과 통합되기 때문이다. 이로써 ABB는 독창적이고 포괄적이면서 개방형 아키텍처 자동화 포트폴리오를 제공할 수 있게 되었다. B&R은 지난 20년간 연평균 매출 성장 11%을 기록하며 견실하게 성장해왔다. 2000년 이후 5배 이상 증가한 6억 달러가 넘는 매출을 기록했다. 특히 4,000개 이상의 전세계 제조기업 고객을 기반으로 급속하게 성장해왔으며, 자동화 소프트웨어 및 솔루션에서 입증된 실적과 함께 기계 및 공장 자동화 분야에서 탁월한 어플리케이션 전문성을 갖추고 있다.

양사는 상호 보완적인 포트폴리오를 갖고 있는데, ABB는 선도적인 공급업체로 유틸리티, 산업, 운송 및 인프라 분야 고객에게 솔루션을 제공하고 있다. B&R은 앞선 솔루션 공급기업으로 플라스틱, 포장, 식음료 등 산업에서 기계 및 공장 자동화 솔루션을 제공해왔다. 개방형 아키텍처에 대한 공동의 노력으로 고객의 선택폭이 확대되었으며, 꾸준히 증가하는 디지털 산업에서 신속하게 연결하는 유연성이 증대될 것으로 보인다.

### 혁신에 대한 견고한 투자

혁신은 양측 회사의 핵심이다. B&R은 매출의 10% 이상을 연구개발에 투자하고, R&D 및 어플리케이션 엔지니어링 분야에서 1,000명 이상의 직원이 근무 중이다. ABB의 경우 매년 R&D 분야에 15억 달러를 사



ABB 그룹 본사 스위스 취리히

용하고 30,000명의 기술자와 엔지니어링 전문가를 두고 있다. 앞으로 ABB와 B&R 모두 연구개발 분야 상당한 투자를 지속할 예정이다.

기계와 공장에 대한 자동화는 4차 산업혁명과 사물인터넷(IoT)의 핵심적인 추진 요소이다. ABB는 강력한 B&R 솔루션 기반 비즈니스 모델을 유지하고, 이러한 심층적인 전문 산업지식을 기반으로 엔드-투-엔드 디지털화 관련 신규 소프트웨어 기반 서비스와 솔루션을 개발해 나갈 계획이다. 업계 선두의 ABB 디지털 솔루션 'ABB Ability'는 이제 B&R의 폭넓은 설치기반, 응용분야, 솔루션 노하우, 시뮬레이션 소프트웨어 전문지식, 진보적인 엔지니어링 툴을 활용하게 된다.

### 입증된 통합 접근

이번 ABB의 인수에 따라 B&R는 ABB 산업자동화(Industrial Automation) 산업본부의 신규 글로벌 사업부 내 '기계 및 공장 자동화(Machine & Factory Automation)'로 귀속되며, 신규 사업부는 현재 대표인 한스 위

머(Hans Wimmer)가 맡는다. 앞으로의 성장과 비즈니스 통합을 위해 양사 모두 B&R 경영진과 직원이 핵심이 된다고 간주하고 있다. B&R 공동창립자인 에르윈 베르네커(Erwin Bernecker)와 조셉 라이너(Josef Rainer)는 통합과정 동안 지속성을 유지하고자 고문으로 활동할 예정이다.

이번 인수는 성장에 초점을 두고 있으며, 양사 모두에게 이득이 되는 원칙에 따르고 있다. 또한 ABB는 자사 PLC 및 서버 드라이브 활동에 단계적으로 새로운 사업부 제품을 추가하게 되었다. ABB는 B&R의 중기 영업 목표를 10억 달러 이상 예상하고 있다.

ABB는 B&R 조직 확대에 투자하고 회사의 성공적인 비즈니스 모델과 브랜드를 구축하는데 전념할 계획이며, 에겔스버그(Eggelsberg)에 위치한 B&R 본사는 기계 및 공장 자동화 관련 ABB글로벌 센터가 될 예정이다.

한편 지난 100년간 오스트리아에서 활동해 온 ABB는 오스트리아에서 가장 큰 산업 자동화 기업으로 자리매김했다. ⚓

# 로크웰 오토메이션, 커넥티드 엔터프라이즈 비전 실현

2020년까지 500억 개 이상의 장비가 인터넷에 연결될 것으로 예측되고 있는 가운데, 이를 어떻게 활용하느냐에 따라 기업 및 제조사의 흥망성쇠가 결정될 것으로 보인다.

데이터의 가치를 극대화 시키기 위해서 로크웰 오토메이션은 정보 솔루션 공급 역량 확장시키고 있다. 제조 업체가 자체 디지털 변환을 이루어 내고 커넥티드 엔터프라이즈의 비전을 실현시킬 수 있도록 지원하기 위함인데, 그 일환으로 MES(Manufacturing Execution Systems, 생산 관리 시스템), 제조 인텔리전스, 분석 애플리케이션 그리고 정보 기반의 서비스 등으로 제조 업체를 연결, 관리, 검증 그리고 생산 최적화를 지원하기 위해 신규 정보 솔루션(Information Solutions)이 확대되고 있다.

로크웰 오토메이션의 정보 소프트웨어 및 프로세스 비즈니스의 부사장인 존 제노비시(John Genovesi)는 “정보의 접근 방식이 산업 분야 제조 운영의 면모를 변화시키고 있다”고 언급했다. 그는 “제조 운영을 보다 스마트하고, 제어 시스템의 데이터를 보다 가치있게 만들어 주는 기술과 인력에 상당한 투자가 이뤄지고 있다. 로크웰 오토메이션은 산업용 사물 인터넷을 구성하는 스마트한 ‘사물(Things)’을 대량으로 납품하는 공급자 역할을 하고 있다”며 “우리가 제품을 더 스마트하게 만들고 제품에서 생산되는 데이터를 활용하는 방안에 대해서 알아가는 동안 10년의 세월이 흘렀다. 이제 한 발짝 더 앞서 나가 통합 제어와 정보 공급을 확장시키면서 고객의 생산 가변성과 위

험을 최소로 줄이고 생산성을 최적화하도록 지원하고 있다”고 말했다.

플랜트와 생산 프로세스가 현재 그리고 기존 시스템을 현대화시키고, 플랜트 네트워크가 기업 비지

니스 시스템에 집중됨에 따라, 제조 업체는 막대하게 많은 양의 데이터에 접근하는 수단을 확보했다. 그러나 대부분 자체 데이터의 유용성을 최대화시키고 그것을 사용 가능한 정보로 변형 시키시는 데에 도움이 필요한 실정이다.

제노비시는 “스마트 제조의 여정에서 OT와 IT 사이의 협력은 선택 사항이 아니라 현실”이라며, “우리는 그 협력을 간소화시키고 실현시키기 위한 전략의 일환으로 제품과 기술 팀에 집중하기 위해 마이크로소프트(MS)와 함께하고 있다”고 밝혔다.

MS의 글로벌 제조업 및 자원팀(Worldwide Manufacturing and Resources Team) 살라얀 아르크안(Cağlayan Arkan) 총괄 책임자는 “로크웰 오토메이션의 커넥티드 엔터프라이즈를 위한 비전은 커넥티드 시스템 안에서 모든 자산에 인텔리전스를 통합시키는 MS의 비전과 일치한다”고 말했다. 그는 “우



리는 로크웰 오토메이션의 조직을 위해 새로운 가치를 창출할 수 있도록 OT와 IT의 융합을 가능케 하는데 중점을 두고, 공동 혁신 프로젝트 마다 도메인 전문가를 참여시켰다. 진정한 엔터프라이즈의 인텔리전스는 기업의 운영, 애플리케이션 그리고 비즈니스 의사 결정을 넘어 에지 장치(Edge Device)로부터의 협력과 호환성을 필요로 한다”고 설명했다.

확장된 로크웰 오토메이션 정보 솔루션 애플리케이션과 서비스에서 마이크로소프트의 인텔리전스 클라우드 플랫폼, 마이크로소프트 Azure IoT 세트, Cortana 인텔리전스 그리고 모바일 서비스의 확장성과 개방성이 사용된다. 이를 통해 제조사는 운영에 최적화된 분석 기능에 접근이 가능하며, 사람, 프로세스, 기술 사이의 협력을 촉진하고, 새로운 결과물의 가치를 이끌어낼 수 있다.

커넥티드 엔터프라이즈로의 여정의 진행

정도와 상관없이 – 인프라가 어느 정도 갖춰지지 않은 경우 – 로크웰 오토메이션 정보 솔루션은 최적화 방식으로 계획부터 실행까지 각 과정에서 생산 운영을 지원할 도메인 전문가를 지원한다. 로크웰 오토메이션의 확장된 정보 솔루션 전략에 따라 다음과 같은 제품들이 있다.

- 확장형 분석(Scalable analytics)은 다양한 신규 애플리케이션, 에지 디바이스(Edge Device), 그리고 온/오프 프리미스(On/Off Premise) 클라우드 플랫폼 관련 정보에 밀착된 데이터를 산출한다. 원격 모니터링, 기계 성능, 장비 상태와 진단, 그리고 예측형 유지보수 솔루션으로 기업에서 자체 데이터로부터 보다 빠르고 쉽게 그리고 점진적으로 이익을 유도할 수 있도록 지원한다. 엔터프라이즈 수준에서는, 이와 같은 솔루션으로 플랜트 데이터를 비즈니스 인텔리전스 전략으로 통합하기 위해 더 강력한 방법을 제공한다. FactoryTalk Analytics가

이러한 솔루션 중 하나다.

- 혁신적인 운영 관리 솔루션 (Innovative operations management solutions)은 품질과 성능을 위해 핵심 애플리케이션에서부터 산업에 특화된 애플리케이션 시리즈 그리고 다중 플랜트 가동에 적용되는 안정된 MES까지 작업 절차 준수, 협력 그리고 확장을 지원한다. 최근 Scalable MES가 출시된 이유다.


- 커넥티드 서비스(Connected Services)는 스마트 생산 시스템의 설계부터 설치 및 최적화까지 사내 팀의 교육과 지원을 돕는다. 실행 중인 생산 데이터의 대부분을 만들어 내고, 지속적으로 개선 전략을 세울 수 있도록 지원한다.

- 협력 툴(Collaboration tools)은 완벽한 지식의 공유와 수집을 통해 팀에서 더 나은 의사 결정이 가능하도록 한다. 이러한 솔루



로크웰 오토메이션의 'FactoryTalk' 클라우드 어플리케이션

션으로는 'FactoryTalk TeamONE'이 대표적이다.

로크웰 오토메이션 정보 솔루션은 자동화 분야에서 10년 이상의 경험, 100만번 이상의 설치 경험 그리고 5,000개 이상의 기업이 함께하는 로크웰 오토메이션 파트너 네트워크 프로그램과 개발자 협력 환경을 토대로 구축됐다. 이들 솔루션은 업무를 위한 생산 시스템에 힘을 불어넣어 주면서, 생산 데이터와 IT 사이에서 가교 역할을 하게 될 것이다. 

## FactoryTalk TeamONE 앱: 플랜트 진단과 생산성 향상

로크웰 오토메이션은 iOS 및 안드로이드 스마트폰용 신규 앱인 FactoryTalk TeamONE을 공개했다. 이 앱은 생산 현장, 엔지니어링 및 IT 직원들이 협업을 통해 신속하게 문제를 해결할 수 있도록 돕는다. 스마트폰에서 TeamONE 앱을 사용해 다양한 모듈 중 하나를 선택한 다음 Allen-Bradley PowerFlex 인버터와 같은 장치에서 직접 정보를 검토하거나, 모든 EtherNet/IP 장치의 고급 작동 정보를 확인할 수 있다. TeamONE 앱은 서버에 연결되는 클라이언트 역할을 하는 것이 아니라 앱의 장치 모듈이 네트워크 상에서 장치와 직접 통신해 실시간 데이터를 확인한다. 최초 릴리즈인 FactoryTalk TeamONE 무료 버전이 현재 출시되어 있으며, 인시던트(Incident), 장치 상태(Device Health), 팀보드(Teamboard), 기술 자료(Knowledgebase), 연결(Connect), 핀보드와 채팅(Pinboard and Chat), 연결(Connect), 트렌드(Trend) 등 8개의 모듈을 제공한다.

로크웰 오토메이션의 통합 아키텍처 모빌리티 플랫폼 책임자인 카일 라이즈너(Kyle Reissner)는 “TeamONE은 팀 협력과 자동화 중심의 데이터를 통합해 제조사 직원의 생산성 향상에 전적으로 초점을 맞춘 최초의 앱”이라며, “이 앱은 아주 흥미 진진하고 혁신적인 수단으로 자주 업데이트될 것이다. 사실 로크웰 오토메이션은 미래형 모듈로 FactoryTalk Analytics 애플리케이션과 적용 콘텐츠까지 통합하려는 계획을 이미 세우고 있다”고 말했다. TeamONE 앱은 지난 2016년 9월 이후 500개 이상의 고객사에 시연됐다. ‘스탠튼 프로젝트(Project Stanton)’로 부르던 린 스타트업 팀의 노력으로, MS와 긴밀한 협력을 통해 개발됐다.





# 현대중공업그룹, 2021년까지 기술개발 3조 5,000억원 투자

지난 4월 1일 현대중공업그룹이 시장과 투자자들의 기대 속에 4개 독립법인으로 새로운 출발을 시작했다.

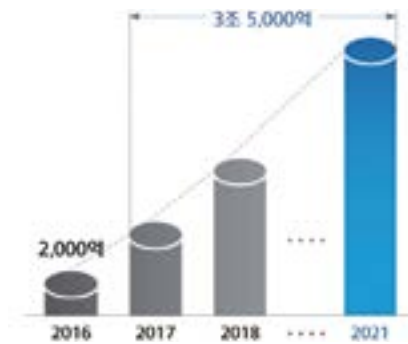
현대중공업, 현대일렉트릭에너지시스템, 현대건설기계, 현대로보틱스 등 4개 회사로 분리 독립한 현대중공업 그룹은 지난 4월 3일 현대중공업 최길선 회장과 권오갑 부회장, 6개 회사 대표 등 주요 경영진이 참석한 가운데 울산 현대중공업 본관 앞에서 기념식 및 제2도약을 선언했다.

이날 현대중공업그룹 4개사는 독립법인의 첫 행보로 2021년까지 기술개발에 3조 5,000억원 투자, 설계 및 연구개발 인력 10,000명 확보, 신인사제도 도입 등을 주 내용으로 한 '기술·품질 중심의 경영 전략'을 발표했다.

주축산업인 조선·해양의 시황 부진과 전 세계적으로 지속되고 있는 경기 침체 등 불안정한 경영환경 속에서도 기술개발과 품질향상에 과감한 투자를 통해 새로운 성장 동력을 찾기 위한 공격적인 행보로 풀이된다.

특히 현대중공업 그룹은 기술, 품질에 중점을 둔 미래경영을 펼치기 위해 신인사제도 도입과 함께 우수한 인력확보를 위해 적극적으로 나선다는 방침이다. 신기술 개발을 위한 설계 및 연구개발 인력은 현재 4,000명에서 2021년 10,000명까지 확대해 나갈 계획이다.

특히 그룹 4개사에 각각 최고기술책임자(CTO)를 부사장급으로 임명해 신제품 개발

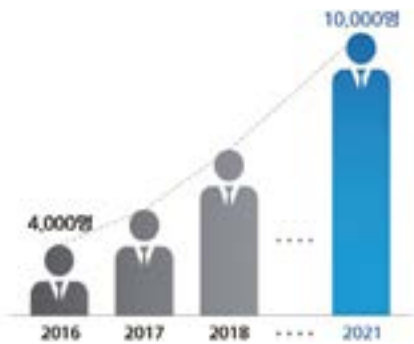


추진에서부터 기술전략 수립, 연구인력 선발, 육성에 이르기까지 종합적으로 관리하게 하는 한편, 품질 조직과 시스템 역시 글로벌 최고 수준으로 강화한다.

새롭게 개편되는 신인사제도는 직급과 임금체계 개편을 통해 우수인재 조기발탁과 직무 전문가를 육성하는 것에 중점을 뒀다. 현 5단계 직급을 단계적으로 3단계 직급으로 간소화해 직급보다는 직무를 우선으로 하는 수평적이고 창의적인 조직문화 조성으로 회사 경쟁력을 강화해 나갈 것으로 기대하고 있다.


이날 현대중공업 권오갑 부회장은 "오늘이 현대중공업의 제2도약을 위한 계기가 되기를 기대한다"며 "앞으로 기술과 품질을 모든 경영의 핵심가치로 삼아 각 분야 글로벌 Top5 진입을 목표로 세계시장에서 치열하게 경쟁할 것"이라고 밝혔다.

이날 발표된 경영전략에 따르면 현대중공업은 5년간 시설투자 3,900억을 포함한 총



2조 500억원을 기술개발에 투자할 계획이다. 친환경 선박 및 스마트십 개발과 해양 플랜트 설계 능력 강화, 디지털화 된 스마트 야드 구축 등을 통해 선제적 기술 확보와 고품질로 세계 1위 자리를 지키기 위한 전략이다.

현대일렉트릭에너지시스템과 현대건설기계는 각각 6,800억원과 6,600억원에 달하는 비용을 기술개발에 투자함으로써 신제품 연구개발을 통한 판매 라인업 확보에 집중, 세계 우수 기업들과 어깨를 나란히 할 수 있는 경쟁력을 확보해 나갈 것으로 기대된다. 또한 현대로보틱스는 OLED 공정용 로봇 사업 확대와 서비스 사업 확장을 위한 부품 공용화 개발, 클린룸 신축 등에 1,100억원을 투자할 예정이다.

현대중공업그룹은 향후 매출액 대비 기술개발 투자를 글로벌 선진기업 수준인 6~7%까지 확대해 기술경쟁력을 지속적으로 강화한다는 계획이다. 

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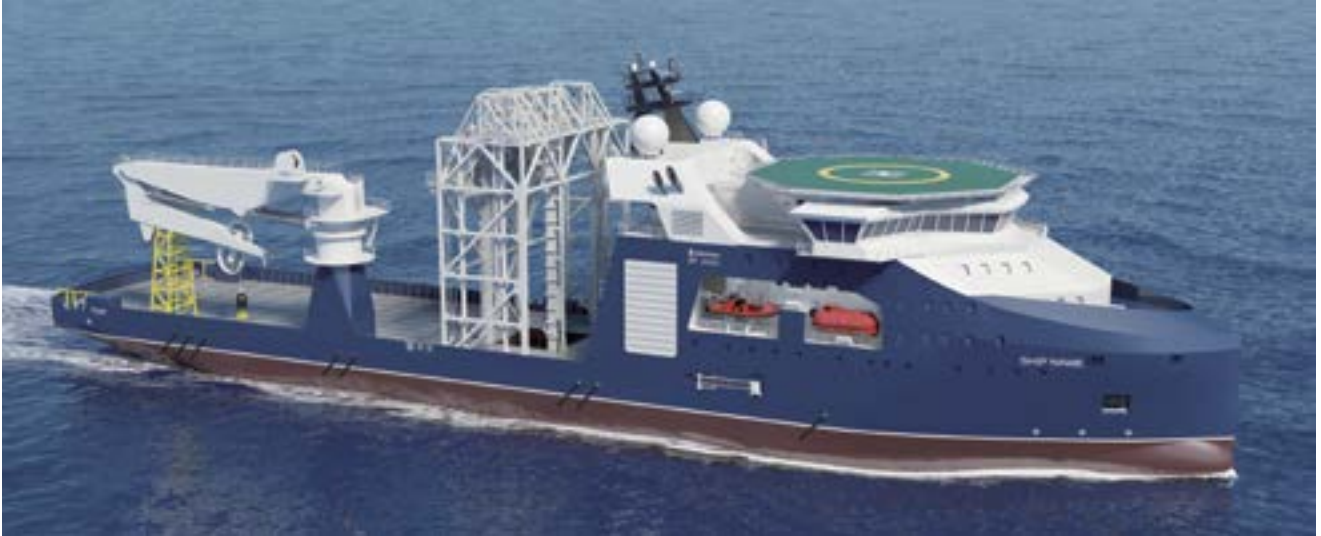
Effectively harnessing the knowledge gained over 40 years is key to ensuring future designs operate safely and efficiently around the world and maintain the UT pedigree

*Rolls-Royce*



The UT XXXX SCV is the generic title for a series of subsea construction vessels of different sizes - 21 to 30m beam. The hull design is optimized as a working platform with low motions in a seaway.





The UT XXXX SCV is a series of different size vessels. The size is mainly determined by the capacity of the offshore crane, which can be from 150 to 600 tonnes.

Over the years UT designs have been created for a wide range of applications. But how will these vessels develop? How will technology be applied? And what will they look like? Here, we take a closer look at four key offshore vessel types in the UT design stable.

### Subsea construction

Subsea construction calls for vessels with offshore cranes and other equipment that enables them to accurately position heavy modules on the seabed. Many of the vessels built to date are basically large platform supply vessels fitted with a crane and systems for deploying ROVs.

Rolls-Royce has developed a family of subsea construction vessels designed specifically for this type of work. With the generic title UT XXXX SCV, this is a series of vessels of different sizes, the size mainly determined by the capacity of the offshore crane which can range from 150 to 600 tonnes.

The family comprises vessels with breadths of 21, 23, 25, 28 and 30m. The hull design is optimised as a working platform with low motions in a seaway. Together with the ability to meet DP3 dynamic positioning rules and the location of the helideck over the wheelhouse, this allows the operator to work the maximum number of days per year.

The vessel with its large open deck area can be configured for different tasks. In addition to construction, it is prepared for a tower, top hole drilling and well intervention, and with its ROV hangar and handling systems can carry out subsea

inspection, maintenance and repairs.

A length of 123m overall has been chosen for the 23m beam member of the SCV family, providing a deck area excluding the moonpool of 1,400m<sup>2</sup>. An offshore crane rated at 250 tonnes is mounted on the starboard side and the ROV hangar has space for three ROVs with the option of an ROV moonpool.

There is accommodation for a total of 120 under the SPS2008 rules. The UT XXXX SCV has a flexible diesel-electric propulsion system with two main azimuth thrusters at the stern, and tunnel and retractable thrusters forward. It will meet ERN 99,99,99,99 standard for propulsion redundancy. Building these SCVs has been simplified as far as possible by simple plate development and logical building block construction.

### Platform supply vessels

Platform supply vessels are the workhorses, supporting offshore oil and gas operations in various ways, taking supplies from shore bases to rigs, platforms and floating production vessels and also increasingly undertaking construction work using an offshore crane of moderate size.

The UT 771 WP is an 85m long design which builds on years of experience and handles the type of commodities that have to be transported, including low flashpoint cargos, in a safe and efficient way. Intended to meet the general needs of the market for a medium size PSV and comple-

menting other UT designs, it has a deadweight of 4,200dwt and a free deck space of 840m<sup>2</sup>. The deck has the capacity to take about 2,000 tonnes of cargo.

Ability to maintain speed in rough seas and elimination of bow slamming are ensured by the hullform which incorporates the wavepiercing bow. The low resistance hullform is powered for 14.5 knots, with a low fuel consumption at typical transit speeds of 10-13 knots.

Accommodation is provided for up to 50 people, and the vessel has low noise and vibration levels. Clean Design class notation implies a minimum of emissions to air or water, and this PSV design can also provide oil spill cleanup services.

This Rolls-Royce design has diesel-electric propulsion for maximum efficiency in various operating modes, such as transit and dynamic positioning. Four compact MTU 4000-series diesels provide the power and propulsion. Manoeuvring requirements are satisfied by two Azipull main thrusters and two forward tunnel thrusters.

Various equipment options are offered for the UT 771 WP, including firefighting and ROV operations. The vessel is also designed for a 50 tonnes active heave compensated offshore crane and a helideck rated for six tonnes helicopters.

## Emerging PSV requirements

The offshore industry is constantly developing new techniques that lead to the need to safely transport new commodities. At the same time new regulations covering carriage

of potentially hazardous cargoes arrive, and old rules are rewritten.

Rolls-Royce develops designs to meet these emerging needs and constraints, working closely with supply ship operators and their customers. One example is where cargo is classed as hazardous or noxious and there is a need to carry increasing quantities, requiring novel arrangements. Another is low flashpoint cargo or acids, where special cargo tank arrangements and venting may be required. In the near future there will be a need to transport increased volumes of nontraditional commodities, while some existing products carried by supply vessels may be reclassified.

## Anchorhandlers

The UT 790 WP design embodies Rolls-Royce design thinking for capable offshore anchorhandlers. This 92m long vessel integrates efficient and safety conscious deep water anchorhandling, easily driven and seakindly hull lines with reduced emissions and enhanced crew safety and comfort in a single package, summarised as: cleaner, safer, deeper.

These goals interact with each other and balancing the conflicting requirements has involved extensive calculation and testing. Shifting moorings in waters up to 2,000m deep means long and heavy wires and chains and a requirement for a highly effective bollard pull, which in turn demands stability.

The UT 790 WP has a bollard pull of 250 tonnes, and a top speed of 17.5 knots is combined with economical cruising at



The efficient UT 833 with up to 180 tonnes of towing force gives a highly competitive fuel cost per square kilometre surveyed.



The UT 790 WP anchorhandler has a bollard pull of 250 tonnes, scalable to meet customer requirements.

12 knots. The design is scalable, allowing owners to go for higher or lower bollard pulls.

Anchorhandlers operate in several modes; heavy pulling, transit, dynamic positioning and standby, leading to varying power demands. To meet these with maximum efficiency and minimum emissions, this Rolls-Royce design has a hybrid propulsion system. Two Bergen main engines (2 x 6,000kW) drive two CP propellers via reduction gears with shaft generators. Four Bergen gensets, each rated at 1,843kW, supply electrical power when required. In some operating modes the shaft generators supply all electrical loads, in others the main engines can be shut down and the shaft generators act as motors, turning the main propellers, which are supplemented for DP and manoeuvring by two tunnel thrusters and a retractable azimuth thruster forward and two tunnel thrusters aft.

AHTS are to a great extent built around the main winch, which in this design is a three drum type with two towing/working drums and one anchorhandling drum, the latter able to hold 18,400m of wire rope, backed up by secondary winches.

The UT790 CD meets all current and anticipated stability requirements, both for stability reserve when laying moorings, and if damaged. Safety-oriented features include a view from the wheelhouse unobstructed by uptakes. The UT 790 CD also carries the full range of Safer Deck Operations equipment developed by Rolls-Royce over the past few years, that reduces the exposure of the deck crew when handling wires and chains and eliminates much heavy manual work.

Taken together, the combination of form and function in the UT 790 CD offers shipowners a tool that can be tailored for today's and future AHT operations.

## Seismic survey

Seismic survey vessels tow an array of streamers - cables containing a great number of hydrophones. Other towed equipment emits sound pulses which are reflected from sub seabed strata and received by the hydrophones. Analysis allows a 3D picture of geology and oil and gas reservoirs to be built up. Areas to be surveyed are large, and there is a demand for towing ever wider and longer streamer arrays to cover the maximum search area.

Rolls-Royce is no stranger to seismic vessel design, and since the acquisition of Odim the company can provide a



The UT 771 WP complements other PSV designs and can carry a range of cargoes in a safe and efficient way. It has a deadweight of 4,200dwt.

range of seismic handling equipment as well as designs and systems for the ship.

The UT833 WP is an advanced seismic survey vessel design meeting present and future needs with specification options to suit individual owners' requirements. It can deploy 18 streamers each 10km long plus the air gun array. The efficient design of the ship with up to 180 tonnes of towing force gives a highly competitive fuel cost per square kilometre surveyed.

This 110m long ship has hybrid propulsion with Promas/InnoDuct system and meets Clean Design class with low emissions. In normal seismic mode the UT 833 WP has a range of about 10,000 nautical miles, or 30,000NM at a 14 knot cruising speed and an endurance of up to 80 days with 72 people on board.

The seismic systems deployed from the ship are extremely valuable and could be hazarded by equipment failure on board, so the UT 833 WP has a high level of system and equipment redundancy. Surveying work is also increasingly carried out in the Arctic, and this vessel can be delivered with deicing and Ice class. Its Rolls-Royce wavepiercing technology with a hull form is efficient in all wave headings and gives less speed loss in head seas than conventional designs.

The UT 833 WP is offered with all main systems from Rolls-Royce, including engines, propulsion, controls, unified bridge and a full range of seismic handling winches.

*"This article originally appeared in In-Depth, the marine customer magazine of Rolls-Royce."*



# Transas vision helps CSMART Academy train the best

State-of-the-art simulators from Transas underpin a transformation in the way Carnival prepares its bridge officers and engineers at its new CSMART training hub to take charge of some of the most expensive vessels in the world.

*Transas*

The culmination of almost two years of intensive R&D investment, Carnival Corporation's new world-class Center for Simulator and Maritime Training (CSMART) officially opened in the leafy suburb of Almere, a half an hour drive from Amsterdam, The Netherlands in the summer of 2016.

The facility embodies Carnival's commitment to a step-change in seafarer training in pursuit of

enhanced safety at sea. CSMART currently runs 17 courses - accredited by the UK Maritime and Coastguard Agency, Netherlands Shipping Inspectorate, and DNV GL - and plans to expand the curriculum to address the increasing complexity of equipment on board contemporary passenger ships. It is technology that officers are unlikely to have encountered in their training at academies before joining Carnival.

With over 10,000m<sup>2</sup> of floor-space spreading over five stories, the new facility houses navigational and engine room simulators in various configurations from classroom stations up to part-task and full mission solutions,

interlinked to provide training and assessment for the entire crew.

Delivered as an Integrated Full Mission Simulation Academy Solution from Transas, these will be in constant use providing training for the thousands of deck and engineering officers that keep the group's 101 cruise ships running, making it one of the world's busiest maritime training facilities. 'Academy' is the approach Transas has conceived to depict its integrated methodology for maritime training, which combines technology, high-quality content and expertise to provide a bridge between STCW and the competency required to take charge of 21st century ships.

CSMART Managing Director Hans Hederström says that, overall, Carnival has invested € 75 million in its new training Center. "Providing the world's best training to our deck and engineering officers is essential in helping us meet our safety priority," he explained. "We recruit the best instructors in the maritime industry, and we have formed important partnerships with companies such as Transas. The solutions provide our instructors with truly state-of-the-art technology, and the ability to offer the best possible experience to the thousands of officers who go through our intensive curriculum."

### Transformative Technology

Transas CEO Frank Coles sees the opening of CSMART as a milestone for Transas, but also for seafarer training and the maritime industry's relationship with technology.

"By applying technological advancements never before utilised within the maritime industry, Transas has created multi-simulator integrated training that delivers an immersive, real world situational environment in which multiple crew members can interact, as if on a real vessel," said Coles. "This is the standard by which all training should be measured."

Training is one of four core elements of Transas' new THESIS concept for enhanced vessel operation, and is integral to its bid to 'connect the dots' of a maritime industry subject to a variety



(from left) Hans Hederström, Managing Director of the CSMART and Frank Coles, Transas CEO at the CSMART

of regulations and standards. In a world of fast-changing technology and connectivity, an individual may also progress towards competency courtesy of training from a variety of sources. Navies, shipping companies, oil & gas companies, maritime schools or training centres, coastguards, pilot associations and even port authorities can be training providers at any given point in a maritime career.

"The Transas approach is to deliver a simulation training quality content development database, and scenarios that involve integrated solutions, because we believe that knowledge exchange today needs to build on a platform including technology, content and expertise," said Coles.

In technology terms, this points towards connectivity within an ecosystem using the Cloud as infrastructure, a Learning Management System drawing on e-tutoring and online seafarer competence records, computer-based training assessment, and scenario-based simulation.

Content, in turn, needs to move beyond regulation to include high quality elements; examples include non-regulated industry-driven content and support for a global ECDIS training network (GET-Net). Other training modules take in leadership and management, fuel saving, operational excellence, sea traffic management, and equipment management.

### The CSMART Grid

For CSMART, Coles adds that 'virtualisation' of simulation tasks has enabled digital solutions company Transas to reduce the number of physical apparatus required for a facility with comparable capability by around three-quarters (from 650 to 150), cutting energy consumption by one-third in the process. Individual hardware pieces are effectively replaced by the NVIDIA GRID platform.



“Besides the power saving, this architecture improves overall redundancy: zero downtime was an important requirement due to the high volume of seafarers on tight, fixed training schedules passing through the centre,” said Coles.

The grid system also facilitates easier and more flexible information exchange between the simulators and other parts of the centre, such as debriefing rooms, supported by CCTV cameras synchronised to all of the workstations, for recording and archiving training classes.

Transas developed 12 cruise ship models to replicate bridge systems on Carnival vessels, and three new cruise ship engine models with different propulsion systems, including some virtual replicas of ship automation systems. Transas also programmed simulation scenarios for 60 sailing areas including the major ports and cruise destinations most frequently visited by Carnival vessels.

The engineering section of the CSMART complex includes four full mission engine room simulators, 12 sets of virtual machinery stations, and two high voltage training systems. In addition, there are two engine room simulator classrooms, each with 12 stations, and four debriefing stations and rooms. To ensure realistic training for engine room and machinery functions, Transas adapted 3D graphics techniques more commonly seen in computer games, which allow trainees to walk through a virtual replica of the vessel's layout, moving their avatar through machinery compartments via gaming controllers or touchscreens and interacting with other trainees.

The navigation section of the simulation complex comprises four full mission bridge simulators with 210 degrees field of view, as well as two sets of bridge wings with dome projections. These will be augmented by six part-task bridge simulators with 120 degrees of visualisation, and two part-task bridges with 180 degrees horizontal field of view. Each bridge simulator is arranged in the same configuration as the actual bridge systems used on board Carnival vessels.



There are seven instructor control stations for monitoring and controlling the bridge simulators. Transas also provided a modelling station with the Model Wizard and Virtual Shipyard software, which will allow the centre to edit and create its own sailing areas and ship models.


### Training philosophy

Carnival expects some 6,500 officers and engineers - from across all ranks - to pass through the doors of its new facility annually. For instance, the cruise operator's captains and officers who have completed all seven weekly courses must take an annual assessment to ensure that their skills and competencies are up to the corporate standard. New hire officers about to join their first cruise ship have to spend two weeks at the centre on simulator courses to familiarise themselves with routine operations.

Overall, the new centre is providing participants with an “extraordinary experience”, Hederström says. He adds that it typically takes less than 30 minutes for officers to forget they are in the simulator altogether, as the bridge equipment and layout is a replica of what they find onboard the latest cruise ships, and begin to behave exactly as they would on board, allowing CSMART trainers to watch a live-feed of what's happening on the bridge.

“State of the art full bridge simulators in combination with a team of highly qualified instructors - most with more than 25 years' experience in the industry - give our bridge personnel the opportunity to advance and test their seafaring, critical thinking and problem solving skills, whilst increasing their confidence.”

Critically, Coles says the integrated approach allows trainers to deliver expertise as the need arises, with simulation drilling down into emerging industry trends such as LNG bunkering and propulsion, or ice navigation.

“We are applying a holistic approach to simulation and training delivery, supporting training providers throughout the whole process from simulator technology selection to the training facility design, course content, training delivery, debriefing and assessment,” he explained. 



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# Unprecedented opportunity: Finding the ROI in IIoT

- Emerson Automation Solutions



Mike Train,  
Executive president of Emerson Automation Solutions

Now more than ever, manufacturers are under pressure to do more with less to improve financial results. Faced with a global contraction in capital spending, manufacturers in the oil and gas, petrochemical, refining, and other process industries need to boost profitability from existing assets. The good news is that not only is it possible, but that the current opportunity is unprecedented in manufacturing history.

Here is why: Every year process manufacturers lose a whopping \$1 trillion due to inefficient operations, according to Refining and Petrochemical Benchmarks, API, Solomon, the Occupational Safety and Health Administration, IHS Markit, and company reports. Ensuring profitability begins with finding a way to improve these operations and recapture those losses. Yet many otherwise successful manufacturers lack the confidence to move away from decades-old work practices. They are uncertain about which approaches will yield the greatest operational improvements.

The answer lies in embracing the Industrial Internet of Things (IIoT). Despite the hype, it is true; the right IIoT strategy can

dramatically improve a plant's operations. But to many in industry, the IIoT is only a promise. A recent IndustryWeek survey reveals that 75 percent of 500 senior industry executives acknowledge the need for IIoT investment, but only 5 percent of those same companies have an in-depth IIoT strategy.

What is holding them back? Many do not understand the business case for investment - which technology investments will move the financial performance needle. And of course, with greater connectivity comes greater security risks for plants to keep data safeguarded. That is why we have been focused on innovation using advanced encryption, private company cloud environments, and advanced new routers with physical, one-way data paths to transform data management practices on site and in the cloud.

With robust security measures in place to protect data and mitigate risk, manufacturers can chart a path to operational excellence through IIoT. The return on this IIoT investment is measurable and significant. With the technology, tools, and a





culture willing to adapt, companies can generate measurable business results among four areas: production, reliability, safety, and energy and emissions. Within these areas, per a recent benchmark analysis of the industry's top quartile performers compared to the industry average, top performers experience:

- two weeks of extra production availability
- operating costs 20 percent lower
- three times fewer safety incidents
- CO<sub>2</sub> emissions 30 percent lower and a third as much spending on energy

It is proof that companies that want to boost profitability to top quartile levels need to generate real gains in these key areas and use IIoT strategies to get there. But you need to know how to get there. All signs point to automation. Automation empowers us with new ways to solve problems by leveraging expertise across an organization: local experts are more efficient, centralized experts can manage fleets of assets


across the globe, and third-party experts can safely and cost effectively manage critical assets outside of a company's core competency.

And this does not have to be a "big bang" infrastructure investment or organizational overhaul. Businesses can invest in small pilots, often less than \$50,000, ensure return on investment (ROI), and take the next step, knowing that each investment can be leveraged toward an organizational top-quartile program. This is why automation is the highest impact investment organizations can make for ROI on their operational excellence initiatives.

For example, a petrochemical company with hundreds of steam traps employed an IIoT strategy that reduced steam consumption by 7 percent. It uses wireless acoustic steam trap transmitters to monitor noise and temperature, then transfers the data to a Microsoft Azure cloud virtual server, so the analytics software can analyze the data and generate alerts. Then, remote access monitoring by experts provides actionable reports to maintenance for repairing or replacing failed steam traps long before they fail.

Operational excellence begins with pinpointing the causes of poor performance, prioritizing actions that can yield the greatest improvement, and establishing a scalable work plan. It also takes management leadership to embrace and deploy the right technology and solutions, a commitment to break down silos and encourage expert collaboration across the enterprise, and courage to drive a culture where it is safe to advocate change. When this happens, process manufacturers experience a return of greater productivity, less downtime, safer operations, and reduced energy costs. The once-muddled path to getting the most from the IIoT becomes clear, and the journey to becoming a top industry performer begins. Ultimately, harnessing the power of the IIoT produces measurable and sustainable benefits that improve a company's bottom line and justify its future direction. With the right roadmap, IIoT's promise can be fulfilled.

### About the Author

Mike Train is executive president of Emerson Automation Solutions. He is responsible for leading strategies and innovations to help customers enhance operations and achieve top quartile performance. Before his current role, Train was president of global sales for Emerson Process Management, overseeing five regional organizations focused on sales, service, support, and customer satisfaction. 



# 전례 없는 기회: IIoT에서 ROI 찾기

에머슨 오토메이션 솔루션즈



마이크 트레인(Mike Train),  
에머슨 오토메이션 솔루션즈 수석 사장



제조 업체들은 그 어느 때보다 제한된 자원으로 더 많은 성과를 내야 하는 압박을 받고 있다. 글로벌 투자 침체에 따라 석유, 가스, 석유화학 정제 및 기타 공정 산업과 관련한 제조 회사들은 보유하고 있는 현재 자산에서 더 큰 수익을 노려야 한다.

다행히도 이러한 과제는 실현 가능성이 크며, 현재 제조업 역사상 전례 없는 기회이기도 하다. 그 이유는 이렇다. 여러 전문기관의 보고서에 따르면 매년 공정 제조 회사들은 비효율적인 운영으로 인해 1조원 달러에 달하는 막대한 손해를 보고 있다고 한다.

수익성을 보장하기 위해서는 기존의 운영 방식을 개선하고 손실을 회수할 수 있는 방법을 찾는 것으로부터 시작한다. 그럼에도 불구하고 많은 우수한 업체들이 오래된 작업 관례에서 벗어나기를 두려워하고 있다. 어떤 방식이 운영에 있어 가장 큰 향상을 산출할 수 있는지 확신하지 못하기 때문이다.

이 문제에 대한 답은 바로 산업 사물인터넷(IIoT)의 수용에 있다. 부풀려진 문구들이 많지만, 적절한 IIoT 전략은 플랜트의 운영을 극적으로 향상할 수 있다. 그럼에도 여전히 산업 내 많은 이들에게 IIoT

는 그저 가능성으로만 고려된다. 최근 IndustryWeek 설문조사에 따르면 500명의 고위 업계 간부들 중 75%가 IIoT 투자의 필요성을 인지하고 있으나, 그 회사들의 단 5%만이 심층적인 IIoT 전략을 갖추고 있다.

무엇이 이들을 주저하게 만드는 걸까? 많은 이들이 기술 투자가 경제적 성과를 움직일 수 있는 눈금이 될 수 있다는 사실을 이해하지 못한다. 게다가 플랜트 내 여러 요소를 더 많이 연결한다는 것은 당연히 보안 위협이 더 커질 수 있고 플랜트 데이터를 더욱 보호해야 한다는 의미이기도 하다. 이러한 이유로 우리는 고급 암호화, 전문 클라우드 환경, 그리고 구역 및 클라우드 내 데이터 관리 관행을 변환하기 위한 물리적 일원 데이터 경로와 같은 혁신에 주력하고 있다. 제조 회사들은 데이터를 보호하고 위험을 완화할 수 있는 강력한 보안 조치를 갖춰 IIoT를 통해 운영의 효율성을 높이는 계획을 세울 수 있다. IIoT 투자로부터 얻을 수 있는 수익은 측정 가능하고 의미가 있다.

회사들은 기술, 도구 그리고 사고방식을 통해서 생산, 신뢰성, 안전



성, 에너지 및 배, 4개 분야에서 측정 가능한 사업 결과를 창출할 수 있다. 이 분야에서, 업계 상위 25%의 성과를 낸 회사들과 산업 평균을 비교한 최근 분석에서 상위 업체들은 다음의 성과를 낸 것으로 드러났다.

- 2주 가량의 추가적인 생산 가용성 증가
- 운영 비용 20% 절감
- 안전 사고 위험 3배 낮춤
- CO<sub>2</sub> 배출량은 30%로 낮추고 에너지 소비량은 1/3로 낮춤

이와 같이 상위 25%의 수준으로 수익성을 높이고자 하는 회사들이 앞서 말한 4개 핵심 분야에서 실질적인 이익을 창출해야 하며, 그러기 위해 IIoT 전략을 활용해야 한다는 것이 입증되고 있다. 그러기 위해서는 목표에 도달하는 방법을 연구해야 한다. 제조 업체의 성과에는 '공정 자동화가 그 저변에 있다. 자동화는 새로운 방법들을 통해 전 조직에 걸쳐 전문성을 활용해 문제를 해결할 수 있도록 한다. 현장 전문가들은 보다 효율적이며, 중앙 제어 전문가는


전 세계의 자산을 관리할 수 있으며, 제3자 전문가는 회사의 핵심 역량 밖의 주요 자산을 안전하고 비용 효율적으로 관리할 수 있다. 이러한 변화의 방법이 엄청난 인프라 투자나 조직적 점검이어야 할 필요는 없다. 에머슨은 상위 25%의 성과를 달성하기 위해, Top Quartile(최고 사분위) 전략을 개발했는데, 사용자는 보통 5만 달러 미만의 작은 규모로 투자를 하고 투자수익률(ROI)을 확인한 후, 각 투자자 조직적으로 Top Quartile 프로그램으로 전략적으로 활용될 수 있다는 사실을 기억하고 다음 단계를 시작하면 된다. 자동화는 이렇게 점진적인 방식으로 진행할 수 있기 때문에 운영 효율성 계획에서 가장 큰 ROI 파급 효과를 가져올 수 있는 투자라고 할 수 있다.

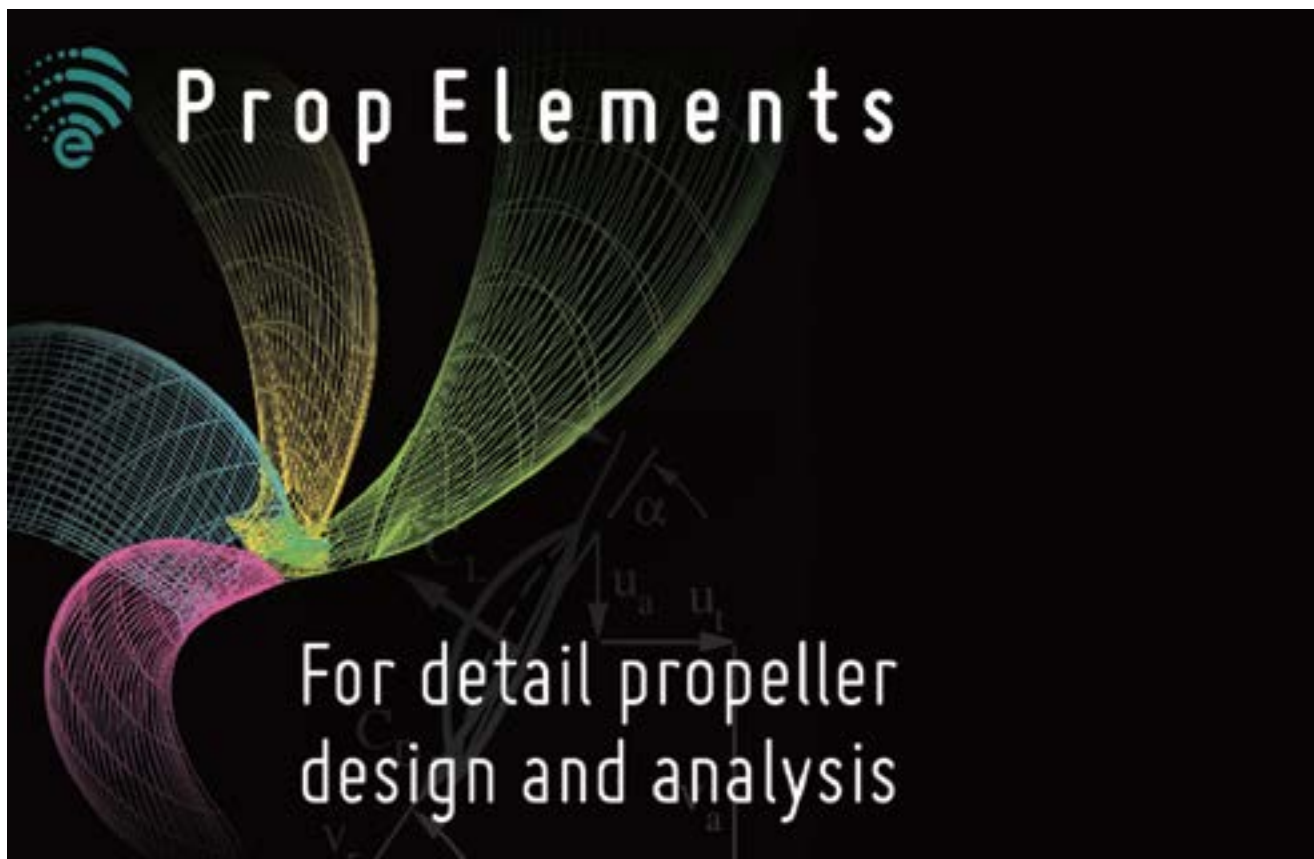
한 예로, 수백 개의 증기 트랩을 갖춘 한 석유화학 회사는 IIoT 전략을 활용해 증기 소비를 7% 줄일 수 있었다. 무선 어쿠스틱 증기 트랩 트랜스미터를 사용해 소음 및 온도를 모니터링 한 후 데이터를 Microsoft Azure 클라우드 가상 서버로 전송해 분석 소프트웨어가 데이터를 분석하고 경고를 생성할 수 있도록 한다. 이후, 전문가들의 원격 접속 모니터링을 통해 실행 가능한 보고서를 유지보수에 제공해 증기 트랩이 고장나기 전에 이를 수리 또는 교체한다.

운영의 효율성을 높이는 것은 먼저 부진한 성과의 원인을 정확히 찾아내고, 최고의 개선을 이루어 내기 위해 우선순위에 따라 조치하고, 점진적 확장이 가능한 작업 계획을 수립하는 것으로 진행된다.

무엇보다 적절한 기술과 솔루션을 수용하고 배치하려는 경영 리더십, 기존 관례를 허물고 기업 전체에 걸쳐 전문 협업을 장려하기 위한 의지, 변화를 모색하고 안전한 문화를 고취하기 위한 용기가 필요하다. 그 결과 공정 제조사들은 더 큰 생산성의 수익, 다운타임 감소, 더 안전한 작업, 그리고 에너지 비용 감소를 경험하게 될 것이다. IIoT 활용에 대한 불확실한 계획을 명확히 하고 그 잠재력을 통해 측정 가능하고, 지속 성장 가능한 성과를 얻을 수 있다. 올바른 로드맵으로 IIoT가 약속하는 모든 것이 실현될 것이다.

#### About the Author

에머슨 오토메이션 솔루션즈 수석 사장인 마이크 트레인(Mike Train)은 전략 및 혁신을 이끌며 고객들이 사업을 강화하고 에머슨의 Top Quartile 프로그램으로 고객을 돕고 있다. 전 에머슨 프로세스 매니지먼트 글로벌 사장으로 5개 조직을 관리하며 지역 판매, 서비스, 지원 및 고객 만족에 앞장서왔다. 



# HydroComp PropElements® 2017

Detail propeller design and analysis for naval architects

*HydroComp, Inc.*

HydroComp PropElements 2017 - the propeller “design for performance” code from HydroComp of Durham NH USA - is the latest build of the company’s commercial software for marine propeller design and analysis. Propeller specialists will find it an essential addition to their software tools, and also tackles the component-level hydrodynamic needs of naval architects.

### Why PropElements?

Still an uncharted domain for many naval architects, propeller design is an iterative process following a typical design

spiral - from initial sizing through detail design. System-level propulsion design and analysis tools (such as HydroComp NavCad®) are used in early design stages to identify principal propeller parameters (e.g., diameter, pitch, blade area, number of blades) and to even make a first assessment on certain performance details, such as hydroacoustics. It is after this point that naval architects typically defer final propeller details to the manufacturer or a specialized consultant. With the advent of custom and semi-custom propellers - commonplace for new vessel designs - naval architects now have a new set of technical challenges. These propellers dif-

fer from stock “series” or “off-the-shelf” propellers in two principal ways. They are:

- designed using contemporary foil geometries, and
  - optimized and fitted to the individual vessel (or vessel type).
- To fully take advantage of the benefits that custom or semi-custom propellers make available - or to evaluate them in service - naval architects must look to a different kind of propeller calculation.

Of course, specialists can use PropElements to help prepare the final design for a particular application, but now with PropElements 2017 - the latest version of HydroComp’s tool for wake-adapted propeller design - naval architects can become a meaningful participant in the design and analysis of these contemporary propellers at later design stages. For example, they can employ PropElements to conduct studies of alternatives prior to development of the final design, as well as to confirm and check these designs.

### How PropElements 2017 works

In wake-adapted propeller design, a custom propeller is optimally matched to the unique inflow properties of the vessel, or its “wake field”. (See Figure 1 below for an example of radial averaged velocities derived from the wake field.) PropElements is able to consider axial and tangential inflow properties, and ascertain optimized distributions of pitch and camber for prescribed foil characteristics. Of course, the propeller design process with PropElements takes into account blade strength, tip and hub loading, and cavitation. Its calculation pages include Propeller, Performance, and Strength; with supplemental calculations such as for the creation of KT-KQ curves. (See Figure 2 for a sample screen shot.)

The foundation of PropElements is a unique distributed blade foil code, with empirical connections that allow analyses to be viscous and fully-scalable. (These corrections are made possible through HydroComp’s experience in hybrid empirical-numerical hydrodynamics.) PropElements also supports standard nozzle styles (such as 19A, 33 and 37), with optional support for contemporary high-efficiency nozzles and tunnel thrusters.

### Detailed analysis of propeller performance

PropElements can also be applied to analysis, as well as design. The ability to investigate radial values of foil lift and cavitation number, for example, can help identify potential sources of root cavitation or blade impulse excitation. It can

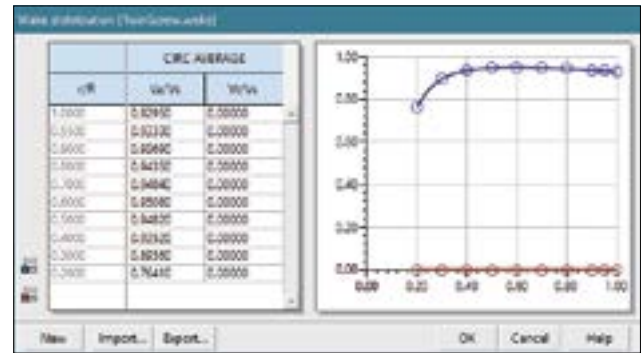


Figure 1. Example of averaged axial and tangential velocities

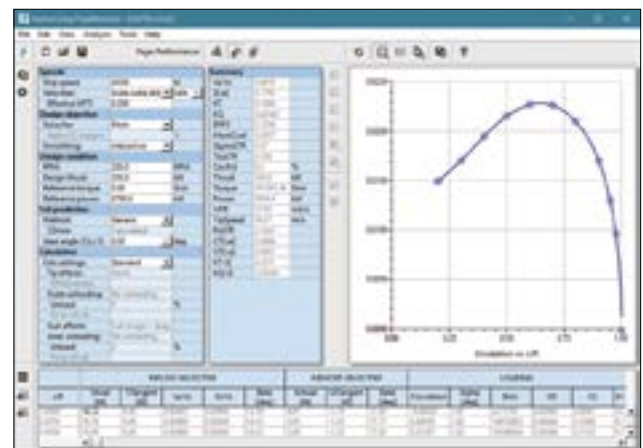


Figure 2. Example PropElements screen shot

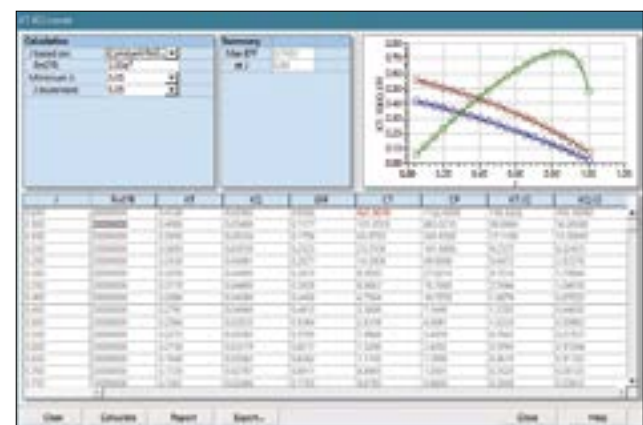


Figure 3. KT-KQ calculation

help evaluate tip loading (for hydroacoustics), and also be employed in forensic investigations of blade failure.

Export of KT-KQ curves can be applied to system level calculations in replacement of direct propeller series predictions. For example, KT-KQ curves from PropElements 2017 can be exported in a form that can be used with

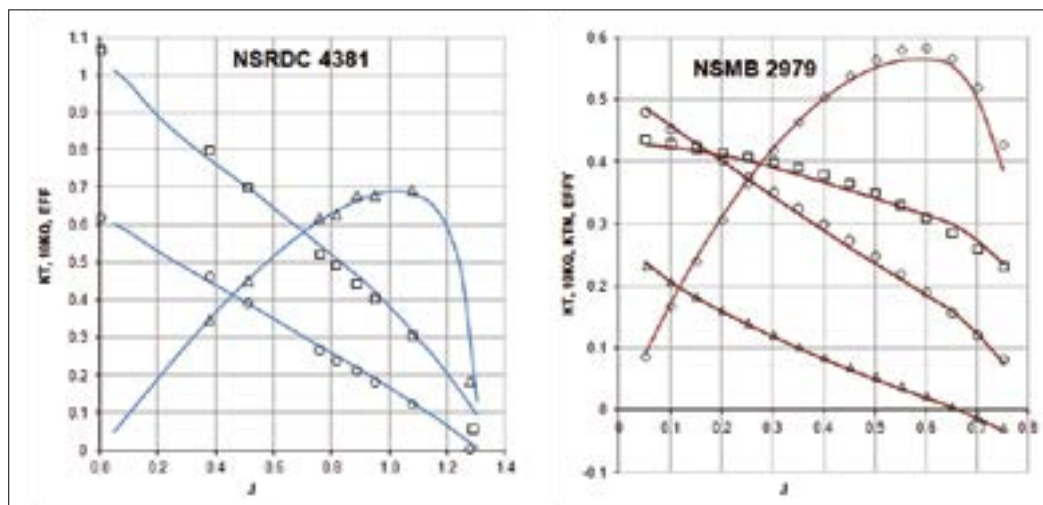


Figure 4. Sample validation for PropElements 2017

HydroComp NavCad for propulsion analysis. (Figure 3 shows the results of a calculation study with PropElements 2017.)

### Interaction with HydroComp design tools, CFD, and FEA

A number of Import and Export options make PropElements an important companion for HydroComp’s NavCad and PropCad® software, as well as the perfect pre-processor for higher-order flow codes, CFD, and FEA. For example, early-stage performance prediction is typically conducted using NavCad. One unique NavCad feature is “Aligned Series” propeller performance, where KT-KQ data from model tests - or from PropElements - can be used to correlate custom propeller performance to series calculations. Then, when the propeller has gone through the “design for performance” process with PropElements, its “design for manufacture” can be completed in PropCad. CFD and FEA calculation benefit from PropElement’s calculation of proper body forces.

### Validation of PropElements

HydroComp conducts formal benchmark validation studies for PropElements using model test data for quantitative fidelity, and CFD studies to confirm scalability and qualitative outcomes. Two examples of these studies for PropElements 2017 are shown below.

#### “Pump flow” calculations

The useful domain for PropElements 2017 is not limited to


marine propellers. It has also been extensively used for propeller-like pump and industrial mixer design and analysis. Novel proprietary features support accurate prediction of static high-thrust loading and corresponding “induced volumetric flow rate” for these devices.

### Summary

Engine power densities will grow; fuel costs will increase; and emission reduction will become more urgent - all leading to the greater use of specialized propeller designs. With more propeller builders now capable of delivering “made to order” propellers, custom and semi-custom propellers of wake-adapted design should be considered for new construction and repowers.

The widespread installation of these propellers also suggests that naval architects need the ability to analyze their performance in greater detail than has typically been available. Whether for confirmation of propeller designs for new-build projects or the post-delivery evaluation of trial performance, HydroComp PropElements 2017 should become a commonplace fixture in a naval architect’s toolbox.

### About HydroComp

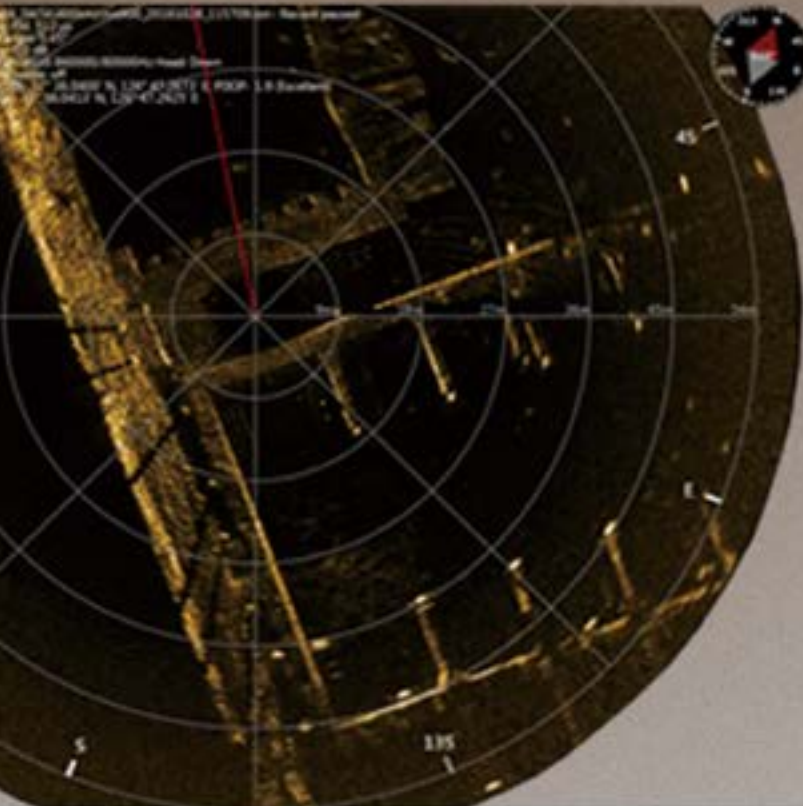
Founded in 1984 and celebrating its 33rd year of operation, HydroComp provides software and services for the performance analysis and design of marine vehicles to industry, research, academic, and government clients. The company is proud to have served over 800 customers from more than 60 countries. 

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## DSME won orders for 3 VLCCs

Daewoo Shipbuilding & Marine Engineering (DSME) announced on April 4 that it won an order worth about USD 250 million from Maran Tankers Management, a subsidiary of Greece-based Angelicoussis Group, for 3 units of 318,000-ton VLCCs (Very Large Crude-oil Carriers).

These VLCCs, which measure 336m in length and 60m in width, are the next-generation eco-friendly vessels that meet the requirements of environmental regulations set forth by the IMO (International Maritime Organization) and incorporate the latest technologies of DSME such as high efficiency engines and fuel-saving technology, etc. They will be delivered to the ship owner by 2018 on a staggered basis.

Including this contract, Angelicoussis Group has placed orders at DSME for 92 vessels to date since its first order placement at DSME in 1994. At present, 18 vessels of Angelicoussis Group are being built at DSME's Okpo shipyard and Romanian shipyard.

An official from DSME said, "Angelicoussis Group, the largest shipping company of Greece, has shown unlimited confidence in revitalization of our company. To reciprocate for the unwavering trust and support that the public, government, creditors, and ship owners have shown to us, all employees of our company will make all-out efforts to bring business back on track."

The latest contract brings total value of new orders at DSME to USD 770 million so far this year for 7 vessels consisting of 2 LNG carriers and 5 VLCCs.

### 대우조선해양, 초대형 유조선 3척 수주

대우조선해양은 그리스 안젤리쿠시스 그룹 자회사인 마란 탱커스(Maran Tankers Management)로부터 318,000톤 규모의 초대형 유조선(VLCC, Very Large Crude-oil Carrier) 3척을 약 2.5억 달러에 수주했다고 지난 4월 4일 밝혔다.



이번에 수주한 선박은 길이 336m, 너비 60m 규모이며, 국제 해사기구(IMO)의 환경규제 기준에 충족하는 차세대 친환경 선박으로 고효율 엔진과 최신 연료절감 기술 등 대우조선해양의 최신 기술이 적용된다. 2018년까지 3척이 순차적으로 선주측에 인도될 예정이다.

안젤리쿠시스 그룹은 1994년 첫 거래 이후 이번 계약을 포함하여 총 92척의 선박을 대우조선해양에 발주했으며, 현재 총 18척의 안젤리쿠시스 그룹 선박들이 대우조선해양 옥포 조선소와 루마니아 조선소에서 건조되고 있다.

대우조선해양 관계자는 "그리스 최대 해운선사인 안젤리쿠시스 그룹이 당사의 화생에 무한한 신뢰를 보여주고 있다"며, "이처럼 우리를 믿고 지원을 아끼지 않는 국민들, 정부, 채권단, 선주사의 믿음에 보답하기 위해서라도 회사 경영정상화를 위해 전임직원은 뼈를 깎는 노력을 다하겠다"고 말했다.

한편 대우조선해양은 올해 들어 LNG선 2척, VLCC 5척 등 총 7척 7.7억 달러의 수주 실적을 거두고 있다.

## WinGD and HHI extend licence agreement for another ten years

Winterthur Gas & Diesel (WinGD) and Hyundai Heavy Industries (HHI) signed an amendment to extend their current Licence Agreement for another ten years in Winterthur, Switzerland on 14 Mar. The agreement covers the sale, manufacturing and servicing of WinGD low-speed marine engines. HHI is a long-standing member of the WinGD family

of low-speed engine licensees.

WinGD and HHI look back on a very long, successful and fruitful relationship. Besides building many engines, HHI has, over the years, also contributed to the development of WinGD low-speed



engines and built the first examples of new engine types like the RT-flex82C/ 82T and X92.

“WinGD and HHI have a long common history of introducing new technologies to the international shipbuilding industry. The extension of our licence co-operation agreement will enable us to strengthen our presence in the important Korean shipbuilding market and ensures that in the years to come our customers will continue to benefit from the availability of competitive, high-quality fuel-efficient and environmentally-friendly main propulsion engines for all merchant vessels built by shipyards in HHI territory; it also shows WinGD’s long term commitment to be a reliable and innovative partner to the Korean ship- and engine building industry” comments Martin Wernli, CEO, WinGD.

### WinGD, 현대중공업과 라이선스 10년 연장 계약

WinGD(Winterthur Gas & Diesel)와 현대중공업은 지난 3월 14일 스위스 빈터투어(Winterthur)에 위치한 WinGD 본사에서 WinGD 저속박용엔진의 판매, 제작 생산 및 서비스 지속을 위한 현행 라이선스 계약을 장기 연장하는 서명식을 가졌다. 현대중공업은 장기간 WinGD 저속 엔진 라이선스를 유지하고 있다.

WinGD와 현대중공업은 그 동안 긴밀한 협력관계를 유지해왔다. 특히 현대중공업은 WinGD의 저속엔진 개발에 기여한 바가 크며, RT-flex82C/82T 및 X92 엔진 등 다양한 신형 엔진들을 생산하는데 일조해왔다.



Mr K. D. Lee, Executive Vice President, HHI (left) and Martin Wernli CEO, WinGD (right), are signing the extension of the licence agreement.

WinGD의 마틴 베르리(Martin Wernli) 사장은 “WinGD와 현대중공업은 전세계 조선관련 산업에 신기술 도입을 위한 공동 협력을 지속해 왔다. 이번 라이선스 계약 연장은 한국 조선 시장에서의 WinGD의 입지를 공고히 할 것이며, 동시에 고 품질 및 저연비의 환경친화적인 WinGD 엔진을 통해 고객사들은 경쟁력을 강화하고 수익을 극대화할 수 있게 될 것이다. 우리는 선박 엔진 분야에서 신뢰할 수 있는 파트너이기 때문이다”라고 말했다.

## Nexans cables to carry green energy to thousands of Norwegian households

Norway’s energy sector is poised for an exciting new era. For many years, the country has been one of Europe’s leading oil and gas exporter, as well as possessing about half of Europe’s hydroelectric water storage reservoirs. Now it is set to more than double its wind energy generation capacity in one move with the construction of the 1 GW Fosen Vind project.

Nexans cables to carry green energy to thousands of Norwegian households Linka AS, the electrotechnical contractor for the project, has chosen Nexans to supply cables for Roan Wind Farm. This is the first of six windfarms in Fosen Vind DA’s development in Central Norway that will be Europe’s largest onshore wind power project.

The Roan Wind Farm is made up of 71 turbines and will have a capacity of 255 MW. Fosen Vind DA has awarded the construction contract to Johs. J. Syltern AS, whose tasks will include trenching and cable-laying. FosenVindNexans will supply 200 km of TSLF 36 kV underground cables to interlink the turbines and transmit the power to the grid. Delivery



will start in April 2017 and run until March 2018, shortly before the completion of the Wind Farm.

“We have enjoyed many years of fruitful cooperation with Nexans on other projects, both large and small, and they have been dependable in all project phases, from tendering and sales processes, logistics planning, right through to the safe trans-

port of cable onto site," said Knut Arne Aasan, CEO of Linka AS. Bård Lillehaug, Nexans Norway's Head of Sales and Marketing, added, "The renewable energy market is an important target area for Nexans. We have supplied cables for the majority of onshore wind farms in Norway and a considerable share of offshore wind farms internationally. The choice of our cables by Linka AS is a very welcome recognition for us."

The total project of six wind farms will comprise of 278 turbines and have an output of 1000 MW, enough energy for 170,000 Norwegian households. It will be completed in 2020.

### 넥상스 케이블, 수 천만 노르웨이 가정에 그린 에너지 송전

노르웨이의 에너지 산업은 새로운 시대를 맞이할 준비를 끝냈다. 수년간 노르웨이는 유럽 내 오일 및 가스 수출분야의 선도 국가로 유럽 수력 발전 저수지의 절반을 소유하고 있다. 노르웨이는 이제 1GW 포센 윈드 프로젝트로 풍력 에너지 발전 용량을 두 배 이상으로 늘릴 준비를 마쳤다.

이 프로젝트의 전기기술 계약업체 Linka AS는 로안(ROAN) 풍력발전단지의 케이블 공급업체로 넥상스를 선택했다. 이는 유럽 내 가장 큰 온쇼어 풍력발전단지 프로젝트로 노르웨이 중부에서 Fosen Vind DA가 개발하는 총 여섯 개의 풍력발전단지 중 첫 번째 단계이다.

로안 풍력발전단지는 7개 터빈으로 이뤄졌고, 용량은 255MW이다. 트랜치 보호 공사

와 케이블 포설은 Fosen Vind DA로부터 계약을 체결한 John J. Sjøtem AS가 진행한다. 넥상스는 전력을 그리드로 송전하고, 터빈을 서로 연결하는 TSLF 36kV 해저케이블 200km를 공급한다. 납품은 2017년 4월부터 시작되며, 풍력발전단지 완공 직전인 2018년 3월까지 진행된다.

Linka AS의 누트 안 아산(Knut Arne Aasan) CEO는 "우리는 지난 수년간 넥상스와의 생산적인 협력을 통해 다양한 프로젝트를 성공적으로 진행해왔고, 넥상스는 입찰에서부터 영업 프로세스, 물류 계획, 현장으로의 안전한 납품에 이르기까지 프로젝트 전 단계에 걸쳐 믿을 수 있는 서비스를 제공해줬다"고 말했다.

넥상스 노르웨이 영업 마케팅 이사인 바드 릴호그(Bård Lillehaug)는 "신재생 에너지는 넥상스에 있어 매우 중요한 시장이다. 넥상스는 주요 노르웨이 온쇼어 풍력 발전 단지에 케이블을 공급해왔고, 전세계적으로도 상당수의 오프쇼어 풍력 발전단지에 케이블을 공급하고 있다. Linka AS가 넥상스 케이블을 선택한 것은 우리에게 있어 매우 기쁜 일이다"라고 말했다.

전체 여섯 풍력 발전 단지는 287개 터빈으로 구성되며, 1000MW의 용량으로 17만 노르웨이 가정에 에너지를 제공할 수 있다.

## Alfa Laval wins SEK 125 million order for marine exhaust gas cleaning systems

Alfa Laval has won an order to supply several Alfa Laval PureSOx exhaust gas cleaning systems. The order was booked late March in the Marine Division's business unit Boiler & Gas Systems. It has a value of approximately SEK 125 million and delivery is scheduled for 2018 and 2019.

The order includes eight Alfa Laval PureSOX exhaust gas cleaning systems (hybrid scrubbers) to be installed onboard two vessels.

"I am very pleased to announce this large order for our scrubber systems. It confirms that Alfa Laval PureSOx is an attractive and proven solution for the reduction of sulfur oxides," said Peter Leifland, President of the Marine Division.

### 알파라발, 해상 배기가스 정화 시스템 수주

최근 알파라발 마린 사업부는 선박 2척에 대한 8대의 알파라발 PureSOx 배기가스 정화 시스템(Hybrid scrubber)을 수주했다. 이 계약 금액은 약 1억 2,500만 SEK에 달하며, 2018년~2019년에 걸쳐 납품될 예정이다.

알파라발 마린 사업부 책임자인 피터 레이프란드(Peter Leifland)는 "이번 저감 장



치 관련 수주 소식을 전하게 되어 매우 기쁘다. 이로써 알파라발 PureSOx는 황산화물 감소를 위한 매력적이고 검증된 솔루션임이 확인됐다"고 말했다.

## DSME signed a LOI with Hyundai Merchant Marine for construction of 10 VLCCs

Daewoo Shipbuilding & Marine Engineering (DSME) announced on April 9 that it signed a Letter of Intention (LOI) with Hyundai Merchant Marine for construction of VLCCs (Very Large Crude Carriers). This LOI includes an option for 5 units to be ordered first and up to 5 units to be ordered additionally. The contract is scheduled for execution by the end of July.

In 2011, Hyundai Merchant Marine placed an order at DSME for 5 units of 13,100 TEU containerships, the largest among those operated by domestic shipping companies. In addition, Hyundai Merchant Marine teamed up with DSME in connection with 6 units of 10,000 TEU containership which was ordered by the UK-based shipping company Zodiac Maritime and chartered out to Hyundai Merchant Marine after delivery, which reflects strong relationship between DSME and Hyundai Merchant Marine.

And official from DSME said, "Domestic and overseas ship owners are still showing strong trust in technological capabilities and competitiveness of DSME. We will return the favor and reciprocate for their trust by providing them with high quality vessels and bringing things back to normal."

### 대우조선해양, 현대상선과 초대형유조선 10척 건조의향서 체결

대우조선해양은 현대상선과 초대형 유조선(VLCC, Very Large Crude-oil Carrier)에 대한 건조의향서(LOI)를 체결했다고 지난 4월 9일 밝혔다. 이번 건조의향서에



는 5척을 우선 발주하고, 최대 5척을 추가로 발주하는 옵션이 포함되어 있다. 본 계약은 7월말까지 체결할 예정이다. 현대상선은 지난 2011년 국내 해운사가 운영하는 컨테이너선 중 가장 큰 13,100TEU급 대형 컨테이너선 5척을 대우조선해양에 발주했고, 지난 2013년에도 영국 조디악이 발주하고 현대상선이 용선한 10,000TEU급 컨테이너선 6척도 대우조선해양과 함께 진행하는 등 깊은 신뢰 관계를 이어오고 있다.

대우조선해양 관계자는 "국내외 선주들은 대우조선해양의 기술력 및 경쟁력에 대해서 여전히 높은 신뢰를 보내고 있다"며 "이런 선주들에게 좋은 품질의 선박을 제공하고 회사를 정상화시켜 보답하겠다"고 말했다.

## Scandlines ensures safety on ferries with Roxtec transits

In order to ensure fire protection and water-tightness, before and after a fire, ferry operator Scandlines in Denmark replaced all other kinds of pipe seals on the recently built hybrid ferries M/V Berlin and M/V Copenhagen with Roxtec transits.

"We chose Roxtec as overall supplier of cable and pipe seals because we had so many different pipe penetrations and retrofits to handle. The bulkheads must withstand 2.5 bar water pressure, and with Roxtec we covered all our needs for quality and flexibility," said Joachim Lund, Dualofficer at Scandlines. "We optimise safety by





selecting Roxtec as supplier of all transits.”

As Roxtec provided full documentation on sealing and insulation requirements and supplied drawings including all needed types of approvals, Scandlines felt very confident in their choice.

Scandlines also uses Roxtec seals instead of traditional cable glands in the cabinets in the engine room. The shipping company wants to increase quality in general, and specifically for the fire-fighting system.

“Safety is extremely important for passenger lines. We invest to be sure

that all cable and pipe transits are in order and that we meet all safety regulations,” said Fini A. Hansen, Coordinating Superintendent at Scandlines.

Scandlines will continue to use Roxtec transits all over their ferries. Roxtec seals are fire rated to marine standards (A60). The estimated cost of a fire on board a ferry is 134,000 euro per minute.

## Wärtsilä to provide solutions and maintenance for Höegh FSRU and LNG vessels



Wärtsilä has been contracted to provide both equipment and maintenance for FSRU and LNG carrier vessels of Norway based operator, Höegh LNG. The orders were booked in the first quarter of 2017.

Two new 170,000 m<sup>3</sup> LNG carrier vessels being built for Höegh LNG at the Samsung Heavy Industries (SHI) and Hyundai Heavy Industries (HHI) shipyards in Korea will each be powered by four Wärtsilä 50DF dual-fuel engines. There is an option for a further three vessels in the SHI series. The two vessels will also feature the latest Wärtsilä regasification technology to operate as FSRUs. The regasification solution to be supplied to these vessels represents Wärtsilä’s latest development in this field. It is based upon the use of seawater and glycol as the intermediate heating medium, a lighter and less space demanding alternative than earlier systems with a propane based heating system. By using seawater as opposed to steam heated solutions, the CO<sub>2</sub> emissions are notably reduced. Furthermore, it will be delivered as a complete module, thereby making installation easy. Typically the value of regasifica-

tion projects is between 20 to 40 MEUR, based on the size, scope, capacity and operational profile of the equipment.

Under a new five year technical management agreement, Wärtsilä will provide support for eight ships of the company’s existing fleet as well as for its two new vessels currently under construction. The services of the technical management agreement include Condition Based Maintenance (CBM) to optimise the availability, reliability, and performance of the Wärtsilä engines. It also includes maintenance planning and advisory services involving the combined technical expertise of both Wärtsilä and Höegh LNG specialists. The customer will also have access to Wärtsilä’s extensive global service network.

“Our long-standing relationship with Höegh LNG is again strengthened through this supply of our state-of-the-art engines and regasification systems, as well as the technical management agreement that will ensure optimal performance of the company’s entire fleet,” said Cato Esperø, Sales Director, Wärtsilä Norway.

“We have confidence in Wärtsilä as a provider of well designed and engineered solutions, and are pleased with the choice of a strong provider as regards to the engines and regasification systems” said Øivin Iversen Chief Technical Officer Höegh LNG.

# Alfa Laval Performance Agreement with Finnlines ensures PureSOx reliability



Leading Finnish shipping operator Finnlines, part of the Grimaldi Group, has placed a service order with Alfa Laval to optimize the performance of its existing Alfa Laval PureSOx scrubber systems. The Performance Agreement was tailored for Finnlines using the Alfa Laval 360° Service Portfolio, a structured selection of well-defined service offerings.

The Alfa Laval Performance Agreement with Finnlines covers PureSOx systems installed on board seven RoRo vessels: Finnulp, Finnmill, Finnhawk, Finnkraft, Finncarrier, Finnmaster and Finnmerchant. The ships are part of the Finnlines fleet operating in the Baltic Sea, where strict SOx emissions limits are in place due to the region's designation as an Emission Control Area (ECA). Finnlines began equipping vessels with PureSOx in 2014, in preparation for the implementation of ECA limits in 2015.

"As one of the most complete and proven SOx scrubber platforms on the market, PureSOx was an obvious choice for us," said Juha Ahia, Manager for Newbuildings & Projects at Finnlines. "But Alfa Laval is more than an equipment supplier. In Alfa Laval, we have a reliable

partner who can make sure our vessels are always in compliance and that we get the most out of our investment."

Finnlines signed the six-year Performance Agreement with Alfa Laval in order to maintain the consistent performance of its PureSOx systems. The service plan includes yearly condition audits, which help ensure correct operation and provide insights into the state of the equipment. These insights will allow any issues to be addressed before they can lead to unplanned shutdowns.

Additionally, Finnlines selected options that will simplify parts management, such as an exchange programme for PAH and turbidity sensors. Vital for proving compliance, these sensors will be exchanged every two years and replaced in the event of a failure. Furthermore, Alfa Laval technicians will track the parts consumption of the Finnlines vessels and provide strategic planning for their spare parts supply.

The services for Finnlines were chosen from a structured selection of service options, designed for easy customization. The Alfa Laval 360° Service Portfolio addresses every phase of the equipment life cycle, with services for start-up, maintenance, support, improvements and monitoring.

"The Alfa Laval 360° Service Portfolio is a clear yet flexible approach to service," said Teun Nikkelen, International Customer Support for Alfa Laval PureSOx. "Working closely with Finnlines, we defined an agreement that would deepen our partnership and secure reliable equipment performance at the lowest total cost of ownership."

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According to Clarkson, global shipbuilding orders stood at 600,000 CGT with 31 vessels in January this year. New orders at Korean shipyards stood at 330,000 CGT with 7 vessels including 2 FSRUs, 2 VLCCs, and 3 product carriers (PCs), which represents the largest share of global market. Korean shipyards carved out 55.5% share of global market, widening the gap with Chinese shipyards (110,000 CGT, 18.3%) and Japanese shipyards (20,000 CGT, 4.1%). Global order backlog stood at 81.87 million CGT in January this year, an all-time low in 12 years and 5 months after 80.99 million CGT was recorded in late August 2004.

Volumes of vessels delivered in the same period reached 5.02 million CGT, increasing sharply from the monthly average of 2.89 million CGT recorded last year. Volumes of vessels delivered tend to decrease in December and increase drastically in January of the following year due to ship

model based on year of production, etc. In January last year, volumes of vessels delivered reached 4.50 million CGT. Newbuilding prices fell noticeably for oil tankers and LNG carriers. Newbuilding prices for VLCC and LNG carrier slid about USD 2.50 million and USD 3.50 million, respectively, from the previous month.

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. ⚓

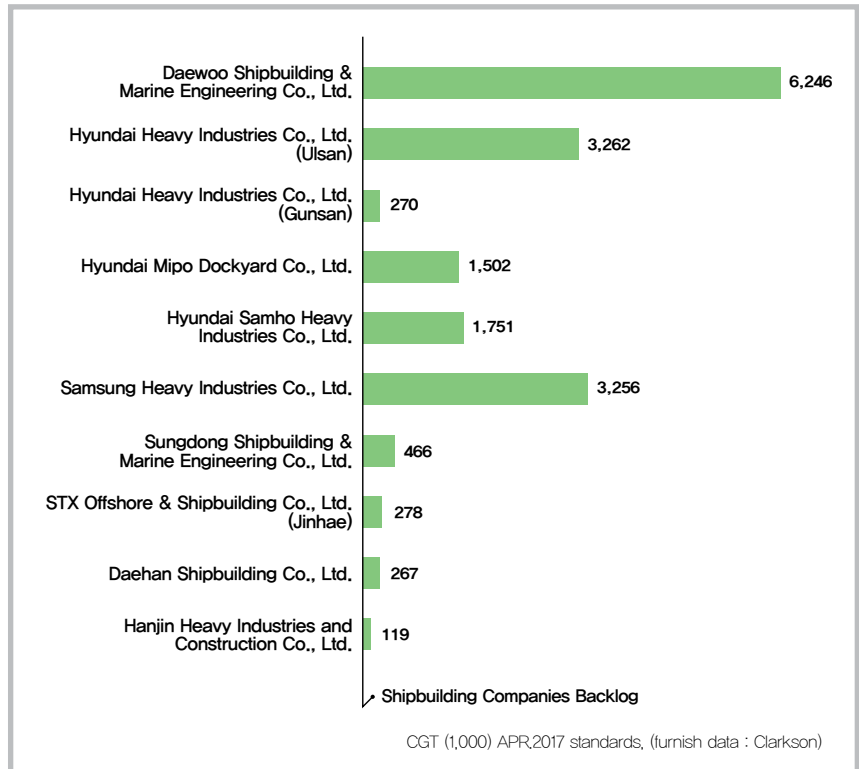


Photo: Hyundai Samho Heavy Industries Co., Ltd.



# Korea Shipbuilding Orders

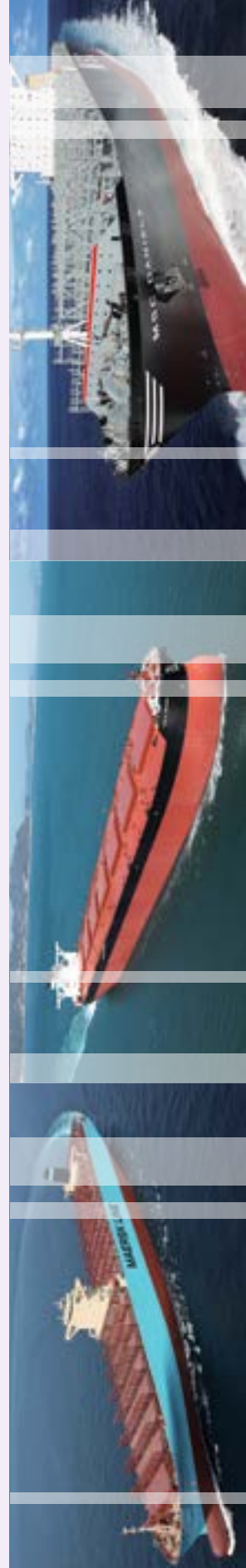
## Korea Shipbuilding Orders awarded to domestic shipyards in 2015~2017

Data	Type	Number of vessel	Amount	Ship owner	Delivery	Shipyard
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
Feb	319,000 DWT VLCCs	2 vessels	USD 198 million	Maran Tankers Management, Greece	-	Daewoo Shipbuilding & Marine Engineering
	158,000 tons oil tankers	5 units (2 optional vessels)	USD 330 million	-	2017's	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	Vales Steamship, Hong Kong	-	STX Offshore & Shipbuilding
Mar	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	2018's	Daewoo Shipbuilding & Marine Engineering
	38,000m³ liquefied petroleum gas and ammonia carriers	2 vessels	-	Asian ship owner	-	Hanjin Heavy Industries & Construction
2015	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
	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
2016	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
	300,000 DWT VLCCs	10 units (5 optional vessels)	USD 1 billion	The National Shipping Company of Saudi Arabia	2017's	Hyundai Samho Heavy Industries
Jun	19,630 TEU container ships	11 vessels	USD 1.1 billion	Maersk Line A/S, Denmark	2018's	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
Jul	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
	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
	84,000m³ LPG Carriers	2 vessels	-	Asia ship owner	2017's	Daewoo Shipbuilding & Marine Engineering
Sep	74,000 tons LR1 tankers	4 units (2 optional vessels)	-	Greece ship owner	The second half of 2017	STX Offshore & Shipbuilding



	Oct	173,400m <sup>3</sup> LNG Carriers	2 vessels	USD 400 million	BW Group, Singapore	The first half of 2019	Daewoo Shipbuilding & Marine Engineering
	Nov	84,000m <sup>3</sup> LPG carriers	2 vessels	-	Asia ship owner	2017s	Daewoo Shipbuilding & Marine Engineering
	Dec	319,000 tons VLCCs	2 vessels	-	Maran Tankers Management, Greece	2017s	Daewoo Shipbuilding & Marine Engineering
	Feb	114,000 tons products carriers	2 vessels	-	Sea Tankers Group	2017, September	Daehan Shipbuilding
	May	158,000 DWT oil products carriers	2 vessels	-	Dias Shipping, Turkey	2018s	Hyundai Heavy Industries
		40,000 DWT products carriers	2 vessels	-	Greece ship owner	2018s	Hyundai Mipo Dockyard
		159,000 DWT oil tankers	2 vessels	-	AMPTC, Kuwait	2018s	Hyundai Heavy Industries
	Jun	75,000 tons product carriers	4 vessels	USD 170 million	Tsakos, Greece	The first of 2018	Sungdong Shipbuilding & Marine Engineering
		180,000m <sup>3</sup> LNG carriers	2 vessels	USD 400 million	SK E&S, Korea	The first of 2019	Hyundai Heavy Industries
	Jul	50,000 tons bulk carrier	1 vessels	-	Ishin Marine Transport, Korea	The end of 2017	Hyundai Mipo Dockyard
		31,000 tons Car ferry	1 vessels	-	Weidong Ferry	The end of 2018	Hyundai Mipo Dockyard
	Sep	180,000m <sup>3</sup> LNG carriers	2 vessels	USD 367 million	Europe ship owner	-	Samsung Heavy Industries
2016		2,800 ton convoy	1 vessel	USD 297 million	Korean Navy	The end of 2020	Daewoo Shipbuilding & Marine Engineering
		2,600 ton frigates	2 vessels	USD 324 million	Department of National Defense, Philippines	2020s	Hyundai Heavy Industries
	Oct	Patrol killer medium	3 vessels	USD 173 million	Korean DAPA	2019s	Hanjin Heavy Industries & Construction
		157,000 DWT oil tankers	2 vessels	USD 220 million	Viken, Norway	-	Samsung Heavy Industries
		113,000 DWT oil tankers	2 vessels	USD 170 million	Nordic American Tankers Limited, Norway	-	Samsung Heavy Industries
	Dec	157,000 DWT oil tankers	3 vessels	USD 170 million	IRISL, Iran	2th quarter 2018	Hyundai Heavy Industries
		14,500 TEU container ships	4 vessels	USD 700 million	Bernhard Schulte, Germany	The end of 2018	Hyundai Mipo Dockyard
		49,000 tons products carriers	6 vessels	-	SFL, France	3th quarter of 2019	Hyundai Mipo Dockyard
	Jan	LNG Bunkering Vessel	1 vessel	-	Fukujin Kisen, Japan	-	Daehan Shipbuilding
		114,000 tons product carriers	2 vessels	-	CLdN, Luxembourg	The first of 2017	Hyundai Mipo Dockyard
	Feb	50,000 DWT product carriers	1 vessel	USD 117.8 million	Greece ship owner	-	Hyundai Mipo Dockyard
2017		300,000 DWT VLCCs	2 vessels	-	Enesel, Greece	The end of 2018	Hyundai Heavy Industries
	Mar	173,400m <sup>3</sup> LNG carriers	2 vessels	-	Europe ship owner	The end of 2019	Daewoo Shipbuilding & Marine Engineering
		114,000 tons oil tankers	4 vessels	USD 240 million	Sovcomflot, Russia	3th quarter of 2018	Hyundai Samho Heavy Industries
		21,000m <sup>3</sup> LPG carriers	2 vessels	-	Solvang ASA, Norway	2019s	Hyundai Samho Heavy Industries
	Apr	VLCCs	1 vessel	-	Neda Maritime, Greece	2019s	Hyundai Samho Heavy Industries
		318,000 tons VLCCs	3 vessels	USD 250 million	Maran Tankers Management, Greece	2018s	Daewoo Shipbuilding & Marine Engineering

\*Note : Based on the press release and public announcements of each shipyards, internal estimation of Monthly KORSHIP (estimation until Apr 15, 2017)



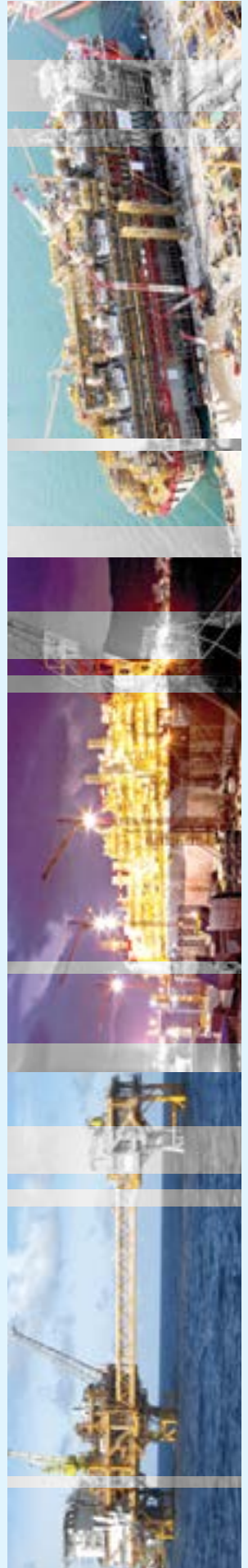
# Offshore plant orders awarded to domestic shipyards in 2011-2017

## Offshore Plant Orders

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	Excellerate Energy, U.S.A	First quarter of 2014	Daewoo Shipbuilding & Marine Engineering
		Semi-submersible Rig	2 units	USD 1.1 billion	Songa Offshore, Norway	Second half of 2014	Daewoo Shipbuilding & Marine Engineering
	Sep	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	-	Toms Offshore Supply AS, Norway	First half of 2013	STX OSV
		Offshore Plant Module	2 units	-	-	From 2013 to 2014	STX OSV
	Nov	Platform Supply Vessel	4 units	KRW 2 trillion	Island Offshore, Norway	Consecutively from the 3rd quarter	of 2013 to the 1st quarter of 2014
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	
	CPF (Central Processing Facility)	-	KRW 2.6 trillion	INPEX, Australia	4th quarter of 2015	Samsung Heavy Industries	
Jan	Semi-submersible rig	1 unit	USD 620 million	Odjell, 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 ESP AS, 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	
	Semi-submersible Drilling Rig	2 units	USD 1.1 billion	Songa Offshore, Norway	Mid 2015	Daewoo Shipbuilding & Marine Engineering	
May	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	-	Petroleum 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	-	Excellerate, U.S.A	Between early 2015-2017	Daewoo Shipbuilding & Marine Engineering	
	Drillship	1 vessel	USD 620 million	Rowan, U.S.A	First half of 2015	Hyundai Heavy Industries	
Sep	Drillship	1 vessel	USD 623 million	-	-	Samsung Heavy Industries	
	Drillship	4 vessels	USD 2.06 billion	Transocean, U.S.A	One-by-one from mid 2015	Daewoo Shipbuilding & Marine Engineering	
Oct	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	Statoil, Norway	2nd half of 2015	STX Offshore & Shipbuilding	
	offshore platform (Top side)	1 unit	USD 1.77 billion	Statoil, Norway	The end of 2016	Daewoo Shipbuilding & Marine Engineering	
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	Enesco, United Kingdom	Third quarter of 2015	Samsung Heavy Industries
	FPSO	1 unit	USD 3.0 billion	Nigeria	Second half of 2017	Samsung Heavy Industries
Jul	Jack-up Rig	2 units	USD 1.3 billion	Statoli, Norway	-	Samsung Heavy Industries
	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
Dec	LNG-FSRU	1 unit	-	Gas Savago (Joint venture)	Sep of 2016	Daewoo Shipbuilding & Marine Engineering
	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
Feb	LNG-FPSO	1 unit	USD 1.45 billion	Petrolim Nasional Berhad, Malaysia	2018	Samsung Heavy Industries
	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
Jun	FPU	1 unit	-	-	-	-
	Offshore Platform	2 unit	USD 1.06 billion	Statoli, Norway	The end of 2018	Samsung Heavy Industries
Jul	FLNG	3 unit	USD 4.7 billion	Royal Dutch-Shell	-	Samsung Heavy Industries
	LNG-FSRU	1 unit	USD 587 million	Maran Gas Maritime, Greece	First half of 2020	Daewoo Shipbuilding & Marine Engineering
Jan	FPU	1 unit	USD 1.27 billion	British Petroleum, United Kingdom	Augst of 2020	Samsung Heavy Industries
	FSRU	1 unit	USD 230 million	Høegh LNG, Norway	May of 2019	Samsung Heavy Industries
Feb	FSRU	1 unit	USD 230 million	Høegh LNG, Norway	4th quarter of 2018	Hyundai Heavy Industries
	FSRU	1 unit	-	Turkey	-	Hyundai Heavy Industries

\*Note : Based on the press release and public announcements of each shipyards, internal estimation of Monthly KORSHIP (estimation until Apr 15, 2017)





# Harbinger of world economic recovery

## - Bulk carrier market buoyant this year

Recovery in bulk carrier segment is directly linked to rebound in global economy. Bulk carrier orders have risen noticeably this year despite difficulties in global shipping market after they plunged to an all-time low last year. Foreign media reported that BDI (Baltic Dry Index) hit 1,196 points, jumping by more than 300% from 291 points registered last February. Moreover, newbuild bulk carrier price rose for almost all types of ship types this year. According to Clarkson, the market price for 180,000 DWT capesize bulk carrier has reached USD 42.50 million. This hike in price has been driven by a series of order placements amid widespread recognition among ship owners primarily of Greece that ship prices have bottomed up.

The recovery in growth of bulk carrier orders is expected to be sustained this year, considering that this year is likely to see a decline in the number of vessels scheduled for delivery by this year or next year in comparison to previous years due to order drought in bulk carrier segment which has remained persistent over the last few years. As a result, shipbuilding market, particularly bulk carrier segment, is regaining vitality.















# 클라우드 기반 장비 분석 솔루션

로크웰 오토메이션 코리아



로크웰 오토메이션은 마이크로소프트(MS) 애저(Azure) 클라우드 역량을 활용해 장비제조업체들에게 필요한 정보를 제공하는 FactoryTalk 분석 솔루션(FactoryTalk Analytics for Machines)을 발표했다. 이 애플리케이션은 기업의 확장된 정보 솔루션 전략의 일부로 구현된 시스템들의 성능 분석에 대한 액세스를 제공함으로써 고객들이 활용할 수 있는 가치 있는 통찰을 확보할 수 있도록 지원한다. 이러한 역량은 디지털화를 진행 중인 제조업체들이 연결된 기술을 자본화해 가용성과 생산량을 증가하고 유지보수 비용을 감소할 수 있도록 돕는다. 장비 제조업체들은 FactoryTalk 클라우드 게이트웨이 장치를 공급 장비에 내장할 수 있다. 시운전을 거친 장비는 즉각적으로 데이터를 수집하기 시작한다. 선별된 컨트롤러에서 얻어진 데이터는 FactoryTalk 클라우드 애플리케이션으로 안전하게 전송되며, 장비제조업체나 엔드유저의 설정은 최소한에 그친다. 그리고 장비제조업체는 사전 구축된 대시보드를 통해 실시간으로 분석 및 실행 가능한 정보에 액세스할 수 있으며, 이 과정은 매우 간단하다.

서비스로서의 소프트웨어(SaaS)로 제공되는 이 클라우드 기반의 애플리케이션은 시스템들이 어떻게 사용되는지, 그리고 시스템의 성능, 상태, 이벤트 및 기타 관련된 활동들에 대한 가시성을 제공함으로써 시스템을 가장 효과적으로 지원할 수 있는 역량을 장비 제조업체들에게 제공한다.

이전에는 제조업체 고객들과 협업을 필요로 하는 장비제조업체들이 사용할 수 있는 표준화된 접근방식이 존재하지 않았다. 로크웰 오토메이션이 정보에 대한 신뢰할 수 있는 액세스를 제공함으로써, 이제 장비 제조업체들은 사전적인 유지보수, 교육 등의 개별화된 서비스를 제공받아 보다 효율적으로 운영할 수 있게 됐다.

-TEL: +82-2-2188-4400

-<http://www.rockwellautomation.co.kr>

# SeaCURE® system production upgrade

EVOQUA WATER TECHNOLOGIES LLC



Evoqua Water Technologies is upgrading its SeaCURE® system production facility in Caldicot, Wales, to meet market demand for ballast water treatment systems, as shipowners look to comply with the entry into force of the Ballast Water Management Convention this coming September.

The upgrade will enable Evoqua to expand production of fully assembled SeaCURE BWTS skids. In addition to the expanded capabilities in Caldicot, additional production capacity will be provided by partners who will be licensed to build the SeaCURE system.

“Over the next five years, ballast water system suppliers could struggle to meet demand if they fail to invest in their production and supply lines,” said Chris Thomas, Director of Operations, Evoqua (UK). “The investments will mean that shipowners and shipyards will not have to worry about long lead times, which could delay installation and commissioning schedules, resulting in vessel off-hire.”

The investment in Evoqua’s production plant includes a new compressed air system, dedicated welding bays and upgraded testing facilities, while component and assembly lines and warehouse capacity have been optimised utilising LEAN processes to streamline production and delivery.

Matt Granitto, Business Manager, Ballast Water, Evoqua (USA), said “Roughly 4000 vessels have been fitted with a treatment system to date, leaving about 30,000 vessels needing to retrofit an effective solution within the next five years. With concerns having already been raised about a potential supply and installation bottleneck, shipowners and yards do need to plan ahead and make sure that suppliers can deliver on time. The investments we have made will allow us meet the market requirement.”

-TEL: +1-724-772-0044  
-http://www.evoqua.com

# 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

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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  
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 Main Products : Quick Closing Valve, Ball Valve, Bellows, Beal Valve  
 TEL : +82-51-311-2511

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 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  
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 Main Products : Fitting & Valve, Vacuum Clamp  
 TEL : +82-55-783-1000

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 Main Products : O-ring, Sealing, Gasket  
 TEL : +82-51-831-1615

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 Main Products : Rudder Body, Winch, Crane  
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 Main Products : Powder Coating  
 TEL : +82-51-831-4810

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 Homepage Add. :  
 Main Products : Cargo Reducer Piece  
 TEL : +82-51-831-1784

### CEPHAS PIPELINES CO., LTD.

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 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  
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 TEL : +82-51-831-3607

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 Main Products : Main Bearing support, Chain Wheel, Gear Wheel  
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 Main Products : CO<sub>2</sub> Welder, DC Tig, Welder, AC ARC Welder  
 TEL : +82-51-724-6777

### DAEHEUNG IND. CO., LTD.

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 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  
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 Main Products : Flower Meter, Viscometer, Control Valve  
 TEL : +82-51-831-3720

### DAEHWA TECHNICAL CO., LTD.

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 Main Products : Shot & Blast, Painting, Painting's Manufacture  
 TEL : +82-55-329-5705

### DAEJUNG SPECIAL STEEL CO., LTD.

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 Main Products : Winch, Shaft, Gear Clutch  
 TEL : +82-51-831-1133

### DAEKYUNG CO., LTD.

Head Office : Saha-gu Busan  
 Homepage Add. : www.dkhoist.com  
 Main Products : Chain Block, Lever Block Trolley  
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 Homepage Add. : www.dae-rim.kr  
 Main Products : Head, Air Receiver Tank, Pressure Vessel, Reactor  
 TEL : +82-51-831-1456

### DAESAN ENGINEERING CO., LTD.

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 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.

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 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

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 Main Products : Hot Dip Galvanizing, Pipe for Shipbuilding  
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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.

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 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 Piping, 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 Compressor, 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 : Compressed 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 Outfittings  
 TEL : +82-51-831-0849

**HAE DONG METAL CO., LTD.**

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

**HAE DUK RUDDER & R.STOCK CO., LTD.**

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

**HAE SUNG INDUSTRIAL.**

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

**HAEWON INDUSTRIES CO.**

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

**HAEWON IND. CO., LTD.**

Head Office : Sasang-gu Busan  
 Homepage Add. : www.haewon.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 Emission 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.hosent.co.kr  
 Main Products : Sewage Treatment System, Plasma Bilge Separator, E/R Package Unit, Tank Package Unit, Ventilator  
 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 plate 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.jwcojoint.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 POLSTAR 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-mgpps.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](http://www.enpos21.com)  
 Main Products : Electric 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](http://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](http://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](http://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](http://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](http://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. : [www.kspco.com](http://www.kspco.com)  
 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](http://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](http://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](http://www.kukdongelecom.com)  
 Main Products : Navigation/Signal LT, EX-Plision Proof LT, Fluorescent LT  
 TEL : +82-51-266-0050

**KUKDONG INDUSTRIAL ENGINEERING.**

Head Office : Sasang-gu Busan  
 Homepage Add. : [www.kdie.co.kr](http://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](http://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. : [www.khpc.com](http://www.khpc.com)  
 Main Products : Coupling Flange, Bellows Flange  
 TEL : +82-51-831-5685

**KUMKANG ENGINEERING.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.kkeng.com](http://www.kkeng.com)

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](http://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](http://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. : [www.kjeng.com](http://www.kjeng.com)  
 Main Products : Pipe Piece, Pipe Spool  
 TEL : +82-51-831-1435

**KWANG JIN IND. CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.kjinind.com](http://www.kjinind.com)  
 Main Products : Part of Heat Exchanger  
 TEL : +82-51-831-4131

**KWANG JIN TECH.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.kjntech.com](http://www.kjntech.com)  
 Main Products : Non Asbestos, Teflon, Rubber  
 TEL : +82-51-973-5566

**KWANG LIM MARINE TECH. CO.,LTD.**

Head Office : Sasang-gu Busan  
 Homepage Add. : [www.klimtech.com](http://www.klimtech.com)  
 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](http://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](http://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](http://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](http://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. : [www.kyungilmetal.com](http://www.kyungilmetal.com)  
 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](http://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](http://www.lhe.co.kr)  
 Main Products : Heat Exchanger  
 TEL : +82-55-340-0624

**MANZU INDUSTRY CO., LTD.**

Head Office : Gangseo-gu Busan

Homepage Add. : [www.mrcrkorea.co.kr](http://www.mrcrkorea.co.kr)  
 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.mrcrkorea.co.kr](http://www.mrcrkorea.co.kr)  
 Main Products : Public Addresser Sys, Common Aerial Sys.  
 TEL : +82-51-414-7891

**MARINE TECHNICAL ENGINEERING CO., LTD.**

Head Office : Sasang-gu Busan  
 Homepage Add. : [www.mte.com](http://www.mte.com)  
 Main Products : Oily Water Separator, Bilge Alarm, Air Dryer  
 TEL : +82-51-831-1118

**MARSEN CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.marsen.co.kr](http://www.marsen.co.kr)  
 Main Products : Cargo Tank Monitoring System, Tank High/Overflow Alarm System  
 TEL : +82-51-831-2108

**MAX TECH.**

Head Office : Kimhae Gyeongsangnam-do  
 Homepage Add. : [www.maxtech21c.com](http://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](http://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. : [www.mijinprecision.com](http://www.mijinprecision.com)  
 Main Products : Valve, Tube, Vend, Pipe for ship  
 TEL : +82-51-315-3143

**MIJOO INDUSTRY CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.mijoo.com](http://www.mijoo.com)  
 Main Products : [www.mijoo.com](http://www.mijoo.com)  
 TEL : +82-51-831-1588

**MIRAE ENGINEERING CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.miraeship.co.kr](http://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](http://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. : [www.modernintech.com](http://www.modernintech.com)  
 Main Products : Curtain, Carpet, Upholstery, Mattress for Marine  
 TEL : +82-51-325-0260

**M.T.H CONTROL VALVES CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.mthvalves.com](http://www.mthvalves.com)  
 Main Products : [www.mthvalves.com](http://www.mthvalves.com)  
 TEL : 82-51-974-8831

**MYTEC CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : [www.imytec.com](http://www.imytec.com)  
 Main Products : Heat Exchanger, Pressure Vessel  
 TEL : +82-51-831-7474

**NAMSUNG SHIPBUILDING CO., LTD.**

Head Office : Saha-gu Busan  
 Homepage Add. : [www.namsungship.com](http://www.namsungship.com)  
 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 : +82-51-831-5081

#### **SHIN SHIN HEAVY INDUSTRIES CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Deck Machinery, Hydraulic system, Surface 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.smpo.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, Ceiling 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

#### **SUHHEUNG ENGINEERING CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.shge.co.kr  
Main Products : Steel Grating  
TEL : +82-51-831-1811

#### **SUNBO IND CO., LTD.**

Head Office : Saha-gu Busan  
Homepage Add. : www.sunboind.co.kr  
Main Products : Tank Top Unit, Engine Room unit, Sater Strainer Silenser  
TEL : +82-51-261-3454

#### **SUNG CHANG CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Non-Asbestos Gasket, Spiral Wound Gasket, P.T.F.E Gasket  
TEL : +82-51-316-6300

#### **SEOUNG HYUP MACHINERY.**

Head Office : Sasang-gu Busan  
Homepage Add. :  
Main Products : White Metal, Piston Lo  
TEL : +82-51-303-4112

#### **SUNG IL CO., LTD.(SIM)**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.sungilsim.com  
Main Products : Pipe Spool Pre-Fabrication, Induction Pipe Bending  
TEL : 82-51-831-8800

#### **SUNG KWANG M/C.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Oil Press, Pipe Vending, Pipe Fitting Unit  
TEL : +82-51-831-0620

#### **SUNGWON ELECTRIC CO.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Cable Tray, Starter, Panel, Cable Way  
TEL : +82-51-831-9230

#### **SUNG WON ENTERPRISE CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.sungwonent.co.kr  
Main Products : V-Flow Swing Check, Valves, Manifold Unit  
TEL : +82-51-831-2140

#### **SUNIL INSTRUMENT CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.suniltech.co.kr  
Main Products : Tank Level System, Viscosity System  
TEL : +82-51-831-1994

#### **SUN KWANG P.S.P INC. CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Cargo Line, Ballast Line, Engine Room, I.G Line  
TEL : +82-51-831-3777

#### **S&W CO., LTD.**

Head Office : Saha-gu Busan  
Homepage Add. : www.snwcorp.com  
Main Products : Com Shaft, Valve, Seat, Piston Pin, Bolt, Nut  
TEL : +82-51-205-7411

#### **TAE HWA INDUSTRY CO.,LTD (THI)**

Head Office : Seocho-gu Seoul  
Homepage Add. : www.thi.co.kr  
Main Products : Reciprocating & Screw, Compressor Unit, Brine/ Water Chiller Unit  
TEL : +82-2-598-1126

#### **TAEHWA KALPA SEAL.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.taehta1.com  
Main Products : TH3000, TH3000W  
TEL : +82-51-831-9944

#### **TAE KWANG INDUSTRIES.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.tkic.co.kr  
Main Products : Boiler, Oil Cooler / Heater, Shell & Tube Heat Exchanger  
TEL : +82-51-831-1801

#### **TAESHIN G & W CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.taeshin.co.kr  
Main Products : Co2 / Mag, Mig Arc Welding, Machine, Air Gouging  
TEL : +82-51-831-1100

#### **TAESUNG MACHINERY CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.taesungmc.co.kr  
Main Products : Manufacture of Structures, for Shipbuilding(LNG,LPG) and plant  
TEL : +82-51-971-4006

#### **TAEWON CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.twubc.kr  
Main Products : Flange, Strainer, Pressure  
TEL : +82-51-831-0310

#### **TAEWOONG CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.taewoong.com  
Main Products : Piston Rod/ Crown/ Head, Cross Head Pin  
TEL : +82-51-329-5000

#### **TAEWOONG TECH CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. :  
Main Products : Main Shaft, Connecting Rod, Inter Shaft, Propeller Shaft  
TEL : +82-51-831-6685

#### **TANKTECH CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.tanktech.co.kr  
Main Products : High velocity valve  
TEL : +82-51-979-1600

#### **TK CORPORATION CO., LTD.**

Head Office : Gangseo-gu Busan  
Homepage Add. : www.tkbend.co.kr  
Main Products : Fittings (Elbow, Tee, Reducer, Cap)  
TEL : +82-51-970-6600

#### **TMC CO., LTD.**

Head Office : Kimhae Gyeongsangnam-do  
Homepage Add. : www.besttmc.com  
Main Products : Membrane Sheets, Heavy Steel Corner, Anchor Strip  
TEL : +82-55-340-3000

#### **TYCO MARINE SERVICES KOREA CO., LTD.**

Head Office : Sasang-gu Busan  
Homepage Add. : www.dbefire.com  
Main Products : Fire Fighting System & Equipment  
TEL : +82-51-633-9100

**U-YOUNG PRECISION IND. CO., LTD.**

Head Office : Kimhae Gyeongsangnam-do  
 Homepage Add. : u-nex.com/  
 Main Products : Elec/Hyd. Windless, Elec/Hyd, Winch, Steering Gear  
 TEL : +82-55-326-9691

**U-YOUNG & TECH.**

Head Office : Kimhae Gyeongsangnam-do  
 Homepage Add. : u-nex.com/  
 Main Products : Elec/Hyd. Windless, Elec/Hyd, Winch, Steering Gear  
 TEL : +82-55-326-9691

**WON KWANG VALVE CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : www.wonkwangvalve.com  
 Main Products : Marine Globe Valve, Marine Angle Valve, Marine Gate Valve  
 TEL : +82-51-831-9932

**WOONG CHEON OUTFITTING CO., LTD.**

Head Office : Jinhae Gyeongsangnam-do  
 Homepage Add. :  
 Main Products : Ship Component Parts, Painting, Deck Machinery  
 TEL : +82-55-545-2432

**WOOSUNG FLOWTEC CO.**

Head Office : Gangseo-gu Busan  
 Homepage Add. :  
 Main Products : Simplex Oil Strainer, Can Water Filter  
 TEL : +82-51-831-1531

**WOORYANG B&P IND CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : www.wooryangshot.com  
 Main Products : Deck Outside Monting Item, Engine Room Mounting Item  
 TEL : +82-51-831-5000

**Y.C.P CO., LTD.**

Head Office : Saha-gu Busan  
 Homepage Add. :  
 Main Products : Carbon Steel Precision, Tybe for Hydraulic Line Service  
 TEL : +82-51-264-9300

**YESUNG IND. CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. :  
 Main Products : Rudder Carrier Housing, Complete Stern Tube, Rudder Horn  
 TEL : +82-51-831-5246

**YOOWON INDUSTRIES CO., LTD.**

Head Office : Saha-gu Busan  
 Homepage Add. : www.yoowonind.com  
 Main Products : Steering Gear, Deck Machinery, Auto Filter  
 TEL : +82-51-205-8541

**YOOWON M-TECH CO., LTD.**

Head Office : Saha-gu Busan  
 Homepage Add. : www.yoowonmtech.com  
 Main Products : Steering Gear, Windlass, Mooring winch  
 TEL : +82-51-265-1746

**YOUNGIL CNC.**

Head Office : Gangseo-gu Busan  
 Homepage Add. :  
 Main Products :  
 TEL : +82-51-831-9547

**YOUNG - IN ELECTRIC INDUSTRIES CO., LTD.**

Head Office : Gangseo-gu Busan  
 Homepage Add. : www.younginele.com  
 Main Products : Electric Auto Control Panel, Welding Panel  
 TEL : +82-51-831-7910

**YOUNG NAM IND.**

Head Office : Saha-gu Busan  
 Homepage Add. :

Main Products : Wire lope drum, BASE PLATE ASSY  
 TEL : +82-51-264-7983

**YOUNGSHIN BEND CO., LTD.**

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