Donghae E & T CO., LTD.

Total Engineering Services & Material Distribution

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Chapter I

Company Introduction
For
Donghae E&T Co., Ltd.

Vision & Mission

Vision

We will continue to develop our technologies to maximize customer satisfaction and become a global leader in shipbuilding & offshore and oil & gas engineering and material distribution fields.

Mission

1) **We will provide professional engineering solutions for shipbuilding & offshore and oil & gas engineering and material distribution fields.**

2) **We will make all our best efforts for customer satisfaction.**

3) **We will continue to strengthen our competitiveness and to develop our capabilities to build a better future.**

QHSE Management System

QHSE Management System

Donghae will operate according to QHSE principles, for the best success of the company and for its full compliance with rules and standards typical of the Shipbuilding / Offshore oil and gas industry and with applicable laws.

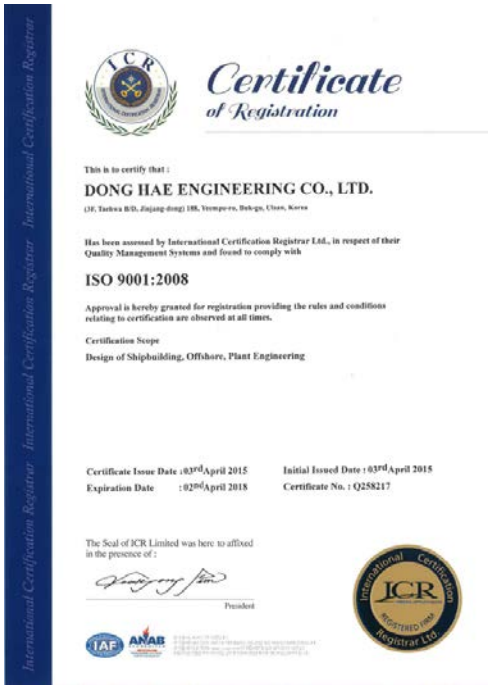
MAIN GOALS:

-. Promote a positive culture by emphasizing Individuals Roles and Responsibilities and personal Accountability.

-. Implement tools and procedures to assure feedback and lesson learned enforcement.

-. Promote the use of safety observations including near miss and at risk behavior reporting

ACCREDITATIONS : ISO 9001 Since 2008



International Certification Registrar International Certification Registrar International Certification Registrar

ICR

Certificate of Registration

This is to certify that :

DONG HAE ENGINEERING CO., LTD.

(3F, Taehwa B/D, Jinjang-dong) 188, Yeompo-ro, Buk-gu, Ulsan, Korea

Has been assessed by International Certification Registrar Ltd., in respect of their Quality Management Systems and found to comply with

ISO 9001:2008

Approval is hereby granted for registration providing the rules and conditions relating to certification are observed at all times.

Certification Scope

Design of Shipbuilding, Offshore, Plant Engineering

Certificate Issue Date : 03rd April 2015 — Initial Issued Date : 03rd April 2015

Expiration Date : 02nd April 2018 — Certificate No. : Q258217

The Seal of ICR Limited was here to affixed in the presence of :

President

IAF ANAB

International Certification ICR REGISTERED Registrar LTD.

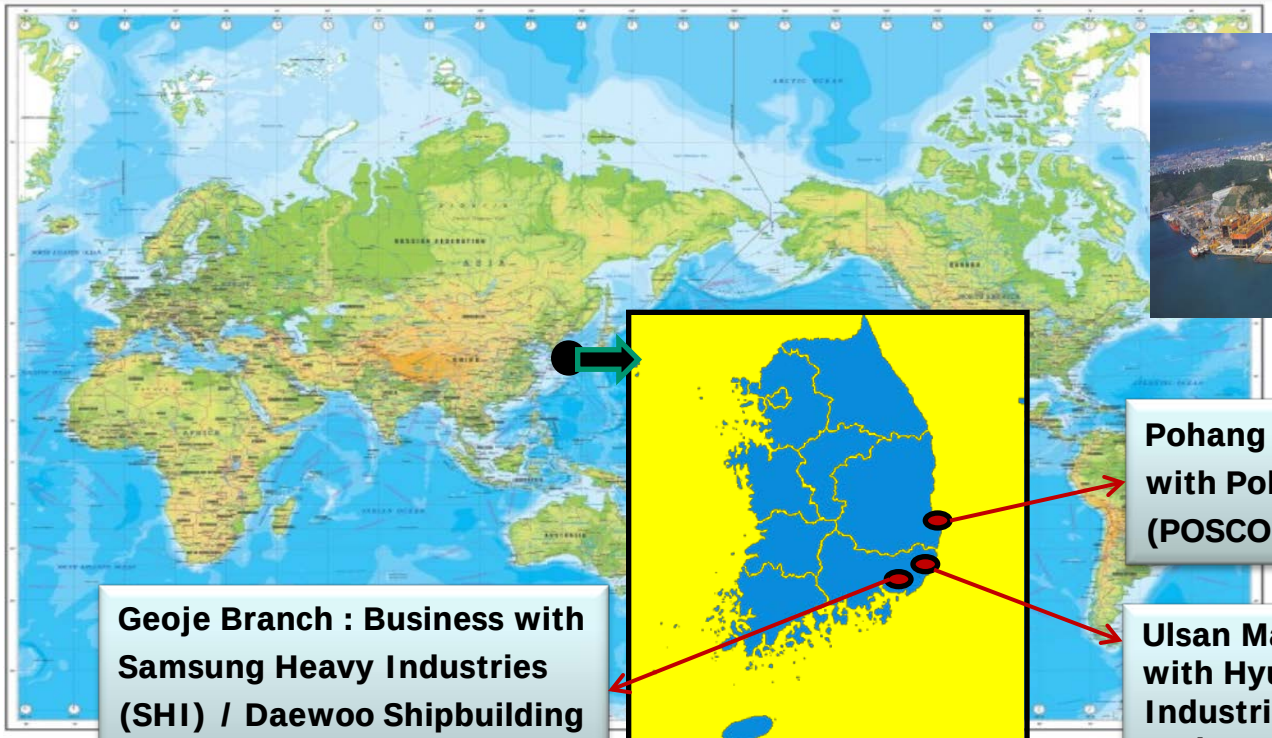
History

Jun. 2018	Company Name Changed to Donghae E & T Co., Ltd. From Donghae Engineering Co., Ltd.
Apr. 2018	Partnership with SAMSUNG CONSTRUCTION & TRADING, and Hyundai Global Service
Jan. 2017	Partnership with KHNP (Korea Hydro & Nuclear Power Co., Ltd.)
May. 2015	Partnership with POSCO Plantec. (Affiliated company of Pohang Steel Co., Ltd.)
Apr. 2015	Acquired Dong-hae Engineering ISO9001 Certification
Oct. 2012	Awarded Citation from CEO of Samsung Heavy Industries
Dec. 2010	Awarded Citation from CEO of Hyundai Heavy Industries
Jun. 2010	Partnership with Hyundai Samho Heavy Industries
Sep. 2007	Awarded Plaque of Appreciation for excellent partnership from Hyundai Heavy Industries' Offshore Division
Dec. 2006	Selected as Korean Management Innovative Small-Medium Sized Enterprise
Sep. 2006	Awarded Plaque of Appreciation for excellent partnership from Hyundai Heavy Industries' Offshore Division
Mar. 2006	Partnership with Daewoo Shipbuilding & Marine Engineering
Feb. 2004	Partnership with Samsung Heavy Industries' Offshore Design Department
Sep. 2003	Partnership with Hyundai Heavy Industries' Plant & Offshore Division
Jul. 2003	Establishment of Dong-hae Engineering

Company Location

Address: Yumpo-Ro 188, Buk-Ku, Ulsan, Korea

The head office of Donghea E&T is Located in Ulsan City which is famous for industrial complex in Gyeongnam Province, Korea. Most of Korean major shipbuilders, automobile companies, refineries and petrochemical companies are condensed in Gyeongnam Province and can be accessed by max. 2 hour-drive from GSOE. Donghae E&T has branch offices in Pohang and Geoje City.



Pohang Branch : Business with Pohang Steel Co., Ltd. (POSCO)

Geoje Branch : Business with Samsung Heavy Industries (SHI) / Daewoo Shipbuilding & Marine Engineering (DSME)

Ulsan Main Office : Business with Hyundai Heavy Industries (HHI), Korea Hydro and Nuclear Power (KHNP) and other Companies.

Business Fields

Engineering Service

- Offshore Projects FPSO/FPU/FSO /TLP/Fixed PF
- Drilling Rig
- Shipbuilding

→

- 3D & 2D CAD
- Various Calculations
- Retrofit Engineering

Material Distribution

Actuators Gear Box	Flowserve(USA) NGC (Japan)
Cladding	Phohom (China)
Valves	RBR (Italy) SWI (Korea) Boteli (China)
Flange Fitting	Rise Tianjin Steel (China)
Insulation	Iking (China)
FRP & HDPE	Beijing ZLRC
SMLS Pipe Welded Pipe	Tianjin Xinyue & Baosteel (China)

Manpower Supply

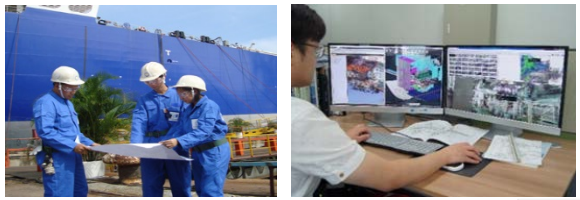
- Project Manage
- Engineering
- Construction
- Commissioning
- QHSE and so on

→

- Working Level
- Management Level
- Supervisors
- Consultants

Organization (Functional)

Engineering Service



Manpower Supply

Material

- Structure
- Process / HSE
- Mechanical
- Piping
- Outfitting
- E&I
- Arch. / HVAC
- Engineer & Supervisor
- Material Distribution

- Structure and Piping Calculation and Analysis
- Detail Engineering
- Fabrication Engineering
- Engineering, Construction, Commissioning & QHSE
- Actuator, Valve, Cladding, Pipe, Flange, Fitting, Insulation, FRP, HDPE etc.

Organization Chart

Manpower summary

Jin-Young, Kim
C.E.O

TOTAL : 220 P,
Including management

Sammy Min
Tech. Outstanding Issues & Consulting 33 years Exp.

Myoung-Sik, Kim
Project Director
33 years Exp.

Dong-Hyun, Park
35 years Exp.

Gy Young, Kim
33 years Exp.

Young-Chul, Kim
28 years Exp.

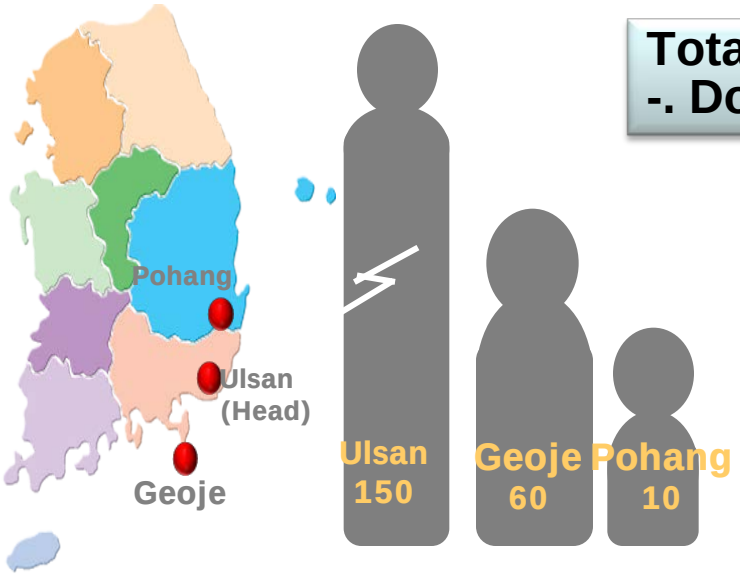
Discipline / Position	STRUCTURE	ARCHITECTURE / HVAC	OUTFITTING	PROCESS & HSE	MECHANICAL	PIPING	E&I	Manpower supply	Document /Finance	Material Distribution	Total number
Manager	5	2	2	3	3	5	5	5	3	7	40
Designer / Engineer	15	8	5	10	5	18	18				79
3D/2D Modeler, Others	30	1	3	3	1	40	15		2		95
Total number	50	11	10	16	9	63	38	5	5	7	214

Engineering and Design resources

(Key Person)

Discipline	Name	Position	Experience for Offshore Project	Foreign Language	Remark
Structure	D.H Park	Manager	35 years	English	
Architecture / HVAC	S.N Kim	Manager	35 years	English	
Outfitting	S.G Ryu	Manager	25 years	English	
Process / HSE	S.M Sin	Manager	22 years	English	
Mechanical	G.I Kim	Manager	32 years	English	
Piping	G.Y Kim	Manager	33 years	English	
E&I	J.S Byeon	Manager	21 years	English	

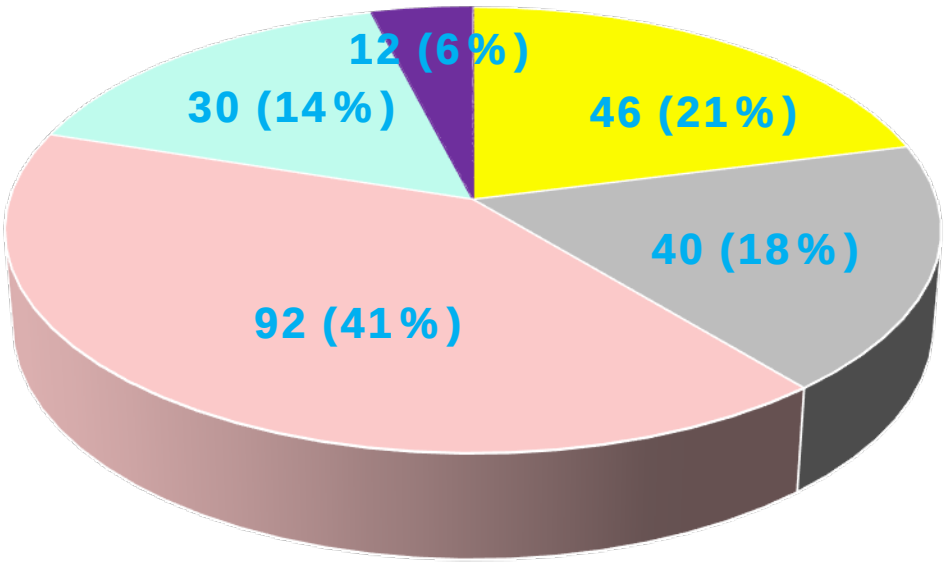
Manpower Status



Total Engineering Manpower
-. Donghae : 220

Career Years	Number of Engineers	%
Under 5	46	21
5 -10	40	18
11-20	92	42
21-30	30	14
Over 30	12	6

Career Proportion for 220 Engineers



Major Customers

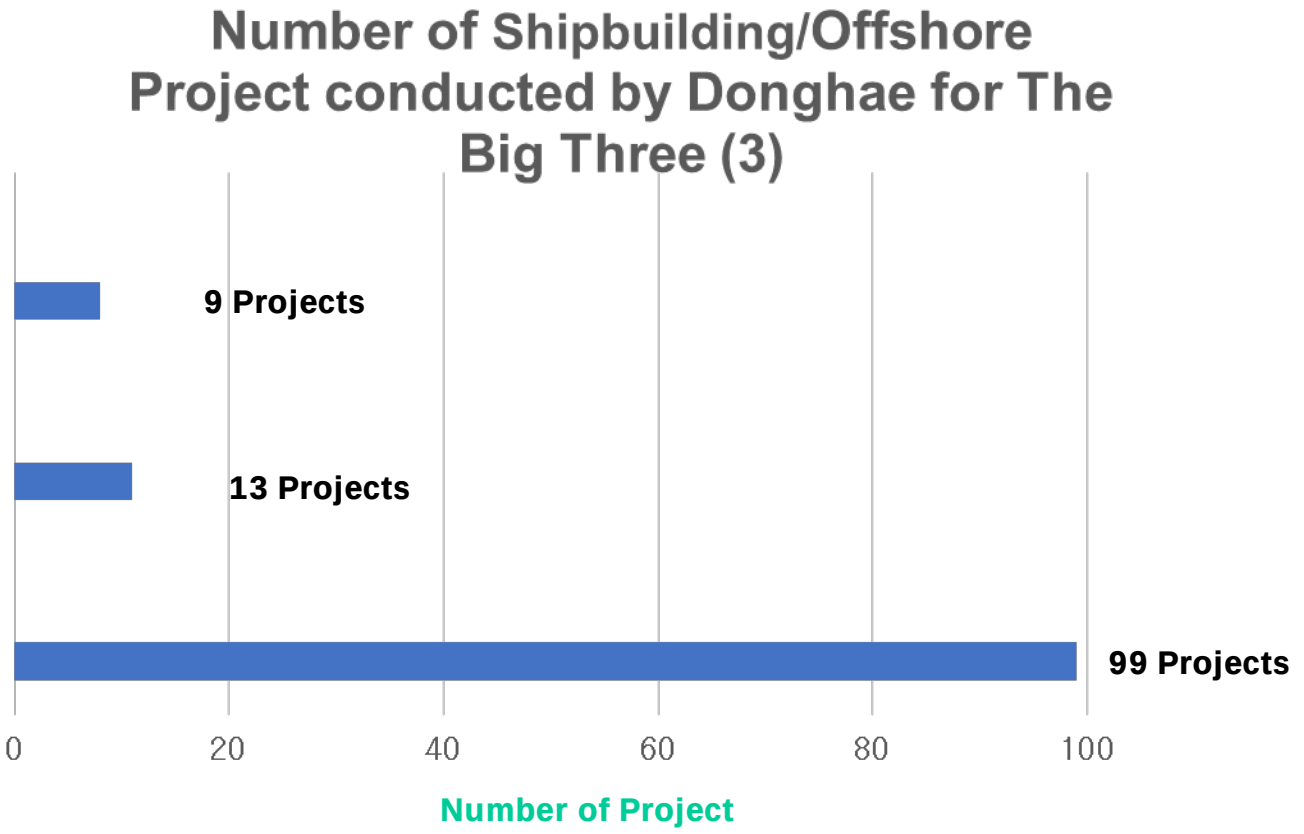
(For Engineering Services and Manpower Supply)

THE BIG THREE (3)

DSME

SAMSUNG HEAVY INDUSTRIES

HYUNDAI HEAVY INDUSTRIES GROUP



Experience Record - Shipbuilding Projects (1/2)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
1	KIZOMBA	340K FPSO	KIZOMBA	HHI	2003.07~2005.06	
2	GUNGEN	152K COT	GUNGEN	HHI	2004.05~2006.03	
3	THENAMARIS	105K COT	THENAMARIS	HHI	2004.07~2006.09	
4	PRIMORSK	100K COT	PRIMORSK	HHI	2004.02~2006.06	
5	SCI	VLCC	SCI	HHI	2004.06~2006.03	
6	NOVOSHIP	105K COT	NOVOSHIP	HHI	2004.02~2006.04	
7	A.P MOLLER	4150TEU Container	A.P MOLLER	HHI	2005.04~2007.06	
8	COSTAMARE	9500TEU Container	COSTAMARE	HHI	2005.07~2007.09	
9	BP	340K FPSO	BP	HHI	2004.10~2006.08	
10	PRIMORSK	166K COT	PRIMORSK	HHI	2006.09~2008.08	
11	ARCADIA	159K COT	ARCADIA	HHI	2006.10~2008.05	
12	NYK	4900TEU Container	NYK	HHI	2007.01~2008.11	
13	PRIMORSK	104K COT	PRIMORSK	HHI	2007.05~2009.02	
14	DYNACOM	VLCC	DYNACOM	HHI	2007.11~2009.07	
15	GUNGEN	151K COT	GUNGEN	HHI	2008.04~2010.01	
16	METROSTAR	VLCC	METROSTAR	HHI	2009.01~2010.11	
17	TRANSOCEAN	Drill Ship	TRANSOCEAN	HHI	2009.01~2010.12	
18	PRISCO	166K COT	PRISCO	HHI	2010.04~2012.02	
19	GUNGEN	151K COT	GUNGEN	HHI	2010.12~2012.10	
20	DIAMOND	Drill Ship	DIAMOND	HHI	2010.06~2012.04	
21	DIAMOND	RIG	DIAMOND	HHI	2012.11~2014.06	
22	BOLLSTA DOLPHIN	Drill Ship	BOLLSTA DOLPHIN	HHI	2010.08~2012.04	
23	BOLLSTA DOLPHIN	RIG	BOLLSTA DOLPHIN	HHI	2012.03~2014.01	

Experience Record - Shipbuilding Projects (2/2)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
24	VLCC	VLCC	KYKLADES	HHI	2017.09~2018.03	
25	VLCC	VLCC	BALENCIA	HHI	2018.01~2018.07	
26	Ballast Water Treatment System	57K Bulk Carrier	KSC	HGS	2017.03~2017.06	
27	Ballast Water Treatment System	112K Product Carrier	AMPTC	HGS	2017.03~2017.06	
28	Ballast Water Treatment System	112K Product Carrier	AMPTC	HGS	2017.06~2017.09	
29	Ballast Water Treatment System	112K Product Carrier	AMPTC	HGS	2017.06~2017.09	
30	Ballast Water Treatment System	151K Crude Oil Carrier	GUNGEN	HGS	2017.03~2017.06	
31	Ballast Water Treatment System	152K LNG Carrier	MISC	HGS	2017.03~2017.06	
32	Ballast Water Treatment System	84K LPG Carrier	PERTAMINA	HGS	2017.03~2017.06	
33	Ballast Water Treatment System	120Ton Derrick Barge	HHI	HGS	2017.03~2017.06	
34	Ballast Water Treatment System	51K Chemical Tanker	INT. SEAWAYS	HGS	2017.03~2017.06	
35	SOx Scrubber	176K Bulk Carrier	PAN OCEAN	HGS	2018.04~2018.07	
36	SOx Scrubber	208K Bulk Carrier	PAN OCEAN	HGS	2018.04~2018.07	
37	SOx Scrubber	228K Bulk Carrier	MOL	HGS	2017.05~2017.11	
38	SOx Scrubber	228K Bulk Carrier	MOL	HGS	2018.09~2018.11	
39	SOx Scrubber	228K Bulk Carrier	MOL	HGS	2018.09~2018.11	
40	SOx Scrubber	327K Bulk Carrier	MOL	HGS	2018.07~2018.09	
41	SOx Scrubber	327K Bulk Carrier	MOL	HGS	2018.07~2018.09	
42	SOx Scrubber	176K Bulk Carrier	COSMOS	HGS	2017.05~2017.11	
43	SOx Scrubber	PCTC	EUKOR	HGS	2018.09~2018.11	

Experience Record - Offshore Projects (1/4)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
1	Benchamas	FIXED PLATFORM	POGO	HHI	1998.03~2003.04	
2	WEST SENO	FIXED PLATFORM	CONOCO	HHI	1999.02~2004.03	
3	BONGKOT-4	FIXED PLATFORM	PTT	HHI	1999.08~2004.06	
4	RBS-8D	SEMI. SUBMERSIBLE	TEXAS	HHI	1999.09 ~2004.08	
5	VEBA	FIXED PLATFORM	BV	HHI	2000.07~2005.11	
6	KIZOMBA B	FPSO	EXXON MOBIL	HHI	2000.09 ~2004.12	
7	BAYU-UNDAN	FIXED PLATFORM	WOODSIDE	HHI	2001.04~2005.12	
8	AMENAM	Drilling rig ship	BP	HHI	2001.06~2005.12	
9	BP THUNDER HORSE	DRILLING RIG	BP	DSME	2002,02~2004.11	
10	SANHA & BB	FIXED PLATFORM	CHEVRON TEXACO	SHI	2002.05~2004.06	
11	KIZOMBA A	FPSO	EXXON MOBIL	HHI	2002.07 ~2005.12	
12	SABRATHA	FIXED PLATFORM	TOTAL	HHI	2002.12~2004.03	
13	Bayu-undan	FIXED PLATFORM	CONOCO Phillips	HHI	2003.05~2003.08	
14	Huizhou	FIXED PLATFORM	CACT	HHI	2003.05~2004.07	
15	WLGP Sabratha	FIXED PLATFORM	AGIP GAS B.V, LYBIA	HHI	2003.07~2004.08	
16	MSP	FIXED PLATFORM	ONGC	HHI	2004.04 ~2004.08	
17	Sakhalin PA-B	FIXED PLATFORM	SHELL	SHI	2004.04~2008.04	
18	RONG-DOI	FIXED PLATFORM	KNOC	HHI	2005.03~2006.03	
19	SAKHALIN	Drilling rig ship	EXXON MOBIL	HHI	2005.03~2006.12	
20	SAKHALIN LUN-A	Drilling rig ship	EXXON MOBIL	HHI	2005.03~2006.12	
21	SAKHALIN PAB	Drilling rig ship	EXXON MOBIL	HHI	2005.03~2006.12	
22	BP PLOTONIO	1.7 MIL BBLS FPSO	BP ANGOLA	HHI	2005.05~2006.08	
23	KNOC RONG DOI PRJ.LQ	FIXED PLATFORM	KNOC	HHI	2005.06~2006.08	
24	Yadana	FIXED PLATFORM	TOTAL	HHI	2005.09~2006.03	
25	EASTERN GAS GATHERNING SYS. Ph. 2	FIXED PLATFORM	SHELL	DSME	2005.10.~2006.09.	

Experience Record - Offshore Projects (2/4)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
26	EGP3A	FIXED PLATFORM	EXXON MOBIL	HHI	2005.10~2006.05	
27	MOHO BILONDO	FPU	TOTAL	HHI	2005.10~2006.06	
28	EAST AREA	FIXED PLATFORM	EXXON MOBIL	HHI	2005.10~2006.08	
29	SAKHALIN 2B, OPF	FIXED PLATFORM	EXXON MOBIL	HHI	2005.10~2006.09	
30	AGBAMI	2.2 MIL BBLS FPSO	Chevron	DSME	2005.10~2007.03	(TOPSIDE)
31	AKPO	2.2 MIL BBLS FPSO	Total FINAELF	HHI	2006.08~2007.07	
32	Umm Shaif	FIXED PLATFORM	ADMA, OPCO	HHI	2006.09~2010.06	
33	SEADRILL DRILLING RIG	RIG	SEADRILL	DSME	2006.10~2007.05	
34	Petroserv GVA 7500	DRILLING RIG	Petroserv S.A	DSME	2007.03~2007.12	
35	WEST-ENS PROJECT	SEMI RIG	SEADRILL	SHI	2007.05~2007.09	(L/Q)
36	Umm Shaif Gas Injection	FIXED PLATFORM	ADMA	HHI	2007.08~2008.10	
37	GAZFLOT DRILL RIG #1	SEMI RIG	GAZPROM	SHI	2008.03~2009.03	
38	GAZFLOT DRILL RIG #2	SEMI RIG	GAZPROM	SHI	2008.03~2009.12	
39	TCM #2	DRILL SHIP	SEADRILL	SHI	2008.05~2009.01	(TOP)
40	USAN	FPSO	TOTAL	HHI	2008.05~2011.04	
41	Odfjell Gav 7500 Semi, RIG	DRILLING RIG	ODFJELL	DSME	2008.09~2008.12	
42	Gazflot	FIXED PLATFORM	VYBORG SHIPYARD JSC	SHI	2008.10~2009.06	
43	SEA DRILL SHIP#3	DRILL SHIP	SEADRILL	SHI	2008.10~2009.10	
44	BONGKOT 4A	FIXED PLATFORM	TOTAL	HHI	2009.06~2011.09	
45	IGD-DAS ISLAND GAS PLANT	On Shore Chemical plant	ADGAS	HHI	2009.11~2013.06	
46	EGP3-B	FIXED PLATFORM	EXXON MOBIL	HHI	2010.01~2011.06	
47	NR2	FIXED PLATFORM	WOODSIDE	HHI	2010.03~2011.10	
48	SHWE	FIXED PLATFORM	DAEWOO	HHI	2010.10~2011.12	
49	NAKIKA	FPU	Shell	HHI	2011.01~2012.11	
50	IGD DAS	Onshore Platform	ADGAS	HHI	2011.03~2011.08	

Experience Record - Offshore Projects (3/4)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
51	Gorgon	FIXED PLATFORM	Chevron	HHI	2011.06~.2012.06	
52	NOBLE	Drilling rig ship	NOBLE	HHI	2011.06~2012.02	(TOP)
53	DIAMOND	Drilling rig ship	DIAMOND	HHI	2011.07~2012.04	(TOP)
54	GOLIAT	FPSO	ENI	HHI	2011.09~2014.04	
55	Q204	FPSO	BP	HHI	2011.09~2014.10	
56	BARZAN	FIXED PLATFORM	RASGAS	HHI	2012.04~2013.05	
57	OFON	FIXED PLATFORM	TOTAL	HHI	2012.05~2012.1	
58	CLOV	FPSO	TOTAL	DSME	2012.05~2013.04	
59	A.P-Moller	JACK-UP RIG	A.P MOLLER	HHI	2012.11~2014.06	
60	EGINA	FPSO	TOTAL	SHI	2012.12~2017.08	
61	DSO	FIXED PLATFORM	CHEVRON	HHI	2012.3~2014.11	
62	MHN	FPU	TOTAL	HHI	2013.02~2017.03	
63	HEBRON	FIXED PLATFORM	EM Canada	HHI	2013.02~2015.01	
64	ICHTHYS INPEX	FPSO	TOTAL	DSME	2013.04~2017.06	
65	Clair Ridge	FIXED PLATFORM	BP	HHI	2013.04~2014.01	
66	HIBERNIA	FIXED PLATFORM	HMDC	HHI	2013.05~2016.02	(Canada)
67	Ichthys	FIXED PLATFORM	INPEX	SHI	2013.05~2014.12	
68	MOHO FPU HULL	FPU	TOTAL E&P Congo	SAMHO HHI	2013.05~2014.12	
69	BCP	FIXED PALTFORM	CARIGALI HESS	HHI	2013.07~2014.08	
70	FAP	FPSO	RASGAS	HHI	2013.09~2017.03	
71	VALEMON	FIXED PLATFORM	STATOIL	SHI	2013.09~2013.12	
72	AASTA HANSTEEN	FPSO	STATOIL	HHI	2014.01~2017.06	
73	GINA KROG	FIXED PLATFORM	STATOIL	DSME	2014.01~2017.06	
74	JANGKRIK	FPU	TOTAL	HHI	2014.02 ~2017.02	
75	DELTA HOUSE	FPSO	LLOG	HHI	2014.03~2014.05	

Experience Record - Offshore Projects (4/4)

No.	Project Name	Type of Project	Client	Contractor	Project Duration	Remarks
76	MHN TLP	TLP	TOTAL E&P Congo	HHI	2014.05~2014.08	
77	BEGRADING	FIXED PLATFORM	Hess E&P	HHI	2014.05~2016.11	
78	BADAMYAR	LCP	TOTAL	HHI	2014.09 ~2017.03	
79	CAGIGALI BCP	FPSO	C.H.P.C SDN.	HHI	2014.12 ~2016.11	
80	NASR	FIXED PLATFORM	ADMA OPCO	HHI	2016.03~2018.08	
81	MAD DOG II	FPU	BP	SHI	2018.01~2019.12	
82	CORL	FLNG	ENI	SHI	2018.08~2020.06	

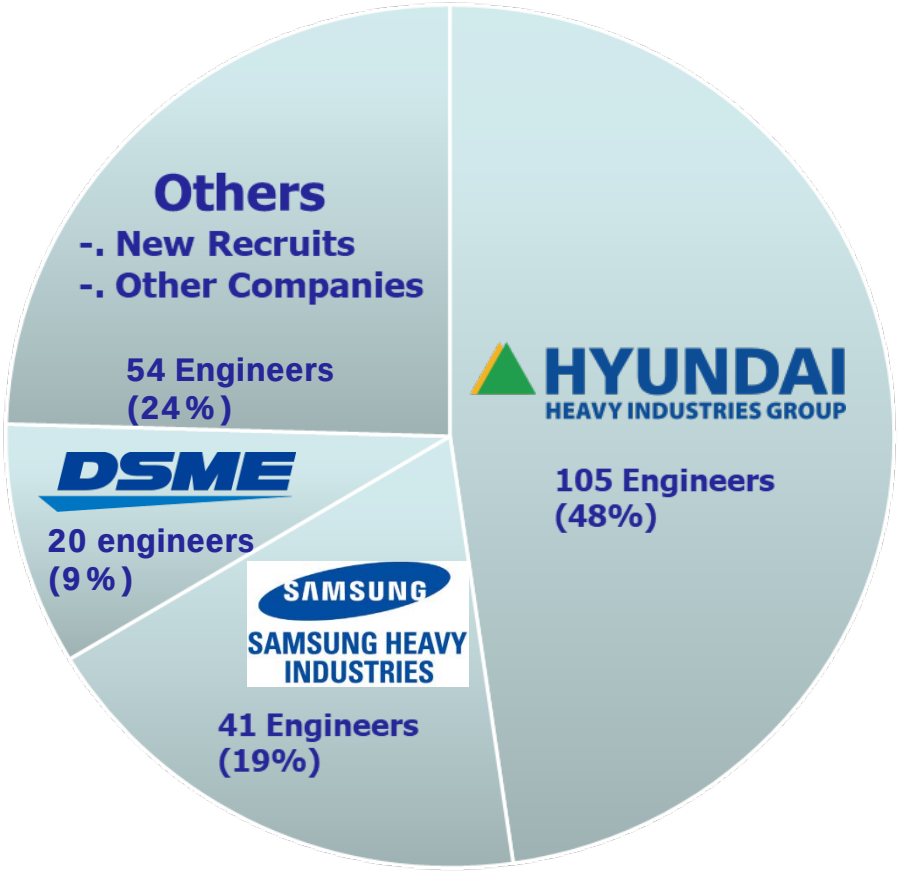
Chapter II

Why should be Donghae?

Career Background of Engineers

Donghae Engineers have following Career Backgrounds.

Where are our engineers from?



Offshore Projects conducted by Donghae

Donghae has conducted following Shipbuilding/Offshore Projects.

The Big Three (3)	Fixed Platform	FPSO / FLNG / FPU	Ship building	Drilling Rig & etc	Total
DSME	2	3		4	9
SAMSUNG HEAVY INDUSTRIES	5	3		5	13
HYUNDAI HEAVY INDUSTRIES GROUP	32	16	39	12	99
Total	**39**	**22**	**39**	**21**	**121**

Unit : Number of Project

Engineering Tools

Engineering Tools of Donghae are completely compatible to The Big Three (3).

DSME

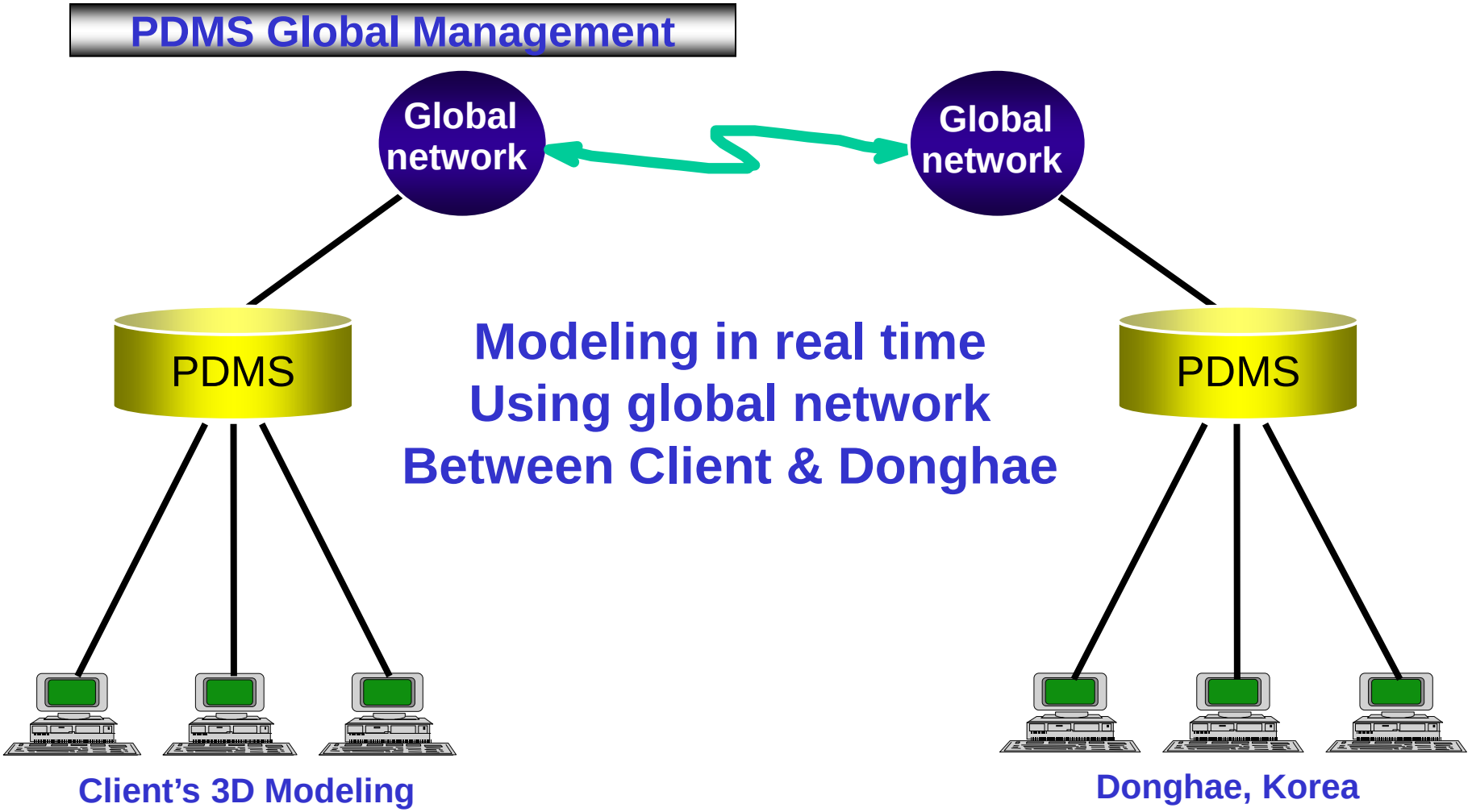
SAMSUNG HEAVY INDUSTRIES

HYUNDAI HEAVY INDUSTRIES GROUP

- **3D CAD**
  - PDMS
  - AM
  - PDS
  - Smart Plant 3D
- **2D CAD**
  - Auto CAD
  - Micro Station
- **Calculation Software**
  - PAT/NANSTRAN
  - ANSYS
  - SACS
  - MIDAS
  - STAAD-PRO
  - CAESAR-II
  - Others

3D CAD Operation

Real Time Design Solution (Example for 3D PDMS Operation)



Engineering Process (1/3)

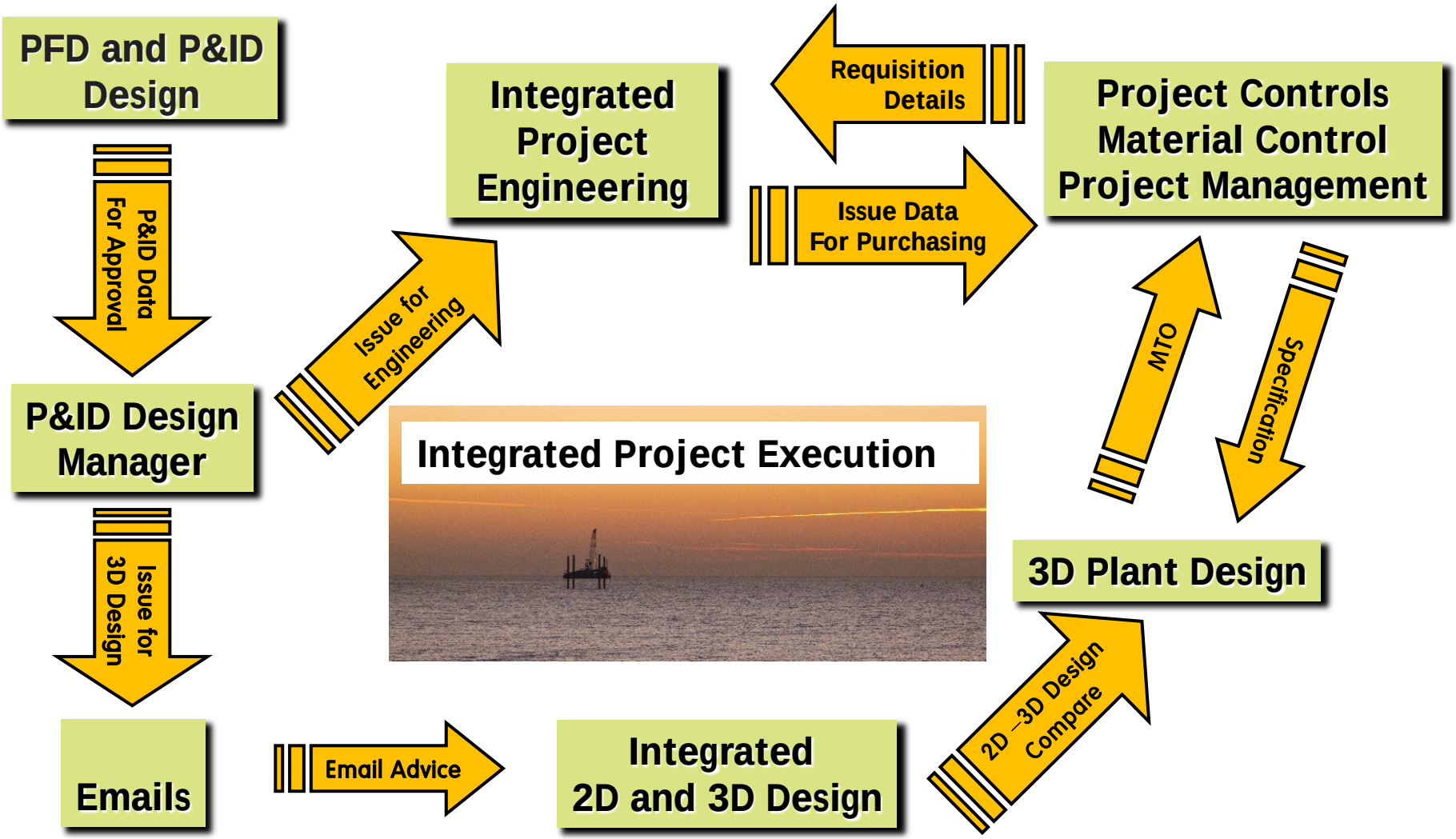
FEED	Front End Eng'g Design
EPIC	Eng'g, Procure, Install, Construc'n
IFD	Issued for Design
VDD	Vendor data for design
IFC	Issued for construction

1) Engineering/ design process

COMPANY			EPIC						Hand Over
Eng'g Develop	FEED	FEED Design Review	IFD	VDD	3-D IFC	2-D IFC	Detailed Design Review	Production Eng'g	As-Built
2-D Eng'g / Design	Plot plan PFD Basic P&ID Basic GA Basic SLD Framing plan	Value Improvement Plan	Structure Configure PFD IFD P&ID IFD GA IFD SLD Control Philosophy	Mark-up vendor data	IFC Structure IFC GA IFC SLD	Generate from 3D IFC P&ID Generate from 3D Generate from 3D			AS - Built draw'g
3-D Design	Conceptual Routing	Estimated routing	Critical Routing		Completed routing		Design Review	Shop drawing	
Material control	Material Selection study	CAT DB /Spec DB Check	Material Spec.	CAT /Spec DB	Finalized DB				
Vendor data	Historical Vendor data	Inquiry for Equipment	Purchase Spec	1st vendor data	Certified vendor data		Final Vendor data		

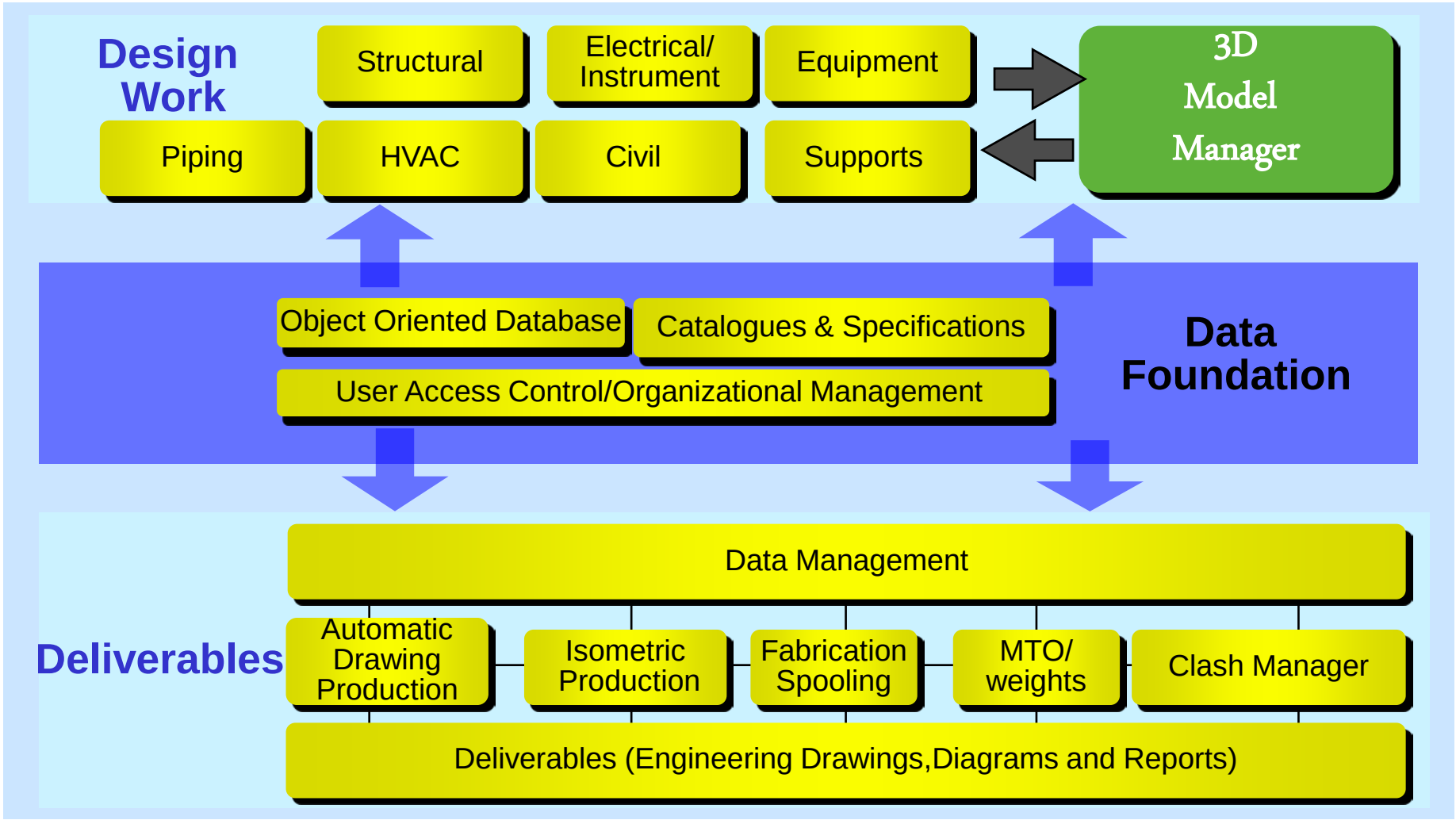
Engineering Process (2/3)

2) Integrated Information Flow for 3-D CAD Engineering



Engineering Process (3/3)

3) Integrated 3D design and Output



Retrofit Engineering

1) BWTS

More than 90 percent of global trade is transported by sea, and each year transfers of up to 12 billion tonnes of ballast water take place around the world because of this. Ballast water is used to maintain the stability and trim of vessels, and to ensure their structural integrity. It is typically pumped in as cargo is unloaded and discharged as cargo is being placed on board.

Ballast water that is taken on in one ecological zone and discharged into another can introduce invasive (i.e.: non-native) aquatic organisms that can have a big detrimental impact on the local biodiversity, economy and even the health of local communities. Bio invasion is one of the four greatest threats facing the world's oceans today, alongside land-based sources of marine pollution, the overexploitation of living marine resources and the physical alteration and destruction of marine habitats.

The proper treatment of ballast water, as required by the IMO and the relevant authorities in the USA, actively removes, kills or neutralises organisms prior to discharge. Ballast water treatment differs from the older conventional process of ballast water exchange, which involves completely flushing the ballast water tanks while underway.

2) SOx Scrubber

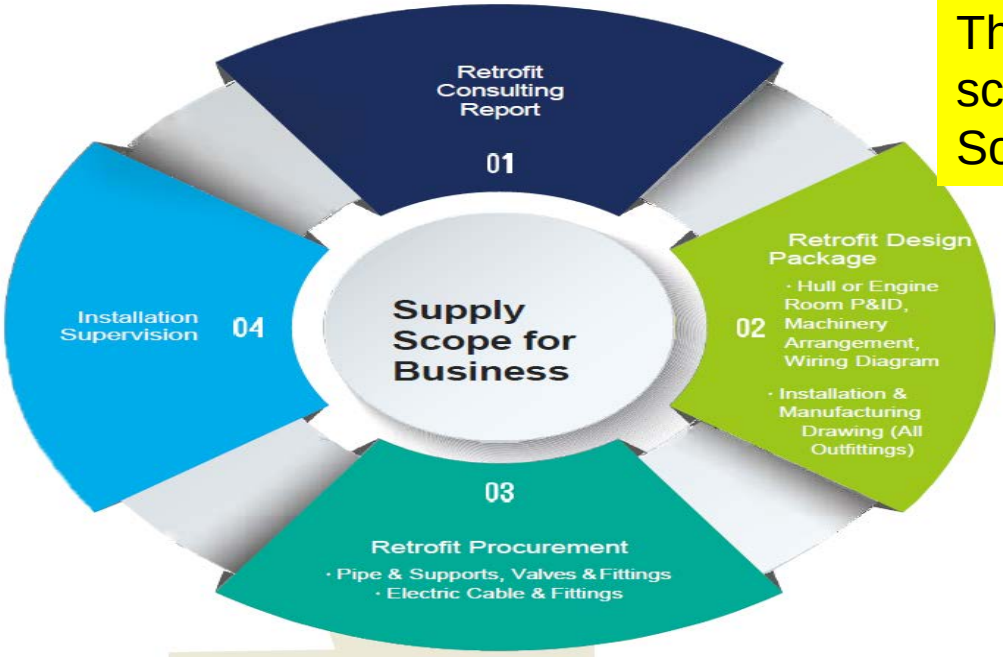
The burning of fossil fuel in diesel engines creates toxic SOx – Sulphur Oxides – that can disrupt the world's eco systems, be damaging to the marine environment specifically and also cause harm to human health. SOx emissions can cause premature mortality, heart attack, lung disease, asthma and other respiratory symptoms.

From 2020, a global 0,5% SOx cap will apply worldwide and the ECA areas around the world are expected to grow and expand in the years to come. The demand for exhaust gas cleaning technology, such as the SOx scrubber, is expected to increase in pace with the tightened SOx regulations.

Retrofit Engineering

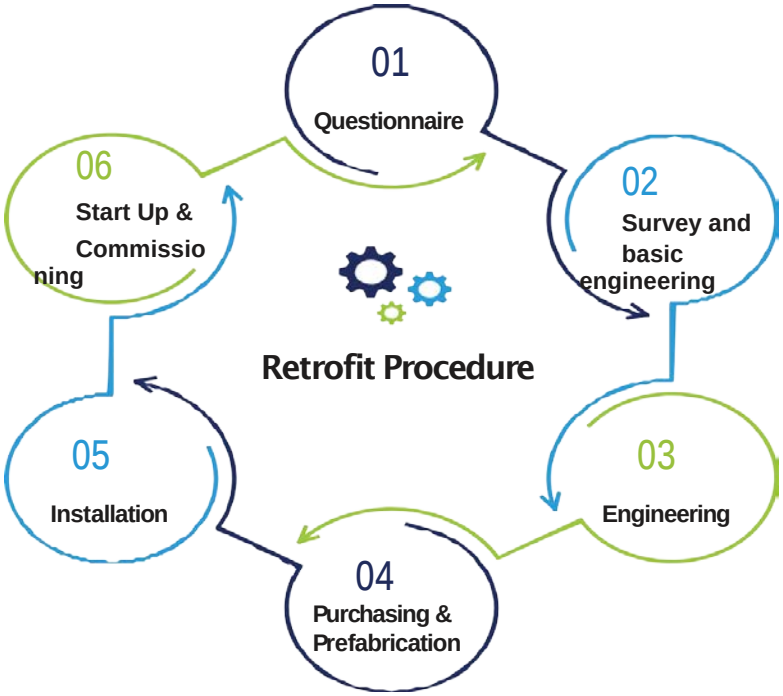
We, Donghae E&T Co., Ltd., offer comprehensive and cost effective BWTS and SOx Scrubber solutions

Based on our extenstive and various experience in retrofit engineering, Donghae E&T can assure that we will be the best partner for BWTS and SOx Scrubber Retrofit on existing ships. Donghae E&T Co., Ltd is a retrofit specialized engineering company which provides comprehensive and cost effective engineering services for BWTS and SOx Scrubber retrofit construction



This picture shows our general supply scope for BWTS and Sox Scrubber Solutions but not limited.

Retrofit Procedure

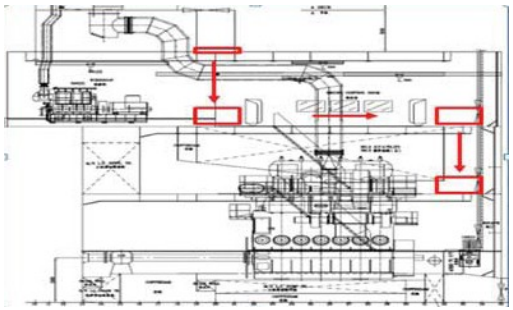


Questionnaire

To be completed by customer

Survey and basic engineering

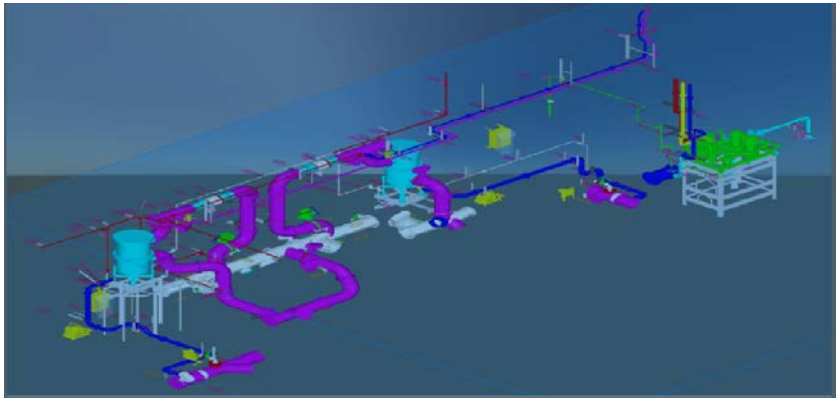
- ✓ Onboard assessment
- ✓ Installation recommendations
- ✓ 3D scanning if required
- ✓ Basic drawings

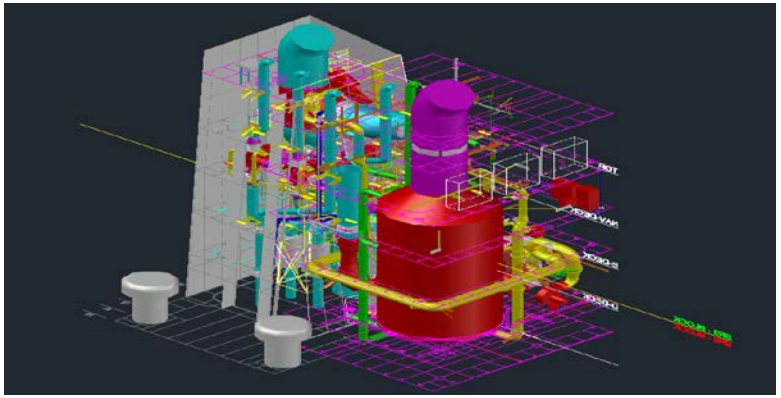


Retrofit Procedure

Engineering

- ✓ Detailed design
- ✓ Meet Class requirements
- ✓ Isometric drawings of piping
- ✓ Material take off list (BOM)
- ✓ Construction drawings
- ✓ Calculations and Documents





Purchasing & Prefabrication

- ✓Procuremement of all equipment and material
- ✓Prefabrication of piping and other facilities.

Installation

- ✓ Project Management
- ✓ Installation Supervision
- ✓ Helpdesk

Start Up & Commissioning

- ✓ Commissioning
- ✓ Start Up
- ✓ Training

Lessons Learned

Donghae has accumulated Lessons Learned through 121 Shipbuilding/Offshore Projects and incorporated them on its engineering.

LL No.	Attributes of Lessons Learned	Remarks
LL-01	Input the “Constructability and Lessons learned” in engineering stage	Refer to III-1, for sample
LL-02	Pre-emptive action for keeping Milestone	
LL-03	Design for maximization of construction efficiency	
LL-04	Trial and error for Block Division of construction	
LL-05	Careful design considering difficulties for installation	
LL-06	Design to take into account operational problems to be predicted	
LL-07	Design to prevent confusion in subsequent processes	
LL-08	Confirmation of interference and omission between inter-disciplines	
LL-09	Design to minimize Hook Up works and prevent Hook Up problems	
LL-10	Listing the items for Client approval in advance for construction	
LL-11	Design simplification for facilitating construction management	
LL-12	Design considering the unique characteristics of project	

Why Donghae? (1/4)

1. Engineers

Qualified Engineers

The qualified engineers from The Big Three (3), who are clearly in Global Top 10 in the Shipbuilding/Offshore EPC industry worldwide, account for 76% of our engineers of Donghae.

Optimized and Professionalized Engineers

Engineers who had mainly specialized in Shipbuilding/Offshore Projects in The Big Three (3) and have joined Donghae and continued to design Shipbuilding/Offshore Projects, so Donghae is proud to be the most optimized design company in this industry with a specialized engineer group for Shipbuilding/Offshore Engineering.

Why Donghae? (2/4)

2. Experience

Richest Experience

Donghae has experience to take part in engineering for 121 Shipbuilding/Offshore Projects from The Big Three (3). In this point of view, Donghae is the world best engineering subcontractor having the richest experience in Shipbuilding/Offshore engineering.

Familiarization for Client Specifications

Donghae has become familiar with the specific client specifications of World Top Class customers such as Statoil, Shell, Exxon Mobile and BP and so on while carrying out Shipbuilding/offshore engineering of 121 projects and experiencing trial and error during the process of incorporation these specifications on our engineering.

Why Donghae? (3/4)

3. Engineering Practice

Engineering Tools | **3D Operation** | **Engineering Process**

Donghae has been conducting Shipbuilding/Offshore engineering through the Big Three (3) Shipbuilding Companies, which are recognized as globally authorized EPC contractors for Shipbuilding/Offshore projects. With regard to all the processes and deliverables officially required by the contract requirements with Oil Major Customers such as Statoil, Shell, ExxonMobil, BP and Total, Donghae also underwent trial and error, but since then Donghae has been providing reliable engineering services. This experience illustrates the following capabilities of Donghae:

-. The Engineering Tools used by Donghae are fully compatible with those of The Big Three (3).

-. Donghae's 3D CAD Operation enables the Real Time Design Solution with the Big Three (3) Engineering Teams.

-. Donghae's Engineering Processes are in line with The Big Three (3).

Why Donghae? (4/4)

4. Lessons Learned

More than three-quarters of all Donghae engineers are ex-members of The Big Three (3). When they were at The Big Three, it was customary for them to experience numerous trials and errors and to incorporate the countermeasures into their engineering. Even after they joined Donghae, they contributed greatly to improve quality of Donghae's engineering by spreading the illustrations for such trials and errors to the existing members of Donghae.

Now, Lessons Learned have become Donghae's database, so that all Donghae engineers have to be trained and prepared with it before starting engineering for a specific project. Thereby Donghae has successfully established the engineering system to avoid the repeated trials and errors committed in the past projects.

Donghae is highly confident that our Lessons Learned database and training system would make significant contribution in lowering Client's project operating costs.

Conclusion

If you choose Donghae as your partner company, you are able to;

1) secure numerous qualified engineers in this Shipbuilding/Offshore Engineering field.

2) share our abundant experiences accumulated through 121 Shipbuilding/Offshore Projects.

3) feel free from the anxiety about the incompatibility for Engineering Practice with an Engineering Partner Company.

4) expect remarkable cost save for your project execution by sharing our Lessons Learned.

Chapter III **Reference information**

1. Constructability & Lessons learned

2. Material Distribution

6. Constructability & Lessons learned (Piping- 1/4) *** Sample ***

SN	ITEMS	DESCRIPTION	Checked by
1	Piping	1) Pipe standard to be reviewed.	
		2) Slope requirements on P&ID. If piping cannot comply with slope requirements shown in P&ID, it needs to be clarified specifically.	
		3) Provision for future items needs to be clarified.	
		4) Vibration on small bore pipe. (Clamp Shoe is not recommended and guide gap needs to be minimized.)	
		5) ATM vent location needs to be clarified as per gas dispersion study.	
		6) Material handling to be reviewed around critical equipment (TG. Compressor, WI Pump, ETC)	
		7) Tapping position for instrument transmitter (for liquid and gas)	
		8) Necessary flange joints for hydrostatic test, chemical cleaning and oil flushing.	
		9) Flange joints between high and low speck break point to be added for pressure test.	

1. Constructability & Lessons learned (Piping- 2/4)

SN	ITEMS	DESCRIPTION	Checked by
1	Piping	10) Necessity of flange joint needs to be reviewed for thread connection to equipment.	
		11) Clashes of the fire seal (wrapping type) on pipe penetration need to be reviewed.	
		12) Where a piping has multi operating and design conditions in P&ID, Piping Engineer to discuss with Process Engineer in advance that it has to be simplified to have a single condition in order to avoid any trouble for application of the paint, insulation thickness and hydrostatic test.	
		13) Minimum distance between pipe drain point and deck floor	
		14) Verification of special flange type (DIN flange, API flange)	
		15) Clarification of the clash between longitudinal weld seams for fitting to fitting connection.	
		16) Verification for accessibility of VCB and requrator on SDV valve.	
		17) Accessibility of the loading points for open drain lines.	

1. Constructability & Lessons learned (Piping- 3/4)

SN	ITEMS	DESCRIPTION	Checked by
1	Piping	18) Bolt removal space for flange joint has to be provided.	
		- Wafer type valve and instrument items.	
		- Large and high pressure flange.	
		- Supports located around flange joint.	
		19) Deluge Piping	
		- Deluge coverage and obstruction to be reviewed during engineering as a normal practice.	
		- One more verification at the completion of design to be done again to make sure.	
		- Keep distance with instrument lightening and height of deluge nozzle not to be higher than lighting to avoid obstruction of deluge spray.	

1. Constructability & Lessons learned (Piping- 4/4)

SN	ITEMS	DESCRIPTION	Checked by
1	Piping	20) Piping Support	
		- Support standard to be reviewed	
		- Standard size for pipe shoe support and shoe material (dissimilar material is not recommended due to blasting work for paint) verification of shoe stiffener for installation of hold down guide.	
		- Pipe support members need to be simplified.	
		- Width of structure secondary member needs to be reviewed for installation of the pipe support	
		- Necessity of drain hole on pipe support	
		- Necessity of tack weld on pipe support	
		- Removal of the PFP upper side of pipe rack and pipe support for piping.	

2. Material Distribution (1/11)

2-1 Actuator (Limitorque Flowserve USA)

Limitorque MX and QX Actuator

Limitorque Pneumatic Actuator

Delivery Performance ➔

USA : GE . CALPHINE

AIGERY : SPE

UAE : ARAMCO

CHINA : HANGJU BOILER

KOREA : KHNP. KOSPO.POSCO.SK.HHI

HYOSUNG. OTHERS

Certificate (SIL 3)

The manufacturer may use the mark:

CERTIFIED • IEC 61508 • SIL 3 CAPABLE

Reports:
FLO 08-10-12 R002 V1R1 IEC 61508 Assessment Mxa Report
FLO 08-01-45 R002 V1 R4 FMEDA Report

Validity:
This assessment is valid for the MXa Electronic Valve Actuator.

This assessment is valid until February 1, 2015.

Revision 1.1 January 13, 2012

exida Certification Services

Certificate / Certificat
Zertifikat / 合格証

FLO 081012 C001

exida hereby confirms that the:

MXa Electronic Valve Actuator

Flowserve Limitorque
Lynchburg, VA - USA

Has been assessed per the relevant requirements of:

IEC 61508 : 2000 Parts 1-7

and meets requirements providing a level of integrity to:

Systematic Integrity: SIL 3 Capable

Random Integrity: Type A Element

PFD_{avg} and Architecture Constraints must be verified for each application

Safety Function:
The Electronic Valve Actuator will move to the designed safe state per the actuator design within the specified safety time.

Application Restrictions:
The unit must be properly designed into a Safety Instrumented Function per the Safety Manual requirements.

Evaluating Assessor

Certifying Assessor

Page 1 of 2

MXa Electronic Valve Actuator

Flowserve Limitorque
Lynchburg, VA - USA

exida Certification Services

Certificate / Certificat / Zertifikat / 合格証

FLO 081012 C001

Systematic Integrity: SIL 3 Capable

Random Integrity: Type A Element

PFD_{avg} and Architecture Constraints must be verified for each application

SIL 3 Capability:

The product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer.

A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than stated without "prior use" justification by end user or diverse technology redundancy in the design.

IEC 61508 Failure Rates in FIT*

Device	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
MXa Electronic Valve Actuator ESD Valve Open/Close Applications no Partial Stroke Test	404 FIT	862 FIT	1,830 FIT	974 FIT
MXa Electronic Valve Actuator PSD Valve Open/Close Applications with Partial Stroke Test	481 FIT	805 FIT	2,540 FIT	368 FIT

Device	λ_{DU}
MXa Electronic Valve Actuator Continuous Demand Mode	392 FIT

SIL Verification:

The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFD_{AVG} considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time, and the specific failure rates of all products included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerances (HFT) requirements.

* FIT = 1 failure / 10^9 hours

Page 2 of 2

2. Material Distribution (2/11)

2-2 Actuator (Nippon Gear Limitorque, Japan)

Nippon BA Gear

Nippon Bevel Gear

Nippon Bevel Gear

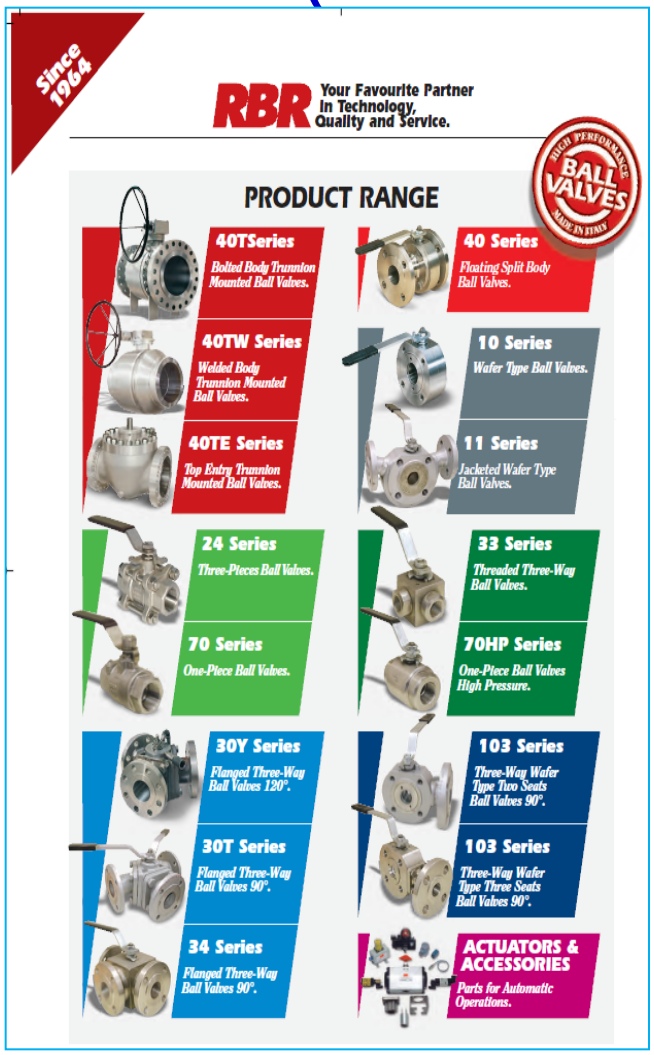
Limitorque JMB Actuator

Limitorque JMB Actuator

Limitorque JMB Actuator

2. Material Distribution (3/11)

2-3.Valves (RBR Valvole S.p.A, Italy)



Delivery performance

Some of the large number of customers utilising RBR BALL VALVES, are herebelow listed.

ABB
AEM
AGIP PETROLI
AKZO NOBEL
AMG PALERMO
ANIC
ASTER
BANDAR IMAM PETR. CO. (BIPC)
BAYER
BHP AUSTRALIA
BOSCO
CAMUZZI
CIBA GEIGY
DEPA
EDISON
ELF ATOCHEM ITALY
ENEL FIUME SANTO
ENEL TORREVALDALIGA NORD
ESSO
FAUJI FERTILIZER CO. - PAKISTAN
FINCANTIERI
FOSTER WHEELER
GUJARAT NARMADA FERTILIZERS CO.LTD
HIMONT
I.F.F.CO. - INDIA
ICAM
INDUSTRIE CAFFARO
KOBE STEEL LTD
MAERSK OIL/GAS
NATIONAL STARCH DIV. ICI ITALY
NUOVO PIGNONE SPA
PETROBEL
Q.G.P.C.
ROSSETTI
SICHUAN NAT.GAS FERT. - CHINA
SIRY CHAMON
SNIA
SWCC SAUDI
TECHNIP
TERMOKIMIK
TPL
TURBOTECNICA
WEST PACIFIC PETR. CO. LTD - CHINA
ADNOC - ABU DHABI
AGIP
AIR LIQUIDE ITALY
ALFA LAVAL
AMGA
ANSALDO
AZZAWIYA OIL REF. CO.INC. LIBYA
BASF
BENELLI
BONATTI
C.N.T.I.C. CHINA
CHINA PETROCHEMIC INT. CO (SINPEC)
DANIELI
DOW CHEMICAL ITALY
EIL
ELSAG
ENEL MONTALTO DI CASTRO
ENICHEM
FARMITALIA
FIAT
FOCHI
GEC ALSTHOM
HENKEL
HOECHST
IBN ZAHR SAUDI
INDUSTRIAL & PET. SUPPLIES SERV.
KALA
LUKE OIL
MOSCOW OIL REF. - UFA OIL REF.
NIGERIAN NAT.PET.CORP. (NNPC)
ONGC
PRAOIL
QATAR VYNIL CO.
SHELL
SILVANI
SNAMPROGETTI
SUI GAS PAKISTAN
TECHINT SPA
TECNIMONT
TOTAL
TUPRAS
UHDE

2. Material Distribution (4/11)

2-4.Valves (SWI, Korea)

Instrumentation Ball valves

Instrumentation Manifolds valves

Instrumentation Check valves

Instrumentation Needle/Relief valves

Instrumentation Gauge Root valves

Isolation Block & Bleed valves

Delivery Performance

Abu Dhabi Company for Onshore Oil Operations (ADCO)
Abu Dhabi Gas Industries Ltd. (GASCO)
Abu Dhabi Gas Liquefaction Company (ADGAS)
Abu Dhabi Oil Refining Company (TAKREER)

Air Liquide	Alcoa Inc.
BASF SE	BP Spain
Caltex	Chevron
Citgo Petroleum	ConocoPhillips
Consolidated Edison	CPC Corporation
Dow Chemical	DuPont
Eastman Chemical Company	Enterprise Products Partners L.P
.	
Equilon Enterprises LLC	ExxonMobil
Formosa Plastics Group	Irving Oil

Kuwait National Petroleum Company (KNPC)

Kuwait Oil Company (KOC)	The Linde Group
The Lubrizol Corp.	LyondellBasell Industries
Maersk Oil	Marathon Petroleum Corp.
Merichem	

National Iranian Oil Company (NIOC)
Rabigh Refining & Petrochemical Company (Petro Rabigh)
Pars Oil and Gas Company (POGC)
Philippine National Oil Company (PNOC)

Phillips 66	POSCO
PTT Public Company Ltd.	Qatar Petroleum

Ruwais Fertilizer Industries (FERTIL)
Saudi Basic Industries Corp. (SABIC)

Sherritt International	Solutia Inc.
Sonatrach	Sterling Energy Plc
Sun Edison LLC	Texas Petrochemicals (TPC)
Valero Energy Corp.	Westlake Chemical

Zakum Development Company (ZADCO)

2. Material Distribution (5/11)

2-5.Valves (BOTELI, China)

Fully Welded Body Ball Valve

2-PC Trunnion Ball Valve

Cryogenic Ball Valve

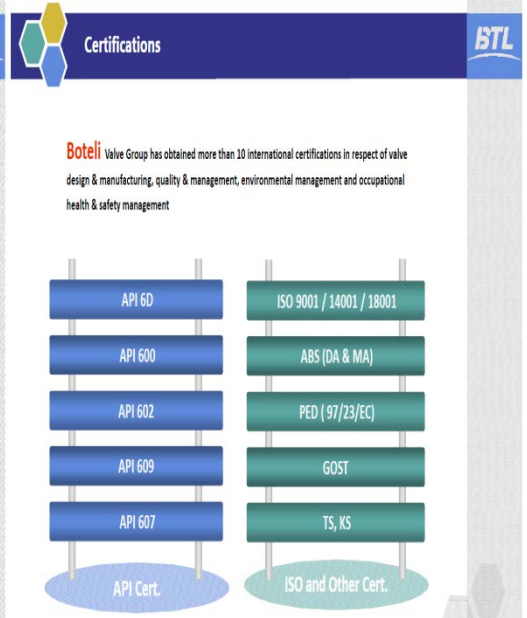
Cryogenic Globe Valve

API 602 Gate Valve

API 600 Gate Valve

API 602 Globe Valve

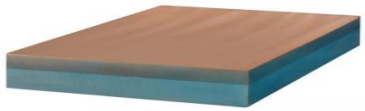
BS 1873 Globe Valve



2. Material Distribution (6/11)

2-6 Cladding (PHOHOM,China)

Cladded Plate

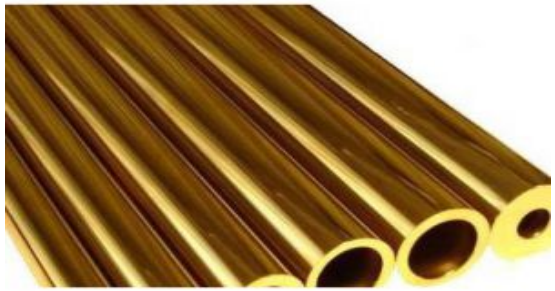


Copper-Aluminuum Bimetal Clad Plate

Copper-Stainless Steel Bimetal Clad Plate

Pipe Products

Tantalum-Steel Bimetal Clad Pipe



Zirconium-Steel Bimetal Clad Pipe

2. Material Distribution (7/11)

2-7 Insulation (Iking, China)

Rock Wool

Glass Wool

2. Material Distribution (8/11)

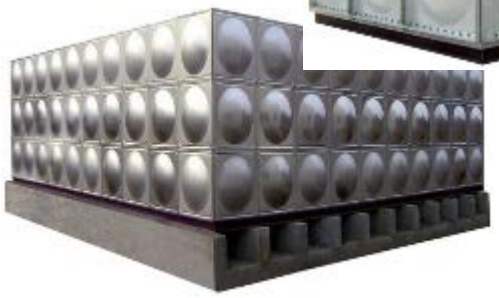
2-8 FRP (ZLRC, China)

FRP Pipe




FRP Tank





2. Material Distribution (9/11)

2-9 FLANGE/FITTING (RISE Steel, China)

Flange

ASTM , ANSI, GB, JIS, BS, DIN, UNI

DN10---DN2000

Flitting

Carbon steel: ASTM/ASME A234 WPB WPC
Alloy steel: ASTM/ASME A234 WP 1-WP 12-WP 11-WP 22-WP 5-WP 91-WP 911
Stanless steel: ASTM/ASME A403 WP 304-304L-304H-304LN-304N
ASTM / ASME A403 WP 316-316L-316H-316LN-316N-316Ti ASTM/ASME A403 WP 316-316L-316H-316LN-316N-316Ti
ASTM / ASME A403 WP 321-321H ASTM / ASME A403 WP 347-347H ASTM/ASME A403 WP 321-321H ASTM/ASME A403 WP 347-347H
Low-temperature steel:ASTM/ASME A402 WPL 3-WPL 6
High performance: ASTM/ASME A860 WPHY 42-46-52-60-65-70

Seamless elbow:1/2"-24"
Welded Elbow: 4"-72"

2. Material Distribution (10/11)

2-10 Pipe (Tianjin Xinyue Steel, China)

CS SMLS Pipe
API 5L PSL1 & PSL2
Max. Gr. X70
A106/A53
A333
A335
Max. Size : 24”

LSAW, HIC Pipe (Max. 58”),
EFW Class 12, 22, 32 (Max. 58”)
1 Seam Up to 48”

SSAW (Max.120”),
ERW (Max. 26”, Up to API 5L Gr. X70)

2. Material Distribution (11/11)

2-11 Pipe (Yantai Baosteel, China)

Seamless
Line Pipe
Boiler Tube
Drill Pipe
Max. Size : 18”

Total Provider for Piping Material

Discipline	Item	Manufacturer1	Manufacturer 2	Manufacturer3	Manufacturer4	Manufacturer5
Piping	Carbon Steel Pipe (SMLS)	Tianjin Xinyue Steel, China	Yantai Baosteel, China	Dexin Steel Tube	Rise Tianjin Steel, China	TIANJIN YOUFA, China
	Carbon Steel Pipe (Welded)	Tianjin Xinyue Steel, China	Yantai Baosteel, China	Dexin Steel Tube	Rise Tianjin Steel, China	TIANJIN YOUFA, China
	Alloy Pipe (SMLS)	Tianjin Xinyue Steel, China	Yantai Baosteel, China	Dexin Steel Tube	Rise Tianjin Steel, China	TIANJIN YOUFA, China
	Stainless Steel Pipe (SMLS)	Shaanxi Huitong, China	Zhejiang Tsingshan, China			
	Stainless Steel Pipe (Welded)	Shaanxi Huitong, China	Zhejiang Tsingshan, China			
	GRP & GRV Piping (FRP)	Beijing ZLRC, China				
	HDPE Piping	Beijing ZLRC, China				
	Wrought Fitting	Rise Tianjin Steel, China				
	Forged Fitting	Rise Tianjin Steel, China				
	Flange	Rise Tianjin Steel, China				
	Special Fitting	Rise Tianjin Steel, China				
	Gasket	Ningbo Sunwell, China				
	Bolt & Nuts	Ningbo Klinger Fastener, China				
	Special Support (Spring Hanger)	Wenzhou J&O Fluid Control, China				
	Casting Valve	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China	RBR, Italy (for BALL valve)	AEA Valve	
	Forged Valve	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China	RBR, Italy (for BALL valve)	AEA Valve	
	Butterfly Valve	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China		AEA Valve	
	Diaphragm Valve	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China		AEA Valve	
	Check Valve (Forged)	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China		AEA Valve	
	Check Valve (Casting)	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China		AEA Valve	
	Air Vent Valve	Boteli Valve Group, China	HUBEI TAIHE PETROCHEMICAL EQUIPMENT, China		AEA Valve	
	Insulation(Piping/Equipment)	Iking, China	EASTM, China			
	Eye Shower	Shanghai Gangsheng, China				
	Quick Coupling	Ningbo Sunwell, China				
	Strainer	AEA Valve, China				
	Expansion Joint	Ningbo Sunwell, China				
	Flexible Joint	Ningbo Sunwell, China				
	Trap	AEA Valve, China				
	Isolation Kit	Ningbo Sunwell, China				
	Cladding Material	Phohom, China				
	MOV / POV / AOV	Flowserve, USA	NGC, Japan			

Q & A Session

Thank you so much!!!