Contents

- Introduction of Korean Register
  - Classification Society
  - Main Activities

- KR’s Expertise for Marine Engineering
  - Structural Analysis
  - Risk Assessment
  - Technical Softwares

- Business Cooperation with Brazil
  - Marine Business Environments in Brazil
  - On-going Business - Offshore Nautical Hub
  - Future Business - Engineering Consulting
Korea – Brazil Business Forum

INTRODUCTION OF KOREAN REGISTER
Classification Society

**Main Role in Maritime Industry**

- Classification societies have a vital role to play in facilitating a sustainable international shipping industry and facilitating a maritime sector that is socially and environmentally responsible and profitable.

- IACS (International Association of Classification Societies)
  - More than 90% of the world's cargo carrying tonnage is covered by the classification design, construction and through-life compliance Rules and standards set by the thirteen Member Societies of IACS
  - ICC (Institute Classification Clause) by IUA (International Underwriting Association of London)
Int’l Association of Classification Societies

- IACS Members (12 Class Societies, Oct-2013)

Major Shares

M&A
Korean Register (Founded 1960, Non-profit Organization, Member of IACS)

- Ships Registered: 3,000 vessels with 63 Million G/T (Oct 2013)
- Authorizations granted by the 65 Administrations
- 65 Worldwide Service Networks (Worldwide: 50, Korea: 15)
- Certification (TPC; ISO, ISM, CE), Inspection (TPI; Ship, Equip, Naval), and R&D projects (Engineering, IT software, Shipbuilding, Green Ship & Offshore project)
KR’s work scope on Marine Project

New Shipbuilding

- New design approval
- Ship survey & audit
- Engineering consulting

Operation

- Periodical survey
- Operation consulting

Terminal and Shore Facilities

- Loading/Unloading facilities inspection
- Design & Engineering of the terminal

KR developed rules (examples)

- LPG
- LNG
- CNG
Classification Society is the hub point for technologies and information regarding to maritime and energy industries.

KR provides state of the art services in:
- B2B, G2G cooperation
- Shipping operation
- Yard development
- enhancing safety-based value chain
1. Scope of Feasibility Study

- Gas transportation
  - mini-LNG FSRU to surrounding islands
  - East Java to FSRU
  - East Java to surrounding islands
- Interim Report (10/21, Jakarta)
  - Technical Seminar for mini-LNG transport solution

2. Ship to Ship Cargo transfer operation

- Standard procedures of Ship to ship operation shall be based on the standard of IMO, OCIMF & SIGTTO etc.
- Ship to ship transfer can be operated from FSRU to LNGC and mini LNGC
Wind Power
- The sole int’l cert. body in Korea
- Design and Project Certification
- Participated in 2.5GW Offshore Wind Plant in Southwest Korea

CE Mark
- The sole certification body in Korea
- Marine Equipment Directive (MED)
- Pressure Equipment Directive (PED)

ISO
- ISO certification body
- ISO 9001/14001/28000
- OHSAS 18001

CDM DOE
- an accreditation body for Designated Operational Entity (DOE) responsible for monitoring Clean Development Mechanism (CDM) by UNFCCC
Green Energy/Environment & Navy

- International Certification Body for New & Renewable Energy (Wind Turbine and Wind Farm) and Green Ship
- Technical solution provider and for air pollution (GHG, NOx, SOx, PM, VOCs) from onshore Power Plant (incl. Nuclear & Fuel Cell Plant), Oil & Gas, Petro Chemical, etc. & offshore plants and ships
- Naval certification and survey program for ROK Navy
Full Service Area

Maritime Shipbuilding & Naval

Oil & Gas Energy

Renewables & Environment

Quality & CE Mark

Mission Keys: Technology, Safety & Environment
KR’S EXPERTISE
FOR MARINE ENGINEERING
Structural Safety Assessment

- **Track Records**

  - **BONGA FPSO DSA Project**
    *Owner: Shell (SHI)*

  - **BAYU UNDAN FSO DSA Project**
    *Owner: ConocoPhillips (SHI)*

  - **MOHO FPU DSA Project**
    *Owner: Total (HHI)*

  - **USAN FPSO DSA Project**
    *Owner: Total (HHI)*

  - **BP Q204 FPSO DSA Project**
    *Owner: BP (HHI)*

  - **CLOV FPSO DSA Project**
    *Owner: Total (DSME)*

  - **Drilling Rig Life Enhancement Project**
    *Owner: KNOC*

  - **ICHTHYS FPSO DSA Project**
    *Owner: INPEX (DSME)*

  - **Jack-up approval & DSA project**

Marine Engineering Consulting
New Projects

1. MOHO NORD FPU Project, TOTAL, HSHI
2. Rosebank FPSO Project, Chevron, HHI
3. EGINA FPSO, TOTAL, SHI
Direct Structural Analysis (DSA)

- **Work Scope for FPSO Project**
  - **Design Brief**
  - **Main Hull**
    - Cargo Hold Analysis (Fore, Mid and Aft Structure)
    - LQ & Laydown Area
    - Spectral Fatigue Analysis
    - Deflection analysis
  - **Strength Analysis for Appurtenance Structures**
    - Flare Tower foundation
    - Crane Pedestal Foundation
    - Turret Interface
    - Module and pipe rack support
    - Riser, Caisson, Mooring Support
  - **Accidental Analysis**
    - Collision Analysis
    - Explosion Analysis
    - Dropped Object analysis
    - Green water protection frame
Direct Structural Analysis (DSA)

- Hold Analysis of fwd. part with Turret Load

**Scope of Work**

- Strength assessment based on owner’s report

- Strength assessment of longitudinal hull girder and primary supporting members, transverse bulkheads within fore part of hull

- Strength assessment of longitudinal hull girder shears structural members in way of transverse bulkheads within fore part of hull

- Strength assessment of moon pool structure, bogie support structure and gentry support leg foundation

- Yielding and buckling capacity according to the acceptance criteria
Direct Structural Analysis (DSA)

- Analysis for Jack-up Drilling Rig
  - In-place Global Analysis
  - Transit Global analysis
  - Fatigue Analysis
  - Local Analysis
    - Hull-Cantilever interaction
    - Spudcan-leg interaction
    - Leg-hull interaction
  - Ultimate capacity of damaged leg
  - Plan approval
  - In-house S/W for
  - SACS post processing
DSA & Life Enhancement

- Analysis for Semi-Submersible Rig
  - Global Structural Analysis
  - Fatigue Life Evaluation and Structural Reinforcement
    - full spectral-based fatigue analysis
  - Rig survey & As-is Condition Assessment
Experience on Offshore Plant

- Accidental Loads

Collision

Explosion

Dropped Objects

Deformed shape and effective plastic strain distribution of inside structure
Collision Analysis using LS-DYNA

Maximum Plastic Strain and Maximum Deformed Depth in the FPU Hull

<table>
<thead>
<tr>
<th>Structure</th>
<th>Maximum Plastic Strain</th>
<th>Maximum Deformed Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boat landing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPU hull</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Risk Assessment for Topside Platform

- Risk Study Procedure and FEEDAS

Module 1. DOP
Module 2. DOSS
Module 3. FERAS
Module 4. NPRAg
Module 5. RAMg

System Design
HAZID
HAZOP
Fire & Explosion Risk Analysis

QRA (Quantitative Risk Analysis)

Emergency System Survivability Ass’mt

Escape, Evacuation & Rescue Analysis

System Reliability Analysis
SIL Verification

Dropped Object Analysis
Ship Collision Analysis
Exhaust Gas Dispersion Analysis
Production Availability
Cryogenic Spill Analysis
LNG-FPSO Project

- Safety Design and Reliability Engineering Technology

- Development of Methodology and Procedure for Production Availability & Risk Analysis

- Development of Safety Modules (FEEDAS - Front-End Engineering and Design with Availability and Safety)
  - Mod 1. Design of Process, based on Availability
  - Mod 2. Design of Safety System, based on SIL
  - Mod 3. F/E Risk Analysis Supporting Tool
  - Mod 4. Non-Process Risk Analysis Guide
  - Mod 5. RAM Analysis Guide

- Verification of Availability & Safety for LNG-FPSO FEED Package
  - Availability to be greater than 90%
  - Human risk to be less than 10^{-3}/year
LNG Fuelled Ship

- Explosion Analysis
  - KR try to leading with regard to rule requirement
    - Contributions to IGF guideline
    - submit a draft for the code
    - Active participation on IGC code revision
    - Setting of requirements for IGF code together with Yards and Owners
  - Safety challenges
    - Gas dispersion/Explosion
    - Finding risk reduction measures
● Scope of Work

- Philosophy
  - Safety Philosophy
  - Escape, Evacuation and Rescue Philosophy

- Study & Report
  - HAZID study report
  - RAM study report
  - HAZOP study report
  - SIL study report
  - Risk Assessment report

- Analysis & report
  - Fire, Explosion and Dispersion Analysis
  - Natural Ventilation Study
  - Flare and Vent Study Report
  - Major Accidents Hazards Consequences analysis
Submarine Risk Analysis

- HAZID Worksheet (KR Practice)

[FMEA type]

- TSF
- MSF
- SSF

- Hazard
- Cause
- Effect
- Existing Safety System
- Frequency
- Consequence
- Risk
- Recommended RCM
- Remarks

- Propulsion
- Static Stability
- Structural Safety
- Dive/Float
- Anchor/Moor/Tow
- Maneuver
- Communication
- Escape/Rescue
- Extinguish
- Accommodation
Structural Design and Safety of Offshore Platforms
Engineering and Construction

NOWATEC E&C Co., Ltd. is a knowledge and technology-based company specializing in the engineering and design of offshore and onshore installations subjected to extreme and accidental loads. Our focus is on innovative engineering and design in developing concepts, functions, and materials in association with health, safety, the environment, and ergonomics.

Our business strategy is the development of products based on:
• Application of advanced data simulation technology in the design process
• Application of the results of research and development projects worldwide and across industries

NOWATEC E&C Co., Ltd. offers a wide range of products and services to help clients reduce risk, increase safety, improve environmental performance, optimize and develop products, and enhance profits in their operations. The company's services include:
• Participation in clients' projects
• Management and coordination of clients' projects

NOWATEC E&C Co., Ltd. aims to achieve:
• Satisfaction of demanding clients
• Outstanding results in engineering, design, and verification projects
• Development of high-quality technical documentation
• Implementation of quality assurance in all project phases
• Innovation bringing involvement in R&D projects

The increasing demand for energy worldwide has created the need for the efficient development of oil and gas resources offshore.

Fast-track engineering and construction projects require new technologies to perform engineering and solve facility safety issues during design and fabrication phases.

NOWATEC E&C Co., Ltd.
Health & Safety Engineering - Main Goals:
• Prevent explosions and fires
• Reduce the consequences of accidents
• Rescue personnel
• Ensure safe working environment
• Protect external environment

Examples of Reference Projects in the Offshore Oil and Gas Industry:
• Engineering and design of jack-up topsides
• Engineering and design of blast walls and fire walls (with more than 40 projects)
• BW Pioneer FPSO for Cascade-Chinook field – Engineering and design of turret wall protection structures
• Scarabeo – Engineering and design of winterization structures for the Arctic
• Skarv – Feasibility study of design of an escape tunnel against explosions and fires
• Engineering and design of towing equipment
• Engineering and design of subsea structures and equipment (manifolds)
• EEF JIP – Explosion and fire engineering of FPSOs (Joint Industry Project)

Key Business Areas:

1. Engineering and Construction of Offshore Oil and Gas Facilities
   • Topsides and supporting structures
   • Design for sloshing impacts in the FLNG storage tanks
   • Processing equipment and piping
   • Turrets
   • Helidecks
   • Flare towers
   • Risers and pipelines

2. Engineering and Construction Services within Safety Design
   • Hydrocarbon explosion and fire risks
   • Blast and fire walls, PFP designs, escape tunnels
   • Collision, dropped object engineering
   • Large scale / full scale fire and explosion testing
   • Large scale / full scale subsea testing
   • Large scale / full scale structural failure testing
   • Large scale / full scale underwater explosion testing
   • Large scale / full scale slamming impact testing

3. Risk Assessment and Risk Management
   • HAZOP, HAZID, SIL and RAM study reports
   • Firewater demand report
   • Quantitative risk assessment report
   • Design accidental load specification

Our Clients Include:
BP, Statoil, Shell, TOTAL, HHI, DSME, SHI, IKM/DSC Eng., Marathon Oil, Norsk Hydro, Kvaerner Eng., ABB Technology, Conoco Phillips, Enterprise Oil, Trellborg Offshore, GE
SeaTrust Software Package

- **SeaTrust-RuleScant**
  - for KR rule approval system

- **SeaTrust-CSR / CSR-H**
  - for CSR approval system

- **SeaTrust-Holdan**
  - for hold analysis advanced system

- **SeaTrust-ISTAS**
  - for Direct whole ship structural analysis system

- **SeaTrust-SHALI**
  - for Shaft alignment system

- **SeaTrust-SLM**
  - for Ship life-cycling management system
1. **Structural Analysis**
   - SeaTrust-HOLDAN/ISTAS/FANSYS/BUCKL
   - SACS and its KR post-processor
   - PATRAN, NASTRAN
   - ANSYS, LS-DYNA

2. **Process Analysis**
   - HYSIS

3. **Risk Analysis**
   - LEAK, FLACS, PHAST

4. **Reliability Analysis**
   - MAROS, RELEX, eSILentia

5. **CFD analysis**
   - ANSYS CFX
   - STAR CCM
- Pre/Post software package for hold analysis and general FE model
- Include advanced auto mesh algorithm
- Report generation
- Support fore and aft hold analysis for CSR vessels
- Support user defined result case
- SeaTrust-RuleScant + SeaTrust-CSR + Advanced Tools
SeaTrust-ISTAS

ISTAS

FANSYS

Drawing & Loading Manual

Global Ship Model

Main Module

Motion & Wave Loads (2D Strip)

Motion & Wave Loads (3D Panel)

Ultimate Strength Check

Buckling Check

Integrated Simulation

F.E Analysis

expansion
Currently a team of 9 people covering:

- Development
- Sales
- Support & training

Development

- Use of state-of-the-art development software
- Implementation of 3D Graphics environment
- Development of engineering software for Ship and Offshore Design, Strength Assessment and Life Cycle Management

Sales

- SeaTrust-Holdan: 16 Clients, 37 copy and 3 site license
- SeaTrust-CSR: 34 Clients, 874 copy license
- Major Customer: about 20 companies, including HHI, DSME, SHI, STX
### Software Support
- 24hr Monday to Friday
- e-mail: hgpark@krs.co.kr
- web site: www.seatrust.kr

### Training
- 15 days of one year
- SeaTrust-CSR, SeaTrust-Holdan

### Event
- SeaTrust Software User Conference for every year
- About 70 participants
Korea – Brazil Business Forum

BUSINESS COOPERATION WITH BRAZIL
Pre-salt Concession

Petrobras concentrates on Offshore Oil & Gas development and production in Pre-salt area.

Total area of the province: 149,000 km²
Concession Area already explored: 41,722 km² (28%)
Concession Area with the participation of PETROBRAS: 35,739 km² (24%)
No concession: 107,228 km² (78%)
- Shipbuilding Plan of Petrobras for Pre-Salt Development

Petrobras will deploy various Offshore Platforms in Pre-salt area by 2020

50 Drilling Rigs: 2012 - 2020

Oil Production, Brazil: 2,022 – 4,200 kbdp

Petrobras

Jack-up Rig
FPSO
Semi-Submersible Rig
Drillship
Marine Business Environment in Brazil

- Shipyards in Brazil

About 50 shipyards are mostly constructing vessels related with O&G Biz

<table>
<thead>
<tr>
<th>Shipyards</th>
<th>Vessels</th>
</tr>
</thead>
</table>
| **Small** | ▪ Supply Vessels  
- PSV  
- AHTS  
- PLSV  
- TUG  
- Pushers |
| **Medium** | ▪ Tanker Vessels  
- Crude Oil  
(Suez, Afra, Pana)  
- Product  
- LPG  
- Bunkers |
| **Large** | ▪ Drilling Platforms  
- FPSO  
- FSO  
- Drillships  
- Semi-sub  
- Modules |

Estaleiros no Brasil
New Shipbuilding Demands

Fleet increase by 2020

Petrobras Fleet Growth Program with Brazilian Vessels

<table>
<thead>
<tr>
<th>PROMEF I and II</th>
<th>EBN I and II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>49 Vessels until 2020</strong></td>
<td></td>
</tr>
<tr>
<td>14 Suezmax</td>
<td>12 Products</td>
</tr>
<tr>
<td>8 Aframax</td>
<td>8 L&amp;G</td>
</tr>
<tr>
<td>4 Panamax</td>
<td>3 Bunkers</td>
</tr>
<tr>
<td>3 delivered Vessels and 22 Vessels in advanced stage of construction</td>
<td></td>
</tr>
<tr>
<td><strong>24 Vessels in hiring phase or initial construction phase</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **39 Vessels until 2017** |
|-----------------|--------------|
| 26 Products | 6 Bunker |
| 7 L&G |
| 2 Vessels in advanced stage of construction |
| **37 Vessels in hiring phase or initial construction phase** |

Equipment demand not yet addressed for 61 Vessels (until 2020)

Example of equipment with potential for national development

- 61 Vacuum Sewage Systems
- 53 Inert Gas Generation Unit

- 72 Life Boats + Davit
- 1,830 Accommodation Cabines
### Logistic Issues in Pre-salt

<table>
<thead>
<tr>
<th>Critical Resources</th>
<th>Situation in (Dec/10)</th>
<th>Deliver plan (<a href="#">to be contracted</a>)</th>
<th>Accumulated values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>by 2013</td>
<td>by 2015</td>
</tr>
<tr>
<td>Drilling rigs WD above 2,000 m</td>
<td>15</td>
<td>39</td>
<td>37 (1)</td>
</tr>
<tr>
<td>Supply &amp; special vessels</td>
<td>287</td>
<td>423</td>
<td>479</td>
</tr>
<tr>
<td>Production Platforms SS and FPSO</td>
<td>44</td>
<td>54</td>
<td>61</td>
</tr>
<tr>
<td>Others (Jackets e TLWP)</td>
<td>78</td>
<td>80</td>
<td>81</td>
</tr>
</tbody>
</table>

- Passengers transported in Pre-salt area **in 2011**
  
  71,343 people per 73 helicopters

- **In 2020**, about 4 times deep-sea Drilling Rigs will be newly deployed

Logistic cost and Safety matters are getting critical
**Concept of ONH**

- **Concept of Solution**

  - **Floating Logistic Hub Island**
  - 600 OSVs
  - 100 Platforms
  - 300 KM

- **Offshore Nautical Hub (ONH) Project**

  - Construction Cost: USD 1 billion (estimated)
  - Main Developer: Quebec (KOR-BRA Consortium)
  - Target Customers: Petrobras and Oil companies in Pre-salt field
  - Function: Platform crew transportation terminal and Rescue center
  - Capacity:
    - 1,200 people transit and 600 accommodation per day
    - Helidecks, Speedboat docks, Hospital and Leisure facilities
ONH Cooperation Structure

- KOR-BRA Consortium (MOU to be signed)

Coordinating & Consulting

Project Developing

Oil Companies in Pre-salt

Korea ECAs

Technical Support

Member Organizations

Financing & Biz Modeling
ONH Construction Plan

Firstly approaching as R&D, then developing Business

- **Cooperation Building**
  - Market research
  - Policy research
  - Technical solution
  - Business scheme
  - Cooperation MOU

- **Promotion & Design**
  - Promotion for Oil Companies (Petrobras, etc.)
  - Concept design
  - Political support

- **Joint R&D**
  - Empirical R&D with Petrobras
    - New technology
    - Cost efficiency
    - Safety

- **Bidding / Construction**
  - Bidding / Contract for construction
    - ONH
    - Speedboat
    - Helicopter

- **Operation**
  - Service begins for 20 years base

**Timeline**
- ~ ’13. Sep
- ’13. Oct ~ Dec
- 1st Half ’14 ~
- 2nd Half ’14 ~
- Mid ’18. ~
Brazilian shipbuilding industry needs Technical Expertise and Support
Strong points of Korean Offshore Technology

- Speed of Responses
- Cost of Services
- Practical Experiences
- Flexibility of Approaches
- Co-work Skills
Future Plan

- Joint Venture for Offshore Engineering Consulting in Brazil

- Brazilian Oil Companies
- Brazilian Shipyards/Engineering Companies
- ‘Science without Borders’ Program
- Brazilian Engineers trained by KR
- ‘Science without Borders’ Program
- Engineering Consulting Partners in Brazil
- Cooperation
- Program Support
- Technical Support
- Employment
- Training
- Reputations in Local
- Technical Manage
- Construction
- Networks

To develop Own Offshore Technology and References for two countries
Advantages by Cooperation

- Logistic solution in Pre-salt
- Enhancement of advanced marine technology
- Development of shipbuilding engineering skills (Design, Risk control, IT convergence, etc.)
- Engineering references for offshore structures in Oil&Gas field
- Potential projects with Brazilian shipyards and engineering companies
- Networking with companies related with Pre-salt Concession

KR hopes to be a new and reliable Partner for shipbuilding industry in Brazil
KR,
Green bridge to the future, with you!

Thank you

Junhoo Jeong
Business Strategy Development Team
Korean Register of Shipping

Tel: +82-70-8799-8097
E-mail: jeongjh@krs.co.kr