

Building a better future  
**Global Leader**



# HYUNDAI HEAVY INDUSTRIES

Rotating Machinery

We build a better future  
**HYUNDAI** | **ELECTRO ELECTRIC SYSTEMS**  
HEAVY INDUSTRIES CO., LTD.

1

Overview of Rotating Machinery

2

Product Classification

3

Product Reliability

4

Introduction of HIEC

5

Major Performance

1.

# Overview of Factory and Product



[ Ulsan, Korea ]

## Annual Capacity

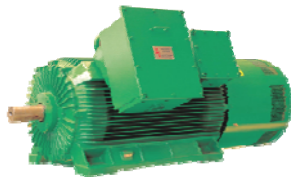
- LV SCIM : 150,000 units
- MV SCIM : 7,000 units
- Syn. Gen. : 5,000 units
- Syn. Motor : 1,000 Units

## Man Power

- 180 Engineers
- 720 Workers



[ Gunsan, Korea ]



## LV Induction Motor

- Rated Output : ~ 1,000 kW
- Rated Voltage : ~ 600 V
- Poles : 2~12



## Synchronous Generator

- Rated Output: ~ 50,000KVA
- Rated Voltage : ~ 22,000 V
- Poles : Over 4



## MV & HV Induction Motor

- Rated Output : ~ 20,000 kW
- Rated Voltage: ~ 14,000 V
- Poles : 2~30



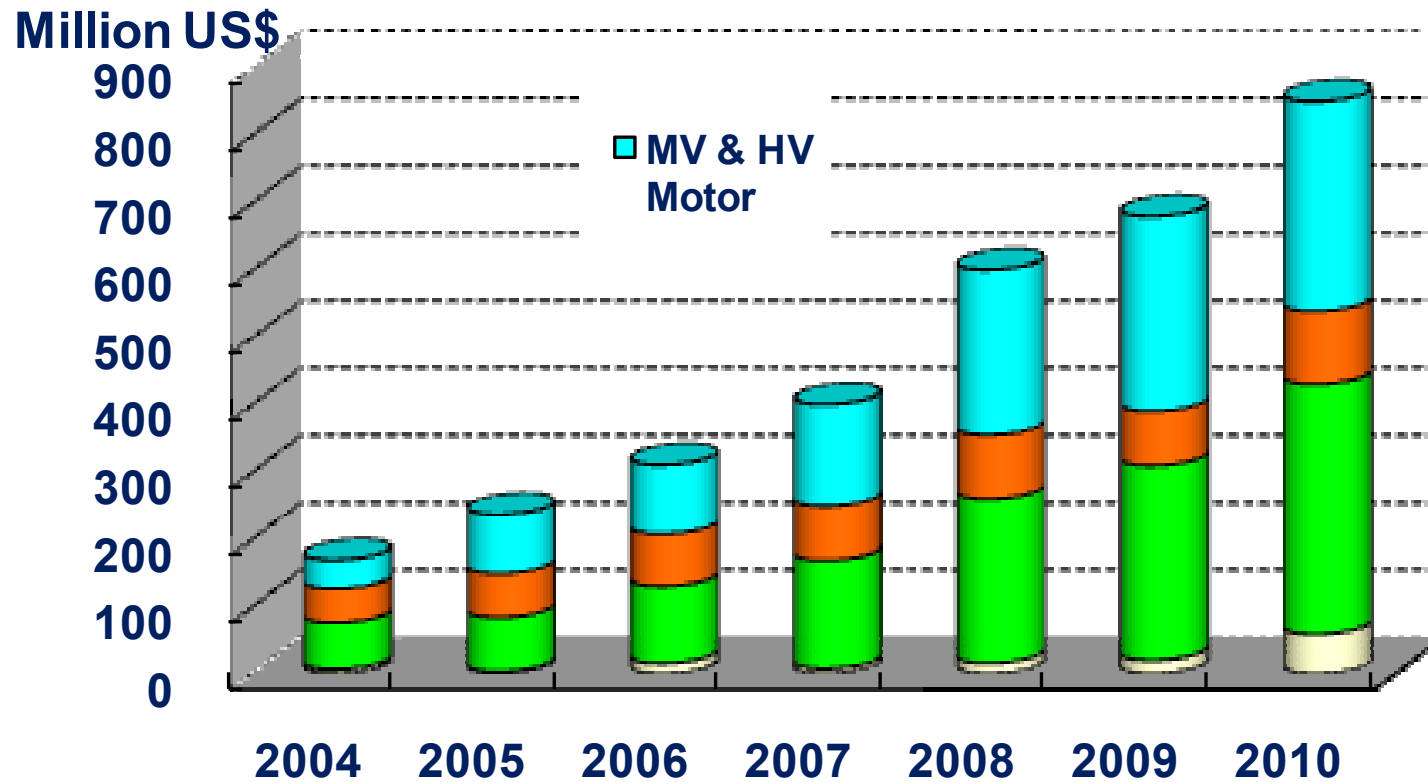
## Synchronous Motor

- Rated Output: ~ 15,000HP
- Rated Voltage : ~ 13,800 V
- Poles : Over 4



- ◆ 1978 – Dedication of Rotating Machinery Factory
- ◆ 1978 – Technical Cooperation with SIEMENS(Germany)  
for Induction Motor & Synchronous Generator
- ◆ 1986 – Dedication of Small Motor Factory Joint Venture with G.E.(USA)
- ◆ 1995 – Technical Cooperation with SIEMENS-WESTINGHOUSE for Turbo Generator
- ◆ 1998 – Establishment of Research & Development Company in Hungary named  
HUNELEC Engineering & Technologies KFT. (H-TEC)
- ◆ 2007 – Accreditation of PTB (Germany) certificate for flameproof motor
- ◆ 2007 – Dedication of Hyundai – Ideal Electric Company in USA
- ◆ 2008 – 16,100th Marine use Alternators were Delivered
- ◆ 2008 – Accreditation of ATEX (BASEEFA) certificate for Ex nA motor
- ◆ 2009 – Accreditation of ATEX (BASEEFA) certificate for Ex p motor
- ◆ 2011 – Accreditation of ATEX (BASEEFA) certificate for Ex d motor

# Annual Sales of Rotating Machinery

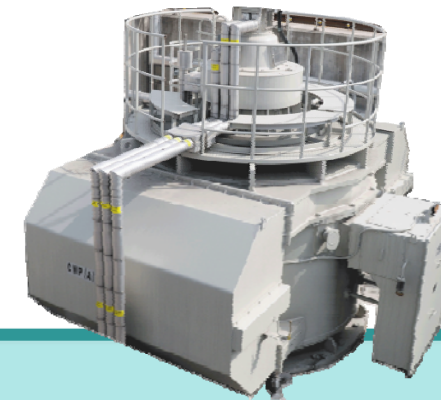
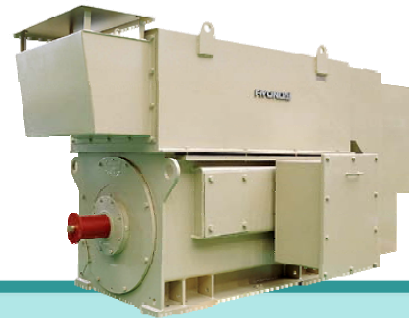
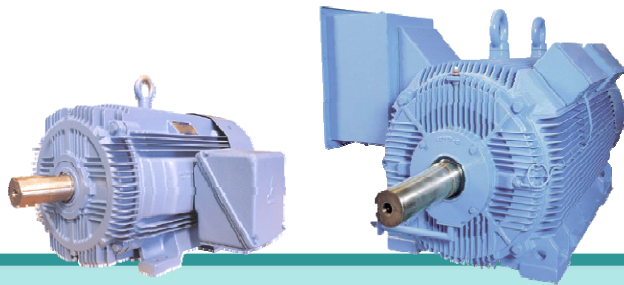


## 2. Product Classification (Motor)

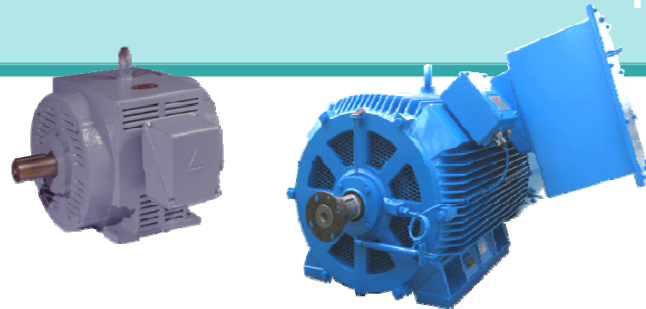
TEFC Type : < 1,000kW

TEAAC Type : < 8,000kW

TEWAC Type : < 20MW



Output [ kW ]



ODP Fin Type : < 1,500kW

ODP Type : < 12,000kW

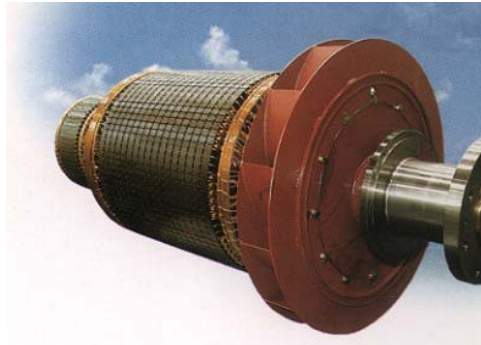
WP Type : < 20MW

# Product (Generator)

Low Voltage



Cylindrical Rotor

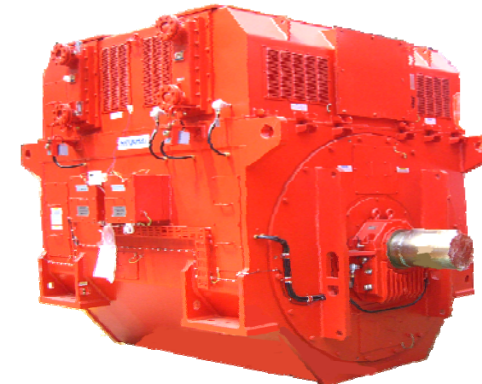
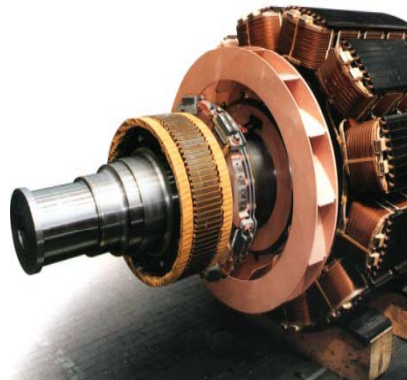


Medium & High Voltage



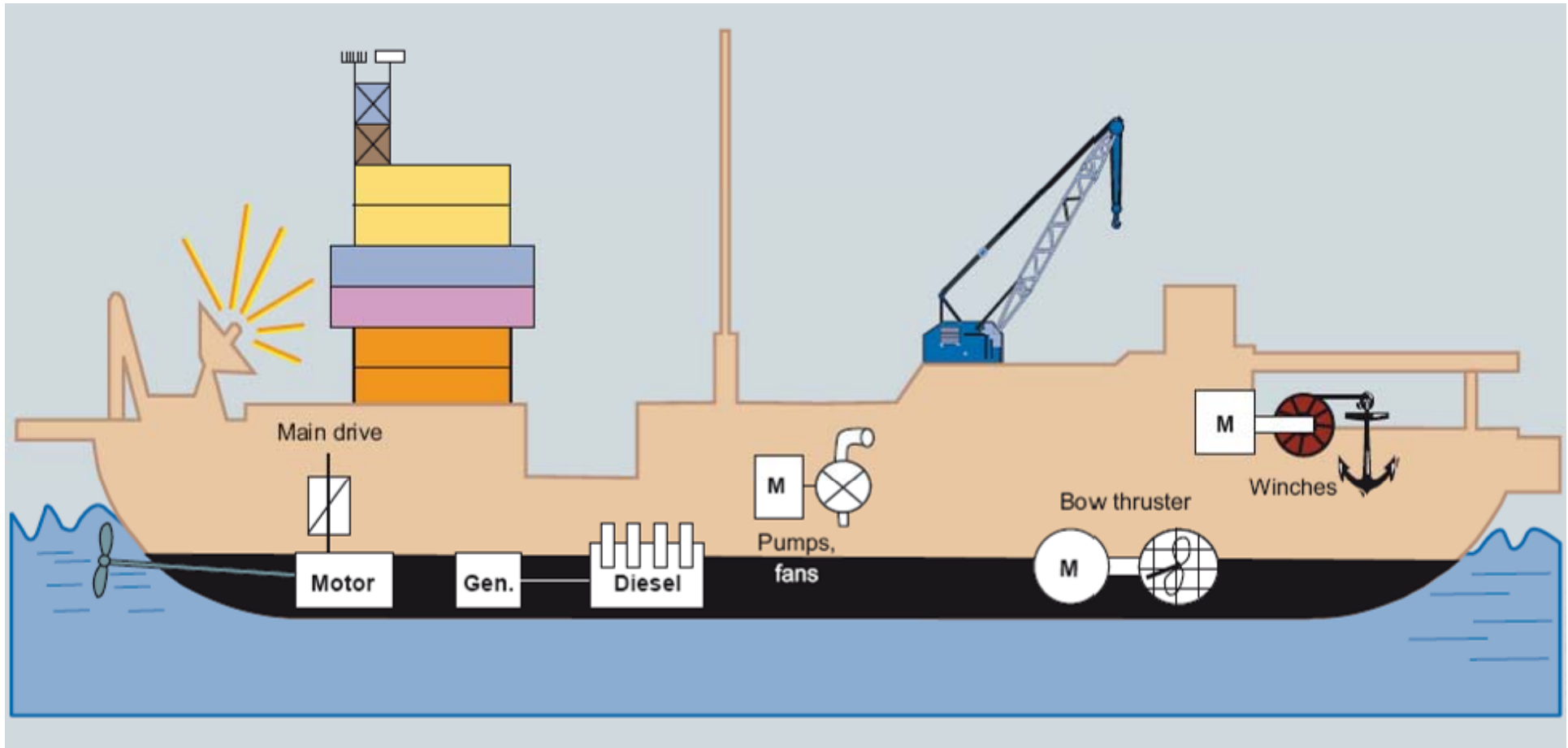
Output [kVA]

Salient Rotor



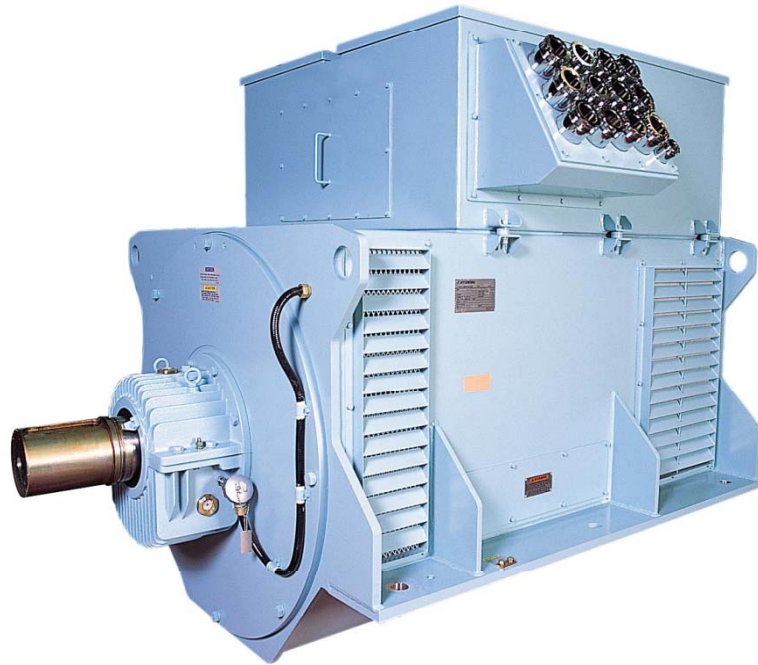


# Application of HHI Marine Motor & Generator



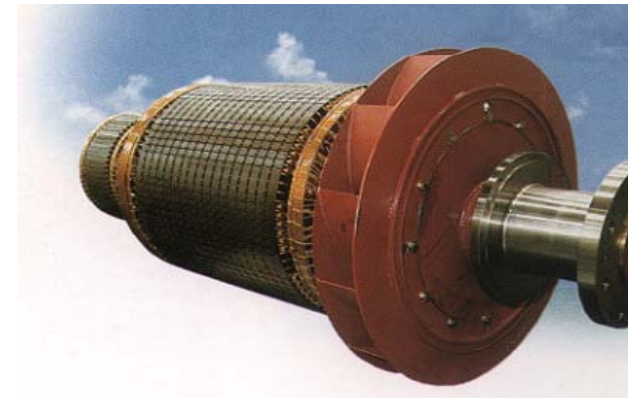


## ● Low voltage



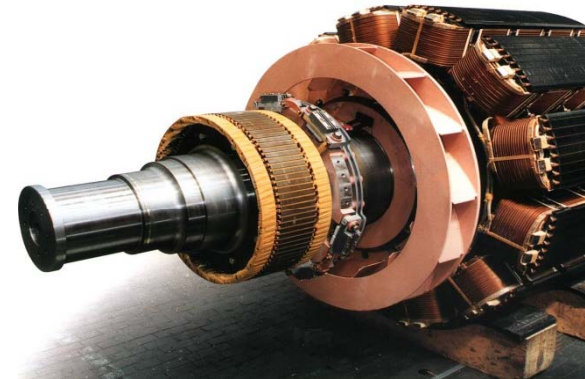
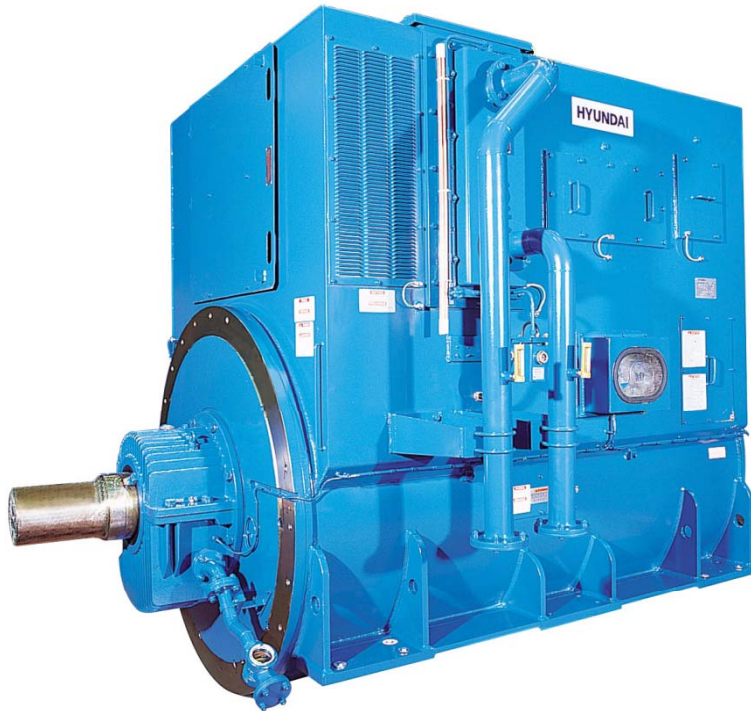
## Marine Generator

Three Phase Synchronous Generators



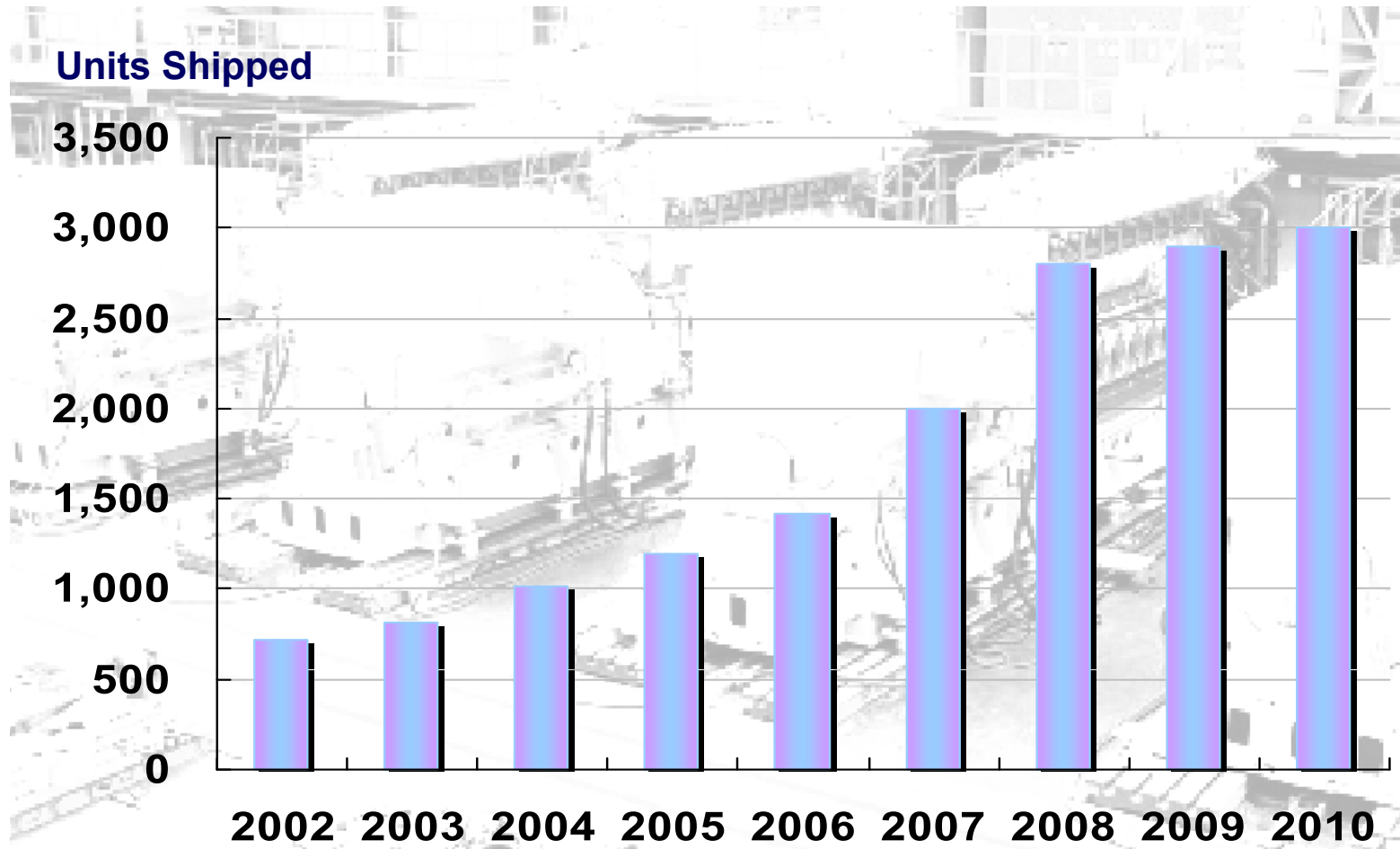
- ✓ Manufacturing Scope : 100 – 6,000 kVA
- ✓ Voltage : 220 – 690 V
- ✓ Poles : 4 – 14 poles
- ✓ Protection Degree : IP23 / IP44
- ✓ Rotor Pole structure : Cylindrical / Salient

## ● High voltage



- ✓ **Manufacturing Scope : 1000 – 50,000 kVA**
- ✓ **Voltage : 3.3 – 14 kV**
- ✓ **Poles : 4 – 14 poles**
- ✓ **Protection Degree : IP23 / IP44**
- ✓ **Rotor Pole structure : Cylindrical / Salient**

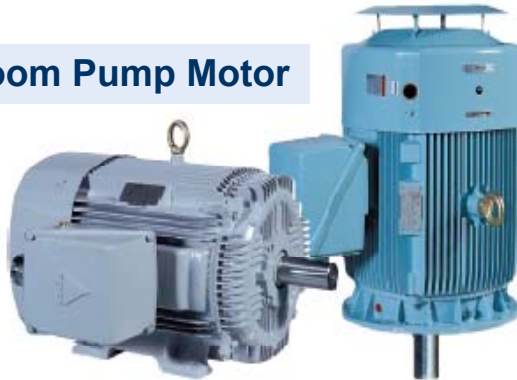
## ● Sales Statistic of Marine-Use Generator



## Marine Motors

Three Phase Induction Motors

Engine Room Pump Motor



Engine Aux. Blower Motor



L.O. Pump Motor



◆ Manufacturing Scope  
0.4 ~ 1,000 kW

◆ Voltage  
220 ~ 690 V

◆ Poles  
2 ~ 10 Pole

◆ Protection Degree  
IP23 / 44

◆ Application

- Engine room pump
- L.O. Pump
- Steering gear
- Oil purifier
- Auxiliary blower for engine



# Applications

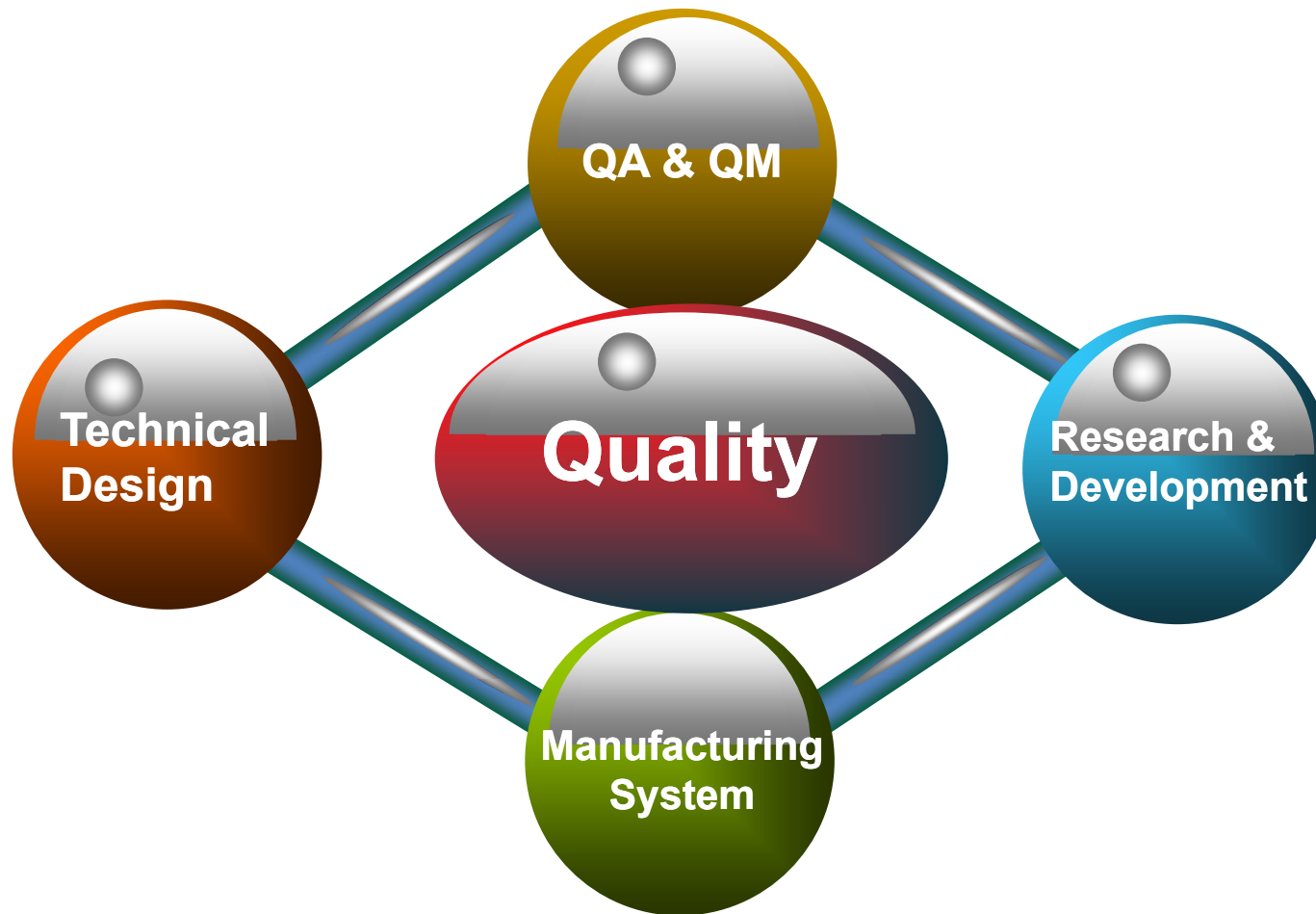
Thruster motor



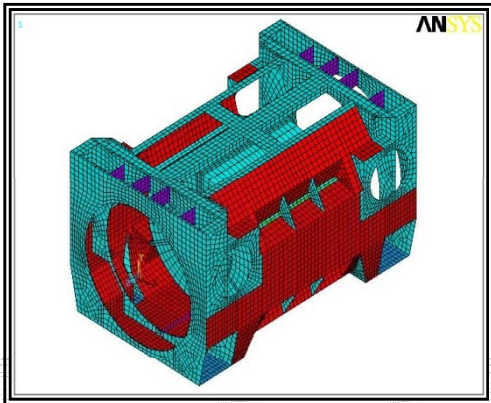
- ◆ **Manufacturing Scope**  
100 ~ 6,000 kW
- ◆ **Voltage**  
220 ~ 690 V
- ◆ **Poles**  
4 ~ 10 Pole
- ◆ **Protection Degree**  
IP23/44
- ◆ **Application**
  - Thruster for Marine Vessel
  - Main Propulsion for Electric propulsion system

### 3. Product Reliability

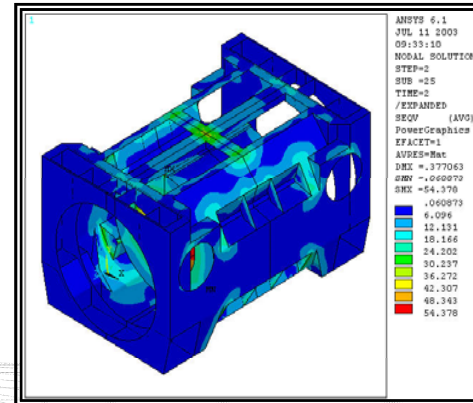
- Reliability of HHI marine-use generator



## Stationary Part Analysis by F.E.M



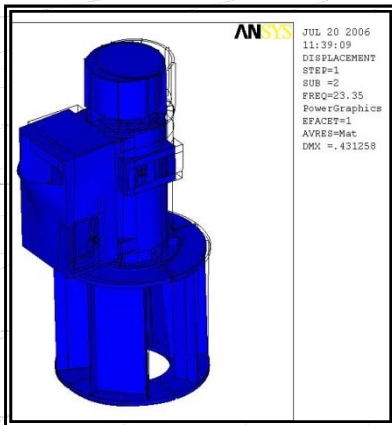
[Finite Element Model]



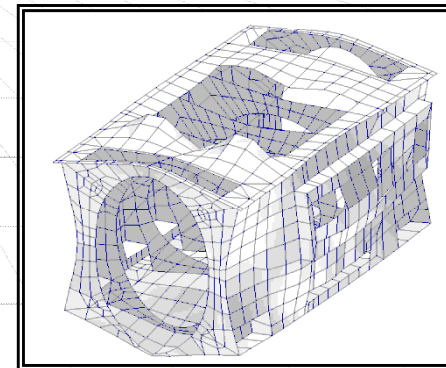
[Equivalent Stress Analysis]

### • Key Factors

- Natural Frequency
- Stress
- Resonance



[Natural Frequency Analysis]

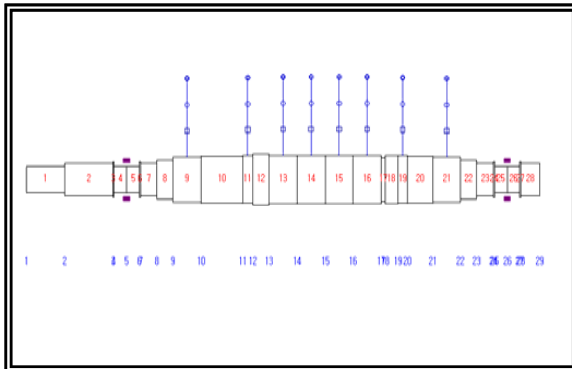


[Mode Shape]

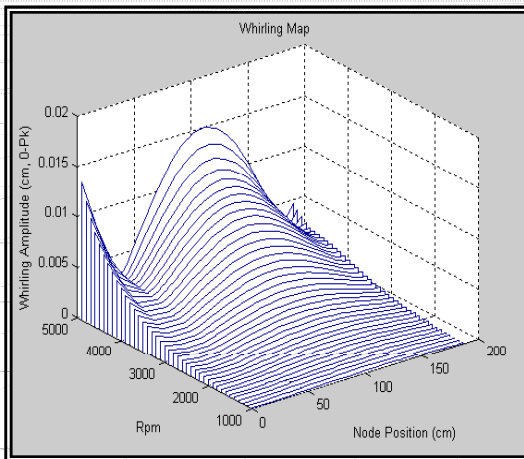
# Rotating Part Design Analysis

## • Key Factors

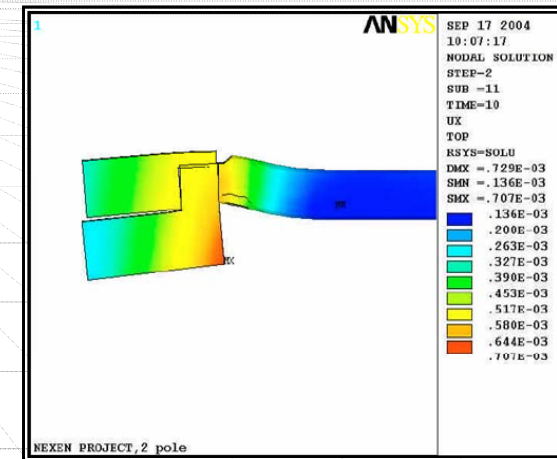
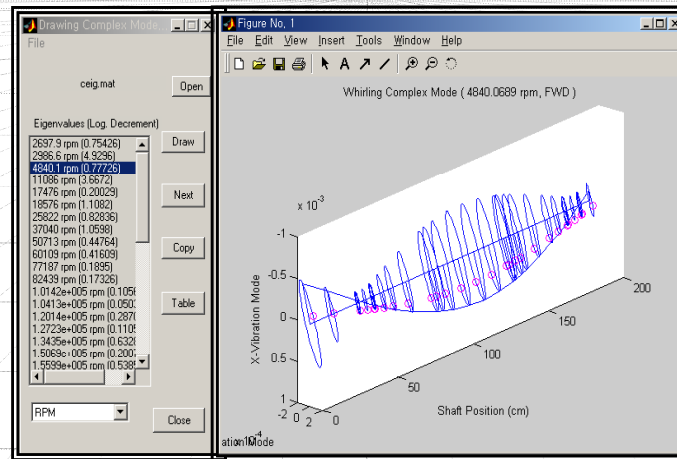
- Magnetic Force
- Minimum Air Gap
- Rotor Critical Speed
- Shaft Deflection
- Stress



[Shaft Design]



[Analysis Results]

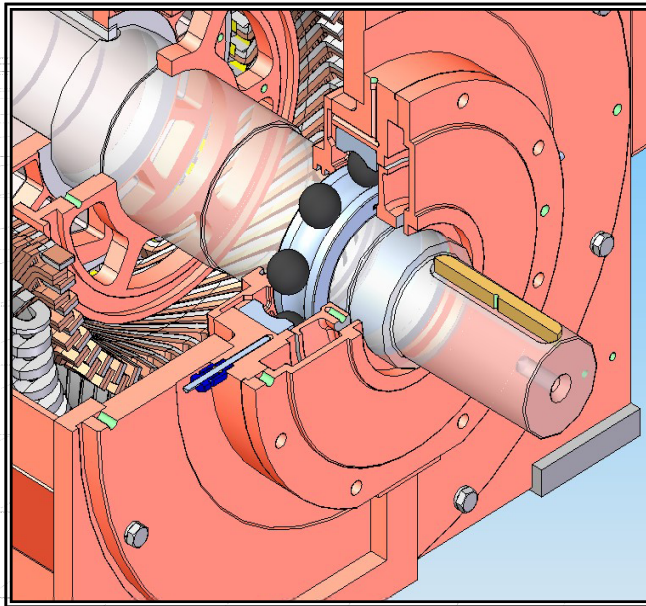


[End Ring Stress Analysis]

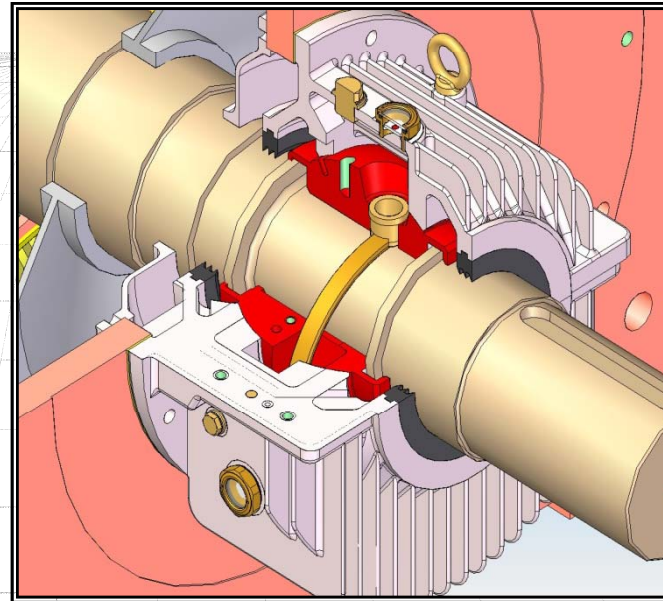


## Reliable Bearing Application

- Low temperature rise & quiet operation
- Easy maintenance allowing dismantling and inspection without disconnecting the motor from driven load.
- Self-aligned oil ring type sleeve bearing application.



[Anti-Friction Bearing]



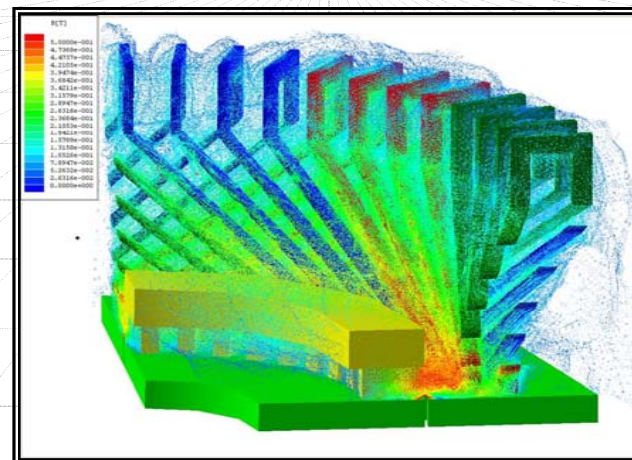
[Sleeve Bearing]

## Proven Up-To-Date Insulation System

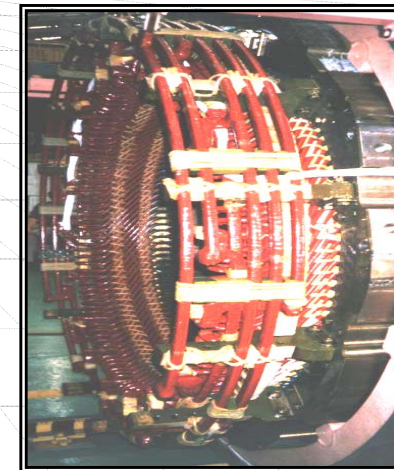
- Over 30 years thermal life time of insulation system & no reduction of insulation properties against thermal shocks and mechanical vibration based on VPI (Vacuum Pressure Impregnation) with mica tape combined with epoxy resin insulation system.
- Enhanced mechanical endurance of winding against inrush current at starting & short circuit condition.
- Anti-corona treatment over than 4kV.



[VPI Insulation System]



[Electromagnetic Force Analysis]



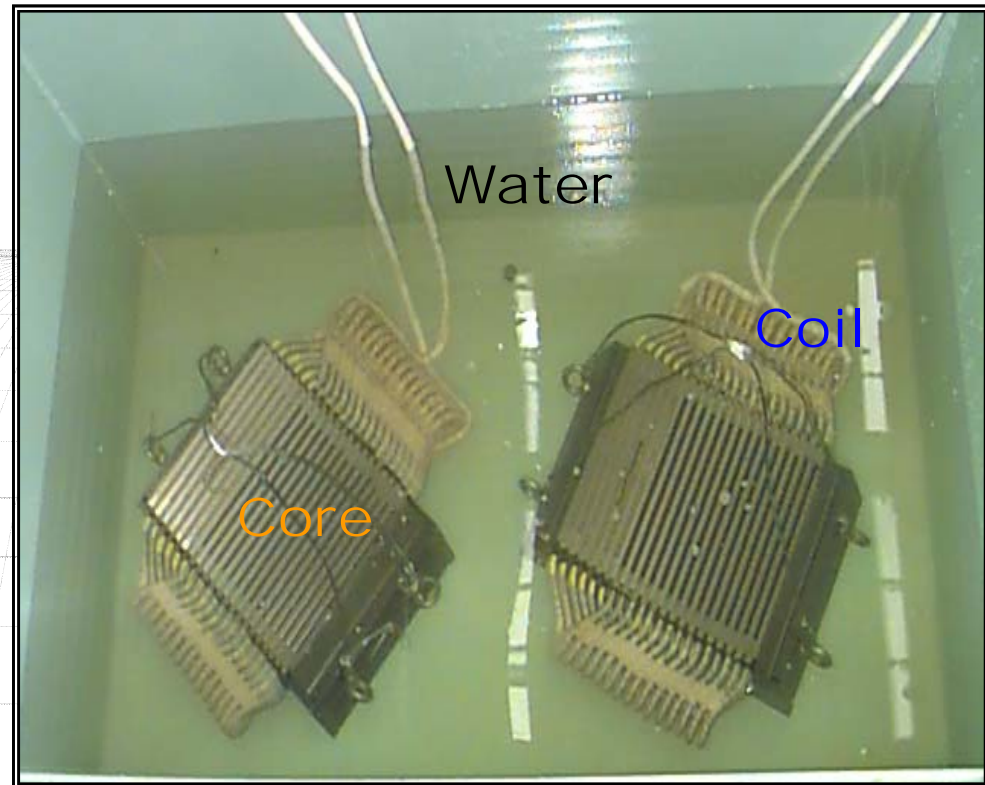
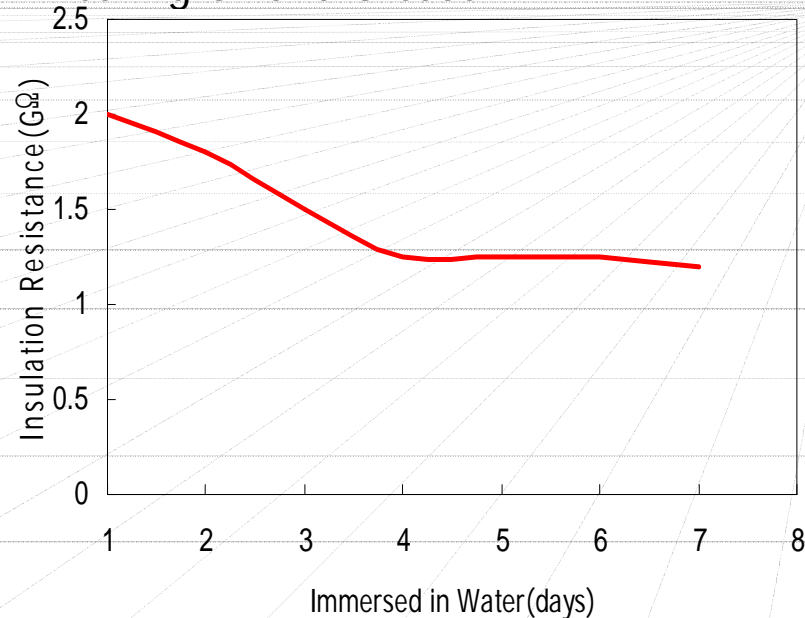
[Reinforced Binding of End Winding]

## Proven Up-To-Date Insulation System

- **Water Immersion** Characteristics meet the NEMA MG1, API 541, IEEE
- Durability against contamination, chemical and oil.

(Compatible with IEC, API, NEMA & IEEE)

- H<sub>2</sub>SO<sub>4</sub> (ACID)
- NaOH (ALKALI)
- NH<sub>4</sub>OH (AMMONIA WATER)
- Bearing Oil and Grease





# Quality Management



- ◆ Own Manual for Quality Assurance
- ◆ Defect-Free Products : 6 Sigma
- ◆ Certified by International standard / classification societies



**ISO 9001, 14001**  
**OHSAS 18001**  
**GOST-R**





## ● LNG CARRIERS



**TSAKOS Group**



TEEKAY CORPORATION



bp



Shell



**NYK LINE**  
 NIPPON YUSEN KAISHA



**KUWAIT OIL TANKER COMPANY S.A.K.**



**Dynacom Tankers Management Ltd.**



Overseas Shipholding Group, Inc.



ناكيلات

- ◆ LNG Carriers
- ◆ Up to 216 km<sup>3</sup>



- ◆ HHI marine-use Generators  
 3,600 kW, 6.6 kV, 60Hz, 720rpm, IP44, 5ST
- ◆ HHI marine-use Motors

## ● LPG CARRIERS



- ◆ LPG Carriers
- ◆ Up to 82 km<sup>3</sup>

- ◆ HHI marine-use Generators  
1,200 kW, 450V, 60Hz, 720rpm, IP44, 3ST
- ◆ HHI marine-use Motors

## ● VLCC



**KUWAIT OIL TANKER COMPANY S.A.K.**



- ◆ VLCC
- ◆ Up to 318K



- ◆ HHI marine-use Generators  
1,200 kW, 450V, 60Hz, 720rpm, IP44, 3ST
- ◆ HHI marine-use Motors



## ● TANKER



- ◆ Tanker
- ◆ Up to 166K



- ◆ HHI marine-use Generators  
980 kW, 450V, 60Hz, 900rpm, IP44, 3ST
- ◆ HHI marine-use Motors



## CONTAINER CARRIERS



- ◆ Container Carriers
- ◆ Up to 11,700 TEU



- ◆ HHI marine-use Generators  
2,500 kW, 6.6 kV, 60Hz, 720 rpm, IP44, 5ST
- ◆ HHI marine-use Motors

## ● BULK CARRIERS



Peter Döhle  
 Schifffahrts-KG



- ◆ LNG Carriers
- ◆ Up to 180K



- ◆ HHI marine-use Generators  
 750 kW, 450V, 60Hz, 720 rpm, IP44, 3ST
- ◆ HHI marine-use Motors

## ● PCC (PURE CAR CARRIERS)



- ◆ PCC
- ◆ Up to 6,500 Units



- ◆ HHI marine-use Generators  
1,180 kW, 450V, 60Hz, 720 rpm, IP44, 3ST
- ◆ HHI marine-use Motors

## ● Drill vessel



**ODEBRECHT**

**TMT**

◆ Drilling ship

◆ HHI marine-use Generators  
8,437KVA, 10P, 11KV, IP44, 6ST / ship



## ● Offshore & Navy vessel



[ FPSO ]



[ Oil Platform ]



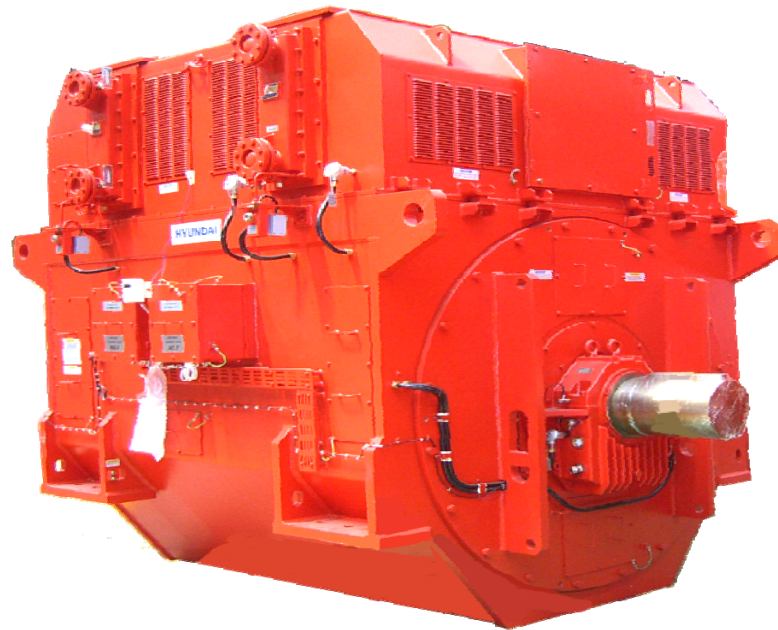
[ Navy ]



[ Ro-Pax Passenger ship ]

# ■ Diesel generator for Electric propulsion vessel

## ● TMT, Taiwan



TMT

◆ LNG Carriers

◆ HHI marine-use Generators  
◆ 11,000/10,000 kW, 6.6 kV, 60Hz,  
14P, 514rpm, IP44, 3/1ST

## ■ Diesel generator for Nuclear power plant

### ● Korea Hydro & Nuclear Power / Shin-Kori 1&2 AAC

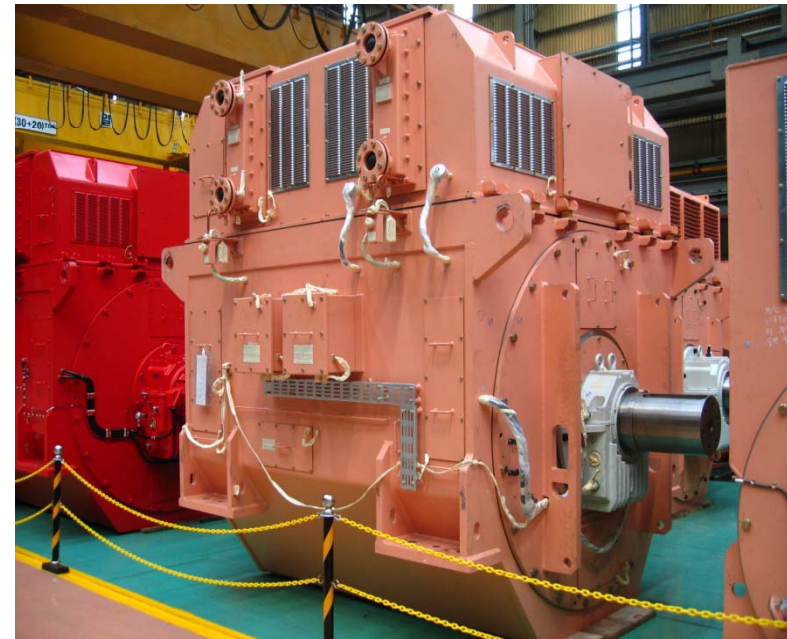
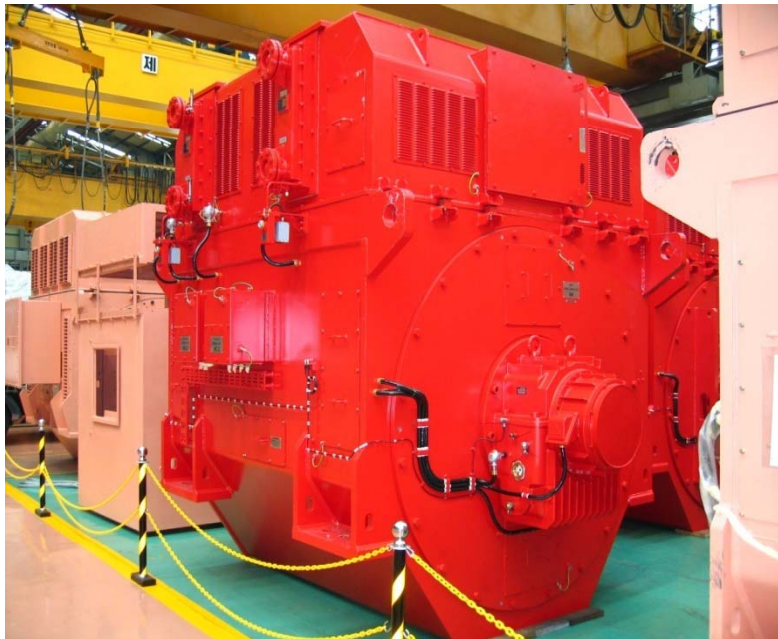


**Synchronous Generator ; 1 set, Del : 2009**  
**3 $\Phi$ , Brushless type, 9,000KVA, 14pole, 60Hz, 4,160V, 514rpm, 0.8 pf, IP23**  
**Dimension & Weight : W4080 x H3590 x L2900, 37.5ton.**



## Diesel generator for Electric propulsion vessel

● **Allsea / Pieter Schelte, Netherland**



**Synchronous Generator ; 8 sets, Del : 2009**  
**3 $\Phi$ , Brushless type, 12,084KVA, 10pole, 60Hz, 11,000V, 720rpm, 0.9 pf, IP44**  
**Dimension & Weight : W3176 x H3180 x L3822, 38ton.**



## Performance Record for LNGC & Drill ship

No.	PROJECT	SPECIFICATION	Q'TY / SHIP	REMARKS
1	DSME / TMT LNGC	18,338KVA, 14P, 6600V, IP44	2	
		6,875KVA, 14P, 6600V, IP44	1	
2	STX / OFFSHORE	7,200KVA, 10P, 11KV, IP44	2	
3	DSME / TRANSOCEAN RIG	8,780KVA, 10P, 11KV, IP44	6	
4	DSME / SEA DRILL RIG	5,885KVA, 10P, 11KV, IP44	8	
5	DSME/250,000 m <sup>3</sup> LNGC	13,625KVA, 14P, 6600V, IP44	2	
		9,125KVA, 14P, 6600V, IP44	2	

## Performance Record for LNGC & Drill ship

No.	PROJECT	SPECIFICATION	Q'TY / SHIP	REMARKS
6	DSME / TMT / DRILL SHIP	8,437KVA, 10P, 11KV, IP44	6	3 ship
7	DSME / ODEBRECHT / DRILL SHIP	8,437KVA, 10P, 11KV, IP44	6	4 ship
8	DSME / PETROSERVE / DRILL SHIP	8,437KVA, 10P, 11KV, IP44	6	1 ship

# 5. Major Customers

Europe

Asia

America



## ● Global A/S Network

### Europe

**HYUNDAI SERVICE CENTER**

Tel :+31 10212 1567  
 Fax :+31 10212 5134  
 Office: Rotterdam, Netherlands

**EFACEC ENERGIA, S.A.**

Tel :+351 229 562 685  
 Fax :+351 229 562 961  
 Office: S. Mamede de Infesta Portugal

**ROTECH ENGINEERING LTD**

Tel :+30 210 4190044  
 Fax :+30 210 4190045  
 Office: Piraeus, Greece

**HYUNDAI TECHNOLOGIES CENTER  
 HUNGARY LTD.**

Tel :+36 1 273 3730  
 Office : Budapest Hermina  
 UT 22, Hungary

**VOGELSANG ELEKTROMOTOREN GmbH (On-going)**

Christian Vogelsang  
 Tel :+49 2327 606 135  
 Office: Mausegatt 13,  
 44866 Bochum, Germany

### Middle East

**WESCO LLC**

Tel :+971 2 555 4436  
 Fax :+971 2 555 3688  
 Office: Abu Dhabi, U.A.E.

### Asia

**SAINI HEAVY ELECTRICAL  
 & ENGINEERING**

Tel :+91 22 2762 2986  
 Fax :+91 22 2762 2976  
 Office: Ghatkopar (W),  
 Mumbai, INDIA

**HHI, Korea**

Ulsan, Head office  
 Tel : +82 52 202 7777  
 Fax: +82 52 202 7770

**SIEMENS INDUSTRIAL  
 WORKSHOP SDN BHD**

Tel :+603 33468000  
 Office: Selanger Durul  
 Ehsan, Malaysia

### America

**Hyundai Ideal Electric Company S.A.**

Charlie Elrod  
 Tel: +1 419 520 3245 Offices:  
 Mansfield, OH, USA

**Madison Industrial Equipment Ltd.**

Mark McRoberts  
 Tel: +1 604 872\*8155  
 Offices: Vancouver, BC, Canada

**RIMES ELECTRO MECANICA CA**

Mario Lanaro  
 Tel : +58 265 6411763  
 Fax: +58 265 6413261  
 Offices: Ciudad Ojeda, Zulia, Venezuela

**EECOL ELECTRIC ARGENTINA S.A.**

Ing. R. Caston Cadile  
 Tel: +54 0261 431 7404  
 Offices: Mendoza, Argentina

**EECOL ELECTRIC CHILE**

Jaime Sanhueza B.  
 Tel: +56 2 620 4226  
 Offices: Conchali, Santiago, Chile