

# Tidal Current Power Development in Korea

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# I. Background

## ❖ Ocean Energy Resources in Korea

- Ocean energy resources are abundant in Korea
- Korea is recognized as one of the most appropriate places for harnessing ocean energy
- Estimated ocean energy resources in Korea :

| Tidal Barrage | Tidal Current | Wave Energy |
|---------------|---------------|-------------|
| 6,500MW       | 1,000MW       | 6,500MW     |



## ❖ **Necessities & Objectives**

- **Development of Basic Technology for Commercialization of Ocean Energy**
- **Development of Environment Friendly Tidal Current Power Generation System for Commercialization - Preparation of ESSD Model of Coastal Zone**
- **Contribution to Expansion of National Green Growth Engine**
- **Contribution to International Society by Technological Support for Mitigation of Climate Change**

## II. R&D Projects

### ❖ National RD&D&D Project

#### ❖ 1st Phase R&D Project Period : 2001 – 2005 (5 years)

- Purpose : Development of System Engineering Technology for Tidal Current Power Generation System
- Funded by Ministry of Land, Transport and Maritime Affairs (MLTM)

#### ❖ 2<sup>nd</sup> Phase R&D Project Period : 2006 – 2010 (5 years)

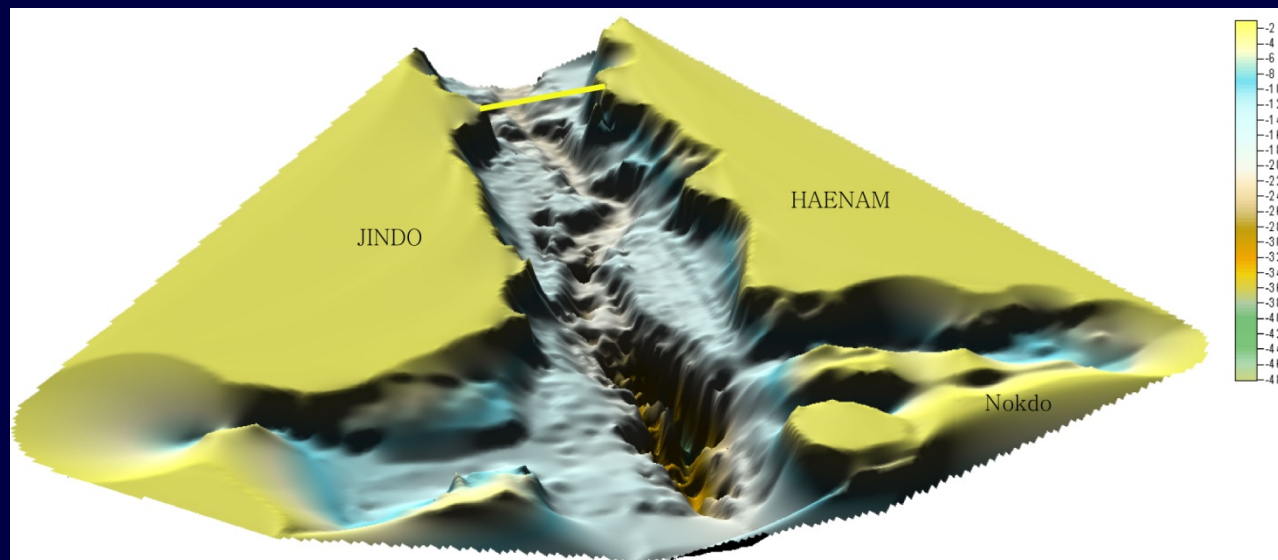
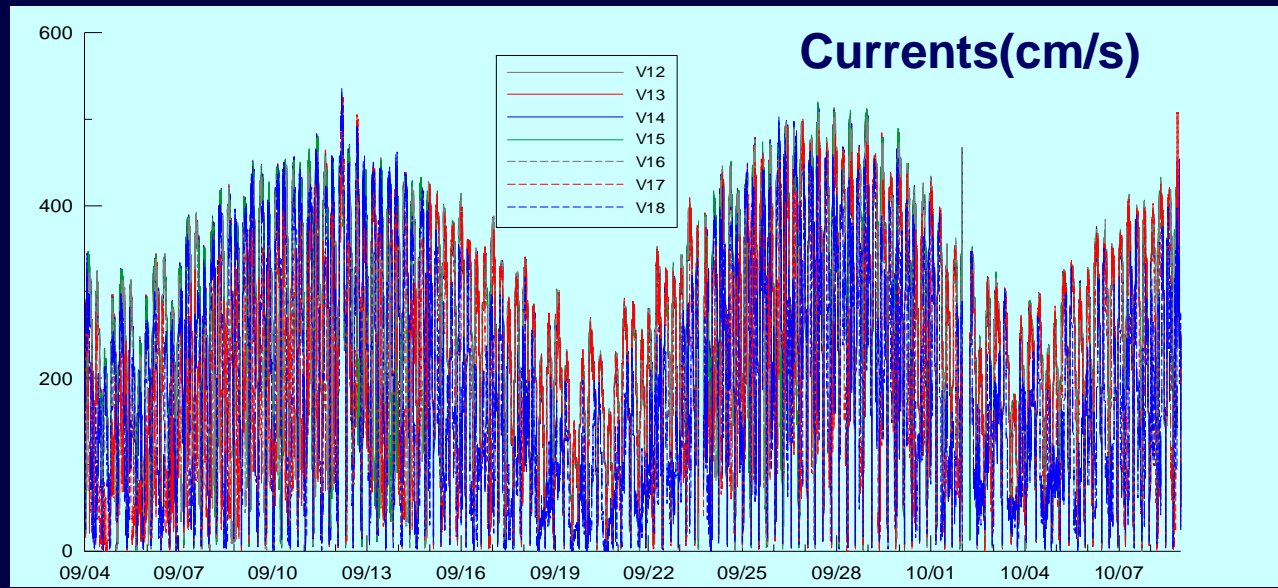
- Purpose :
  - + Development of Tidal Current Power System for Commercialization
  - + Construction & Operation of Tidal Current Power Pilot Plant
- Funded by Ministry of Land, Transport and Maritime Affairs (MLTM)
- Project Partners : Korea East West Power Co. Ltd.

## ➤ Project Contents

| Phase I-1<br>Design & Implementation  |      | Phase I-2<br>Modeling & Analysis   |      | Phase I-3<br>Development  |
|---|------|--|------|---|
| 2001  | 2002 | 2003   | 2004 | 2005  |
| <ul style="list-style-type: none"> <li>• Project planning and Initiation</li> <li>• Tidal Current Energy Conversion Technology Design</li> <li>• Field Measurement &amp; Analysis</li> <li>• Basic Design &amp; Deployment of 10kW Experimental Power Conversion Unit</li> </ul>          |      | <ul style="list-style-type: none"> <li>• Field Measurement &amp; Analysis</li> <li>• Hydrodynamic Modeling on Tidal Regime Change</li> <li>• Analysis of Environmental Change</li> <li>• Development of Power Converter</li> <li>• Design of Turbine using CFD</li> <li>• Design of 1MW Pilot Station</li> </ul> |      | <ul style="list-style-type: none"> <li>• Starting Pilot Plant Construction</li> <li>• Development of Current Power Conversion System Engineering</li> <li>• Development of 500kW Power Converter</li> <li>• Analysis of Performance Characteristics of 500kW Turbine</li> </ul> |
| Phase II-1<br>Full-Scale Demo   |      | Phase II-2<br>Full-Scale Demo  |      | Phase II-3<br>Pre-Commercial  |
| 2006  | 2007 | 2008   | 2009 | 2010  |
| <ul style="list-style-type: none"> <li>• Development &amp; Design of Structure Health Monitoring System</li> <li>• Re-Location of Pilot Plant and Re-design &amp; Re-fabrication of Support Structure due to Accidents during Transport</li> <li>• CFD Modeling of Pilot Plant</li> </ul> |      | <ul style="list-style-type: none"> <li>• Completion of Pilot Plant Construction</li> <li>• Set-up of Monitoring Instruments</li> <li>• In-situ Experiment &amp; Operation</li> <li>• Basic Design of Uldolmok Commercial Plant &amp; Feasibility Study</li> </ul>  |      | <ul style="list-style-type: none"> <li>• Basic Design of Uldolmok Commercial Plant &amp; Feasibility Study</li> <li>• Field Measurement at other Sites</li> <li>• Development of Commercial Tidal Current Power System</li> <li>• Reporting</li> </ul>                          |

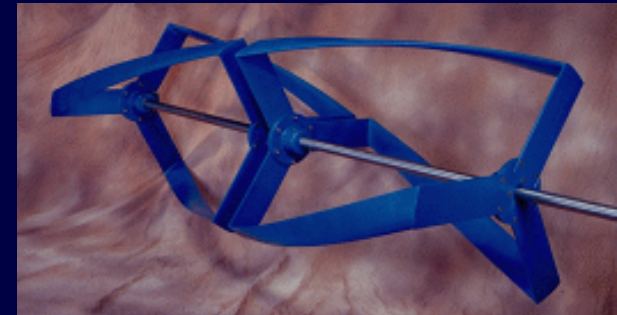
# ➤ Field Measurements in 2002 & 2003







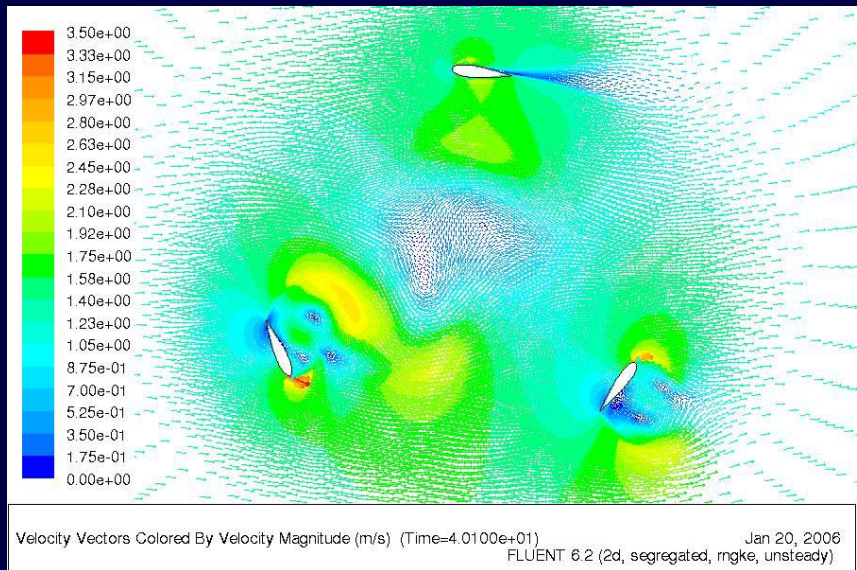
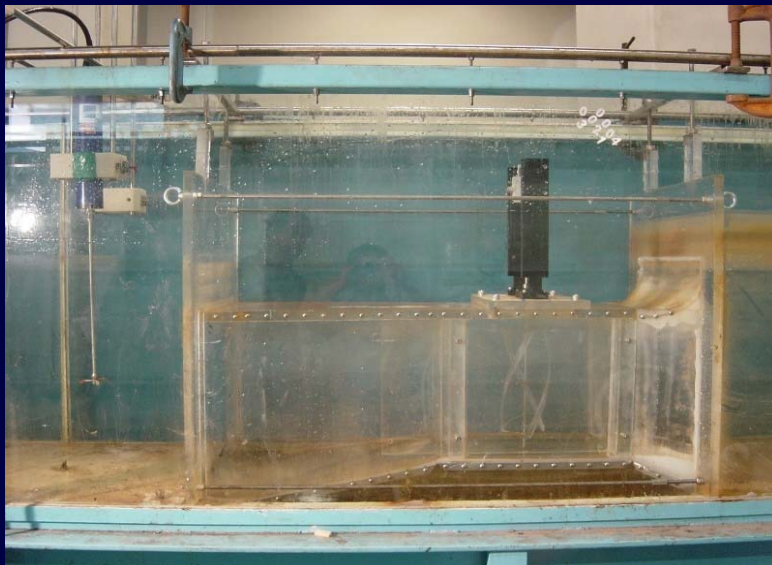
# ➤ Helical Turbine



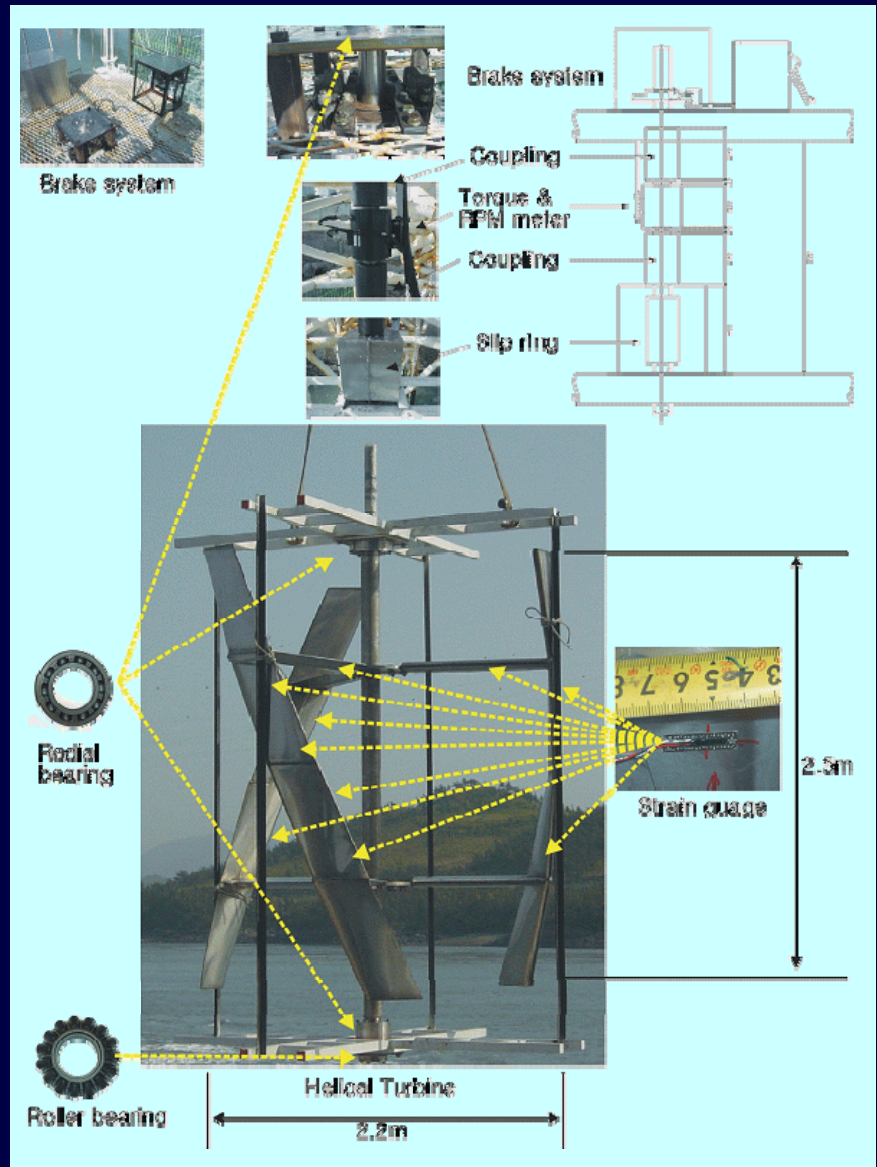
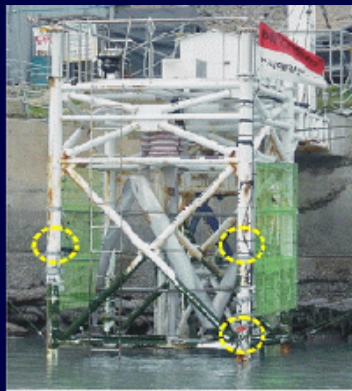
Helical  
Turbine

Lab.  
Experiment

Numerical  
Analysis



# ➤ Field Experiment



# III. Uldolmok Tidal Current Power Pilot Plant

- ✓ Construction of 1MW Uldolmok tidal current power pilot plant
  - Completion : 2009. 5.
  - Field verification tests for tidal current power generation system is in progress
- ✓ Technique of electricity quality improvement
- ✓ Smart monitoring system for plant structure

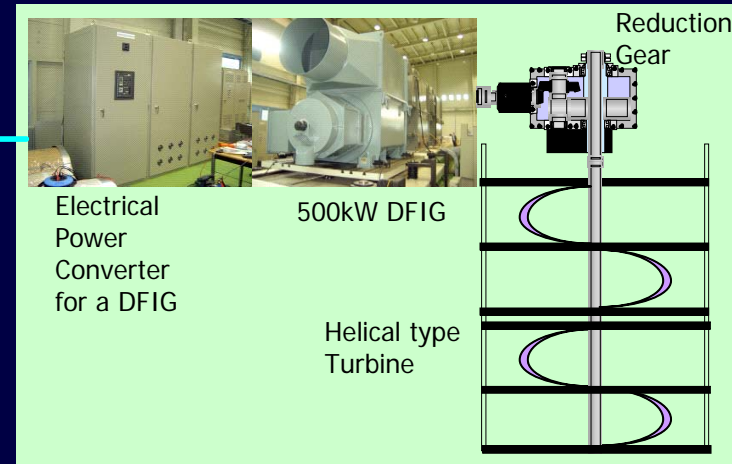
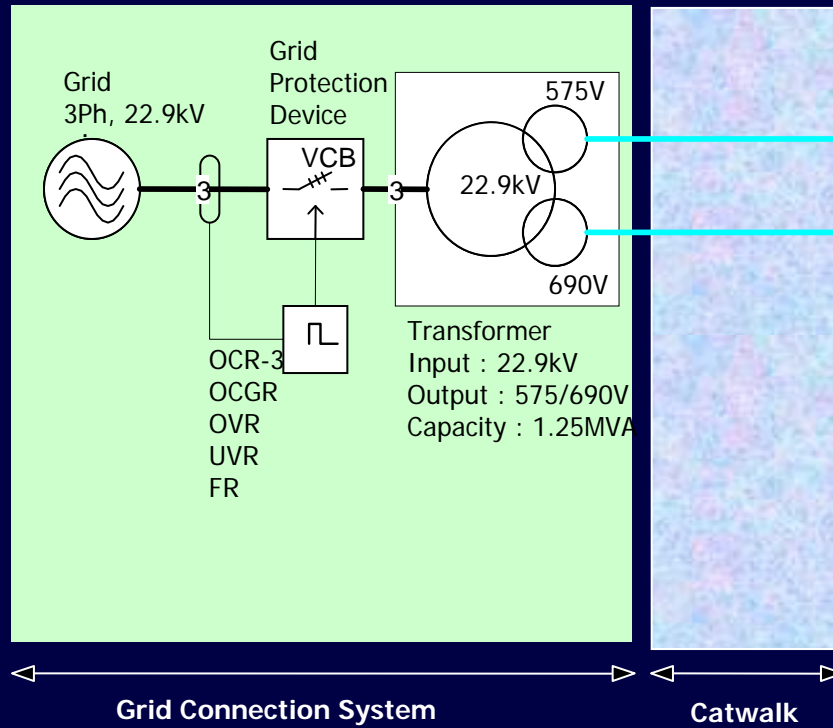


600kW Doubly-fed Induction Generator

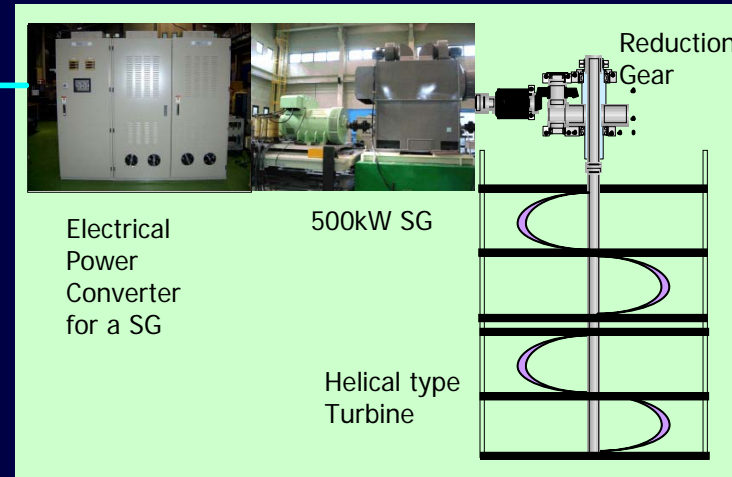


600kW Synchronous Generator

# ❖ Concept of Uldolmok Pilot Plant



Tidal current power plant with a 500kW DFIG

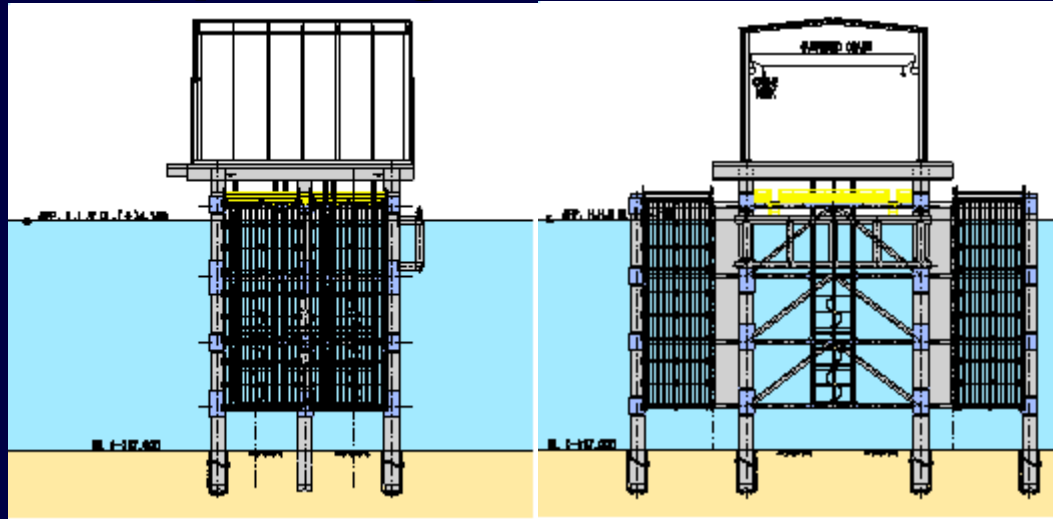


Tidal current power plant with a 500kW SG

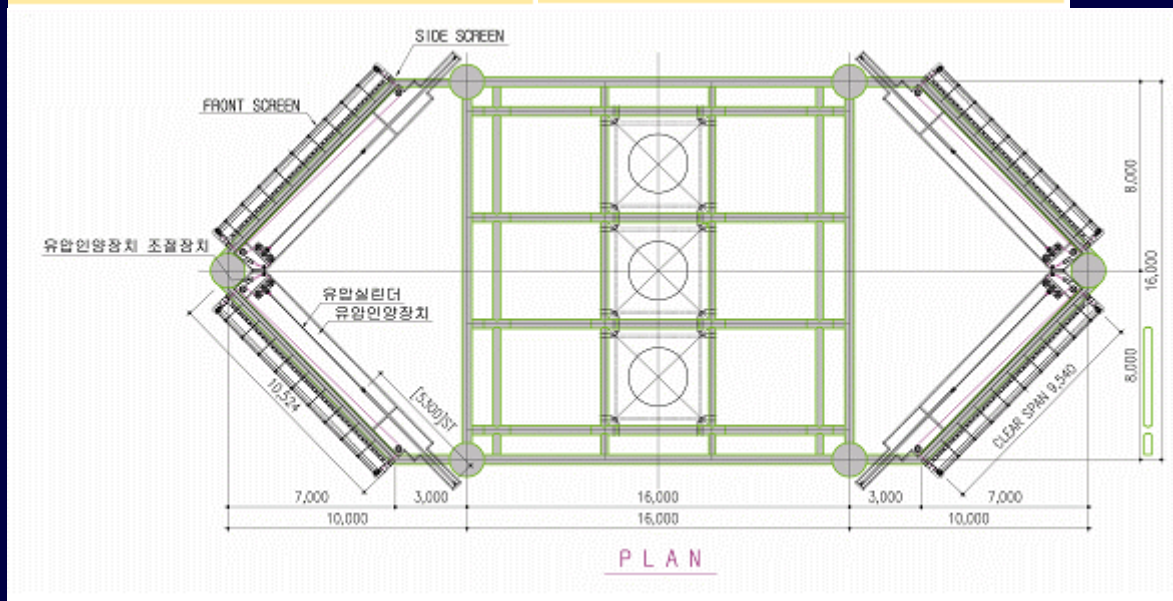
Tidal Current Power Generation System

DFIG : Doubly-fed Induction Generator  
 SG : Synchronous Generator

## ➤ Supporting Structure of Pilot TCPP



- Dimension
  - 16.0m × 36.0m × 48.0m
- Weight
  - Jacket : 790 ton
  - Deck : 100 ton
  - House : 130 ton
  - Catwalk : 112 ton

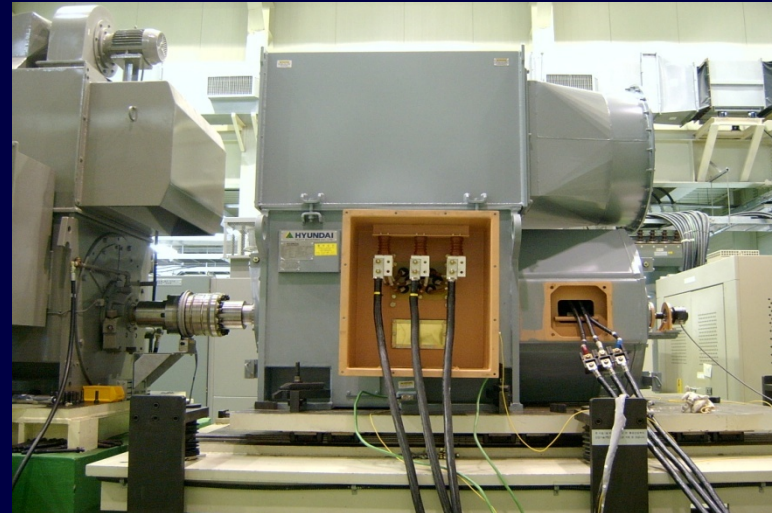


## ➤ Supporting Structure





Synchronous Generator



Doubly-fed Induction Generator



Cage Supporter



Bearing Spider

- Installation of Supporting Structure at 26-27 May, 2008



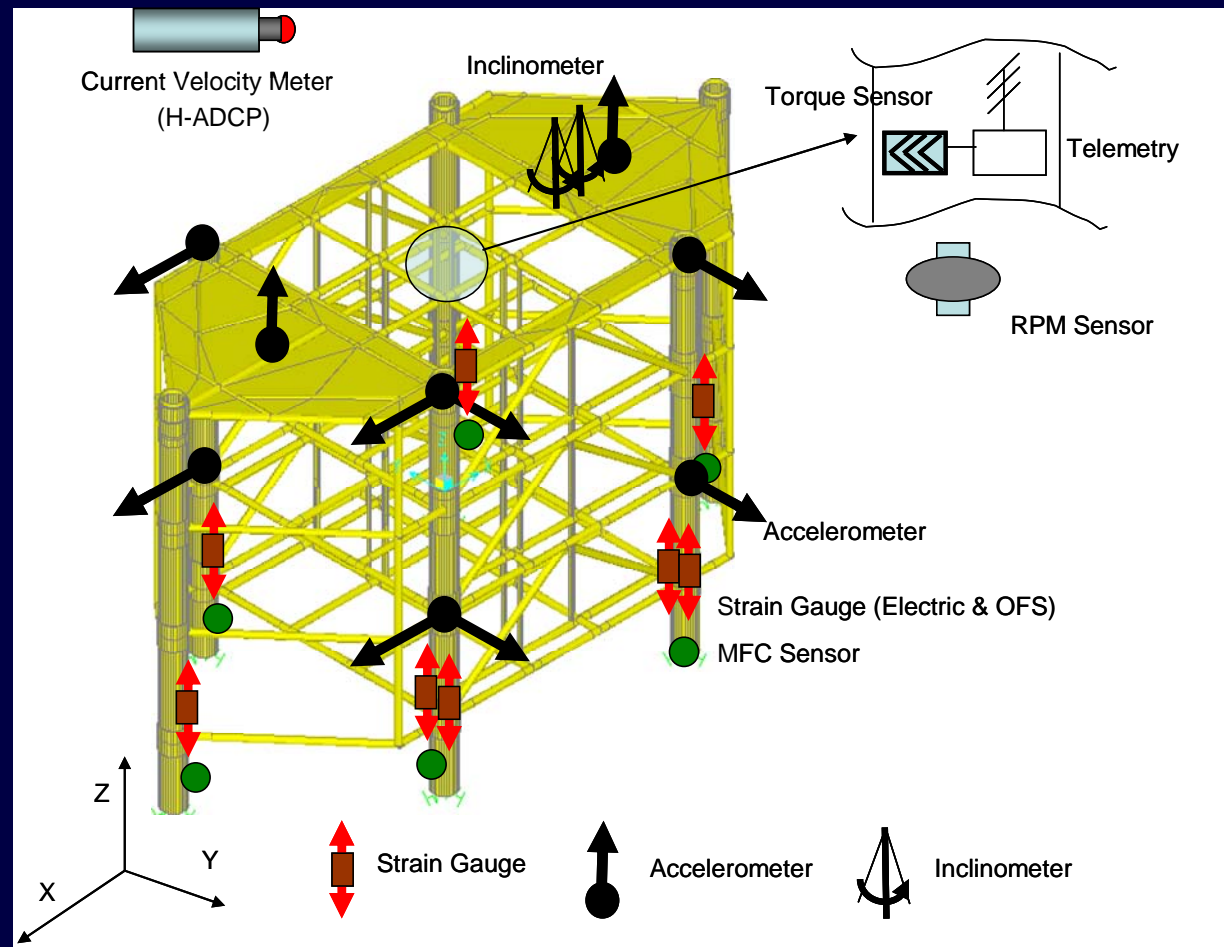


# ❖ Completion of Uldolmok TCPP in May 2009



# ➤ Structural Health Monitoring System

| Measurement Type     | Number of Sensors    |
|----------------------|----------------------|
| Acceleration         | 10EA (X-4, Y-4, Z-2) |
| Strain               | 8EA                  |
|                      | 10EA                 |
| Incline              | 2EA (Rx, Ry)         |
| Torque               | 4EA (2EA/Axis)       |
| RPM                  | 2EA (1EA/Axis)       |
| Impedance            | 6EA                  |
| Temperature          | 2EA (Air/Water)      |
| Current Speed        | 1EA (H-ADCP)         |
| No. of Total Sensors | 45 EA                |



## IV. Future RD&D&D Plan

### ➤ Mid-Term RD&D&D Plan for Tidal Current Power Development (2011 – 2015)

- ✓ Basic Design of Commercial Plant at Jangjuk channel and Feasibility Study
- ✓ Development of Floating Type Supporting Structure
- ✓ Development of Various Horizontal Axis Turbine
- ✓ Design and Operation of Environmental Monitoring System
- ✓ Analysis of Environmental Impact
- ✓ Standardization of Tidal Current Power System and Dissemination

# Thank you

