

Tidal and Tidal Current Power Study in Korea

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KORDI**

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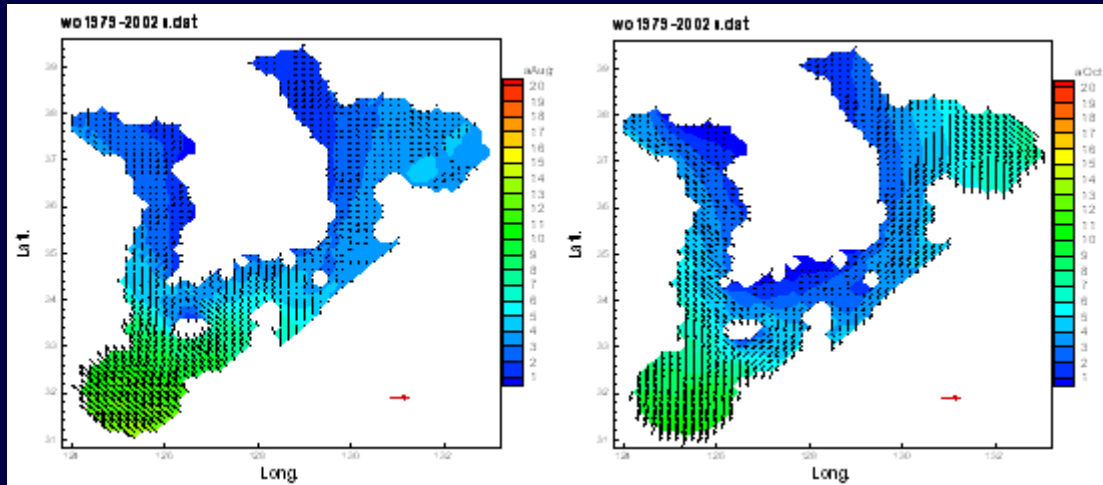
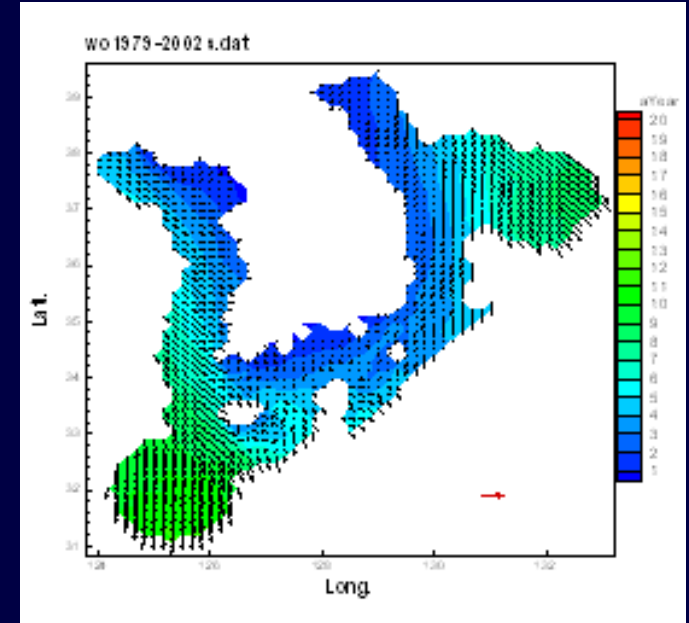
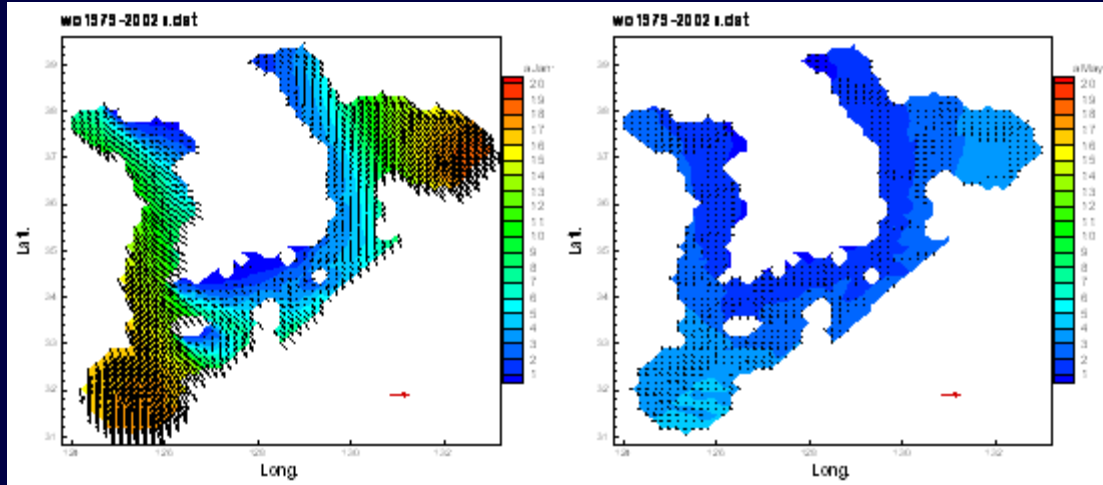
I. Background

- Western and Southern coasts of Korea are well known for high tides and strong tidal current.
 - Western coast : Tidal Power (**Siwha, Garolim, Incheon**)
 - Southern coast : Tidal Current Power (**Uldolmok**)
- Estimated wave energy resources along Korean coast is about 650MW
- Since 2000, KORDI has been focusing on developing technology **for practical application**
 - Tidal Energy (Barrage)
 - Tidal Current Energy (1MW Pilot Plant)
 - Wave Energy (500kW OWC Pilot Plant)

- Tidal Power : 2,400MW
- Tidal Current Power :
500MW



➤ Wave Energy Density in Korean Coastal Waters(650MW)



- ◆ NW (Winter)
- ◆ SE (Summer)
- ◆ Annual mean :
2~12kW/m

II. Research Projects

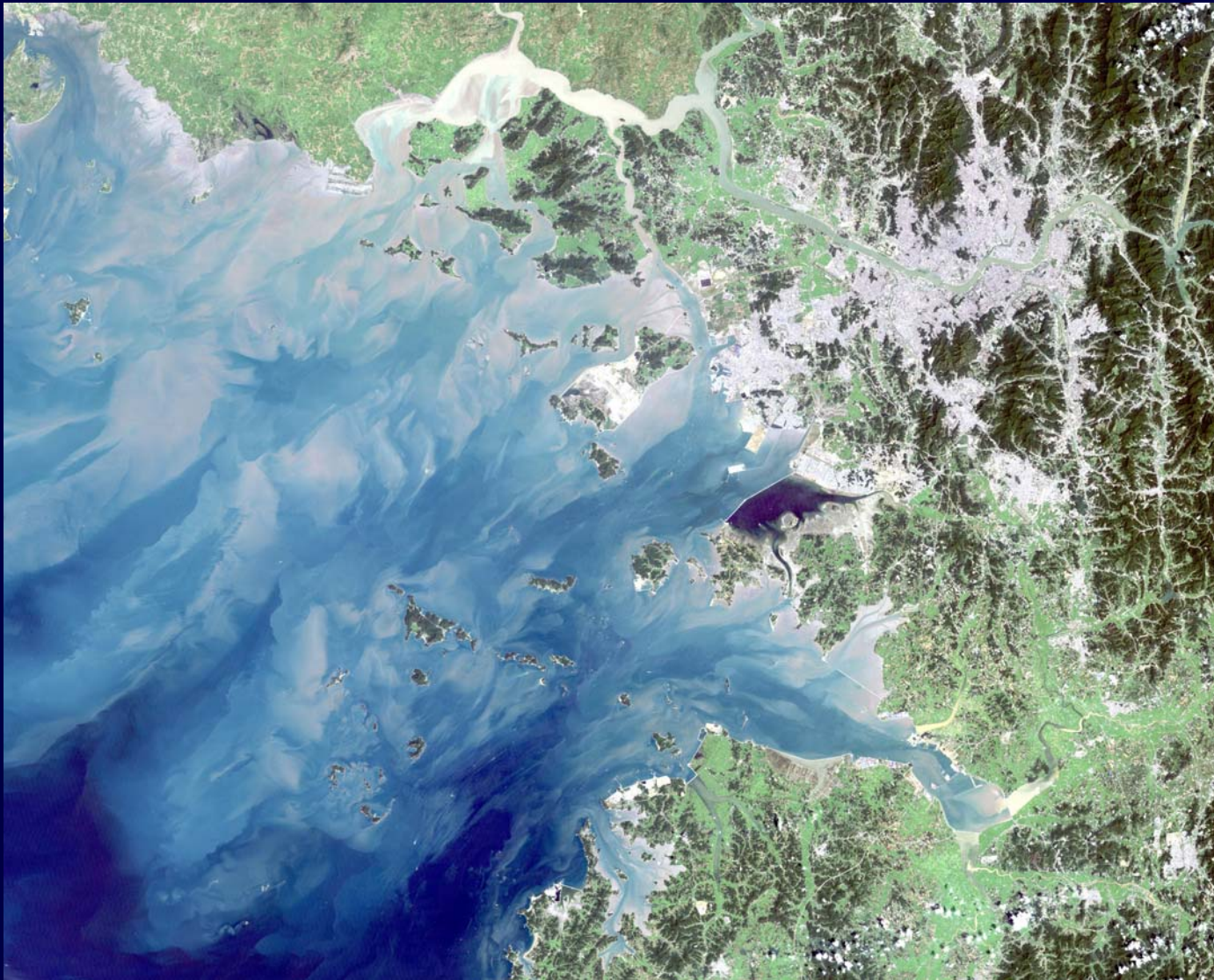
- **Study for the Development of Ocean Energy in Korea**
 - **Phase I : 2000-2005 (13.5M\$)**
 - **Tidal Power : Shiwha & Garolim (1.1M\$)**
 - **Tidal Current Power : Uldolmok (10.6M\$)**
 - **Wave Energy (1.8M\$)**
 - **Phase II : 2006-2010 (34.8M\$)**
 - **Tidal Power : Incheon (9.6M\$)**
 - **Tidal Current Power : Uldolmok & Others (14.2M\$)**
 - **Wave Energy : Jeju (11.0M\$)**
 - **Ministry of Maritime Affairs and Fisheries (MOMAF)**

- **Feasibility Study of Garolim Tidal Power Plant**
 - 2005. 12 – 2007. 1 (1.2M\$)
 - Korea Western Power Co. Ltd.
- **Estimation of Tidal Energy Resources in Korea**
 - 2004. 6 – 2006. 5 (0.5M\$)
 - Ministry of Commerce, Industry and Energy (MOCIE)
- **Design of Sluice Structure for Tidal Power Plant**
 - 2005. 12 – 2007. 12 (0.7M\$)
 - Ministry of Commerce, Industry and Energy (MOCIE)
- **Others**

III. Tidal Power Projects

III-1. Sihwa Tidal Power Plant

- Tidal Barrage of 12.7km had been completed in 1994
 - To get fresh water and reclamation
 - Lake water was polluted by sewage and wastewater
 - Tidal Power Plant was proposed as a counter measure in 1997 (KORDI)
 - Basic Plan of Sihwa Tidal Power Plant was carried out in 2000 (KORDI)
- Freshwater Lake was given up in 2001
- Feasibility Study in 2002 (KORDI / KOWACO)

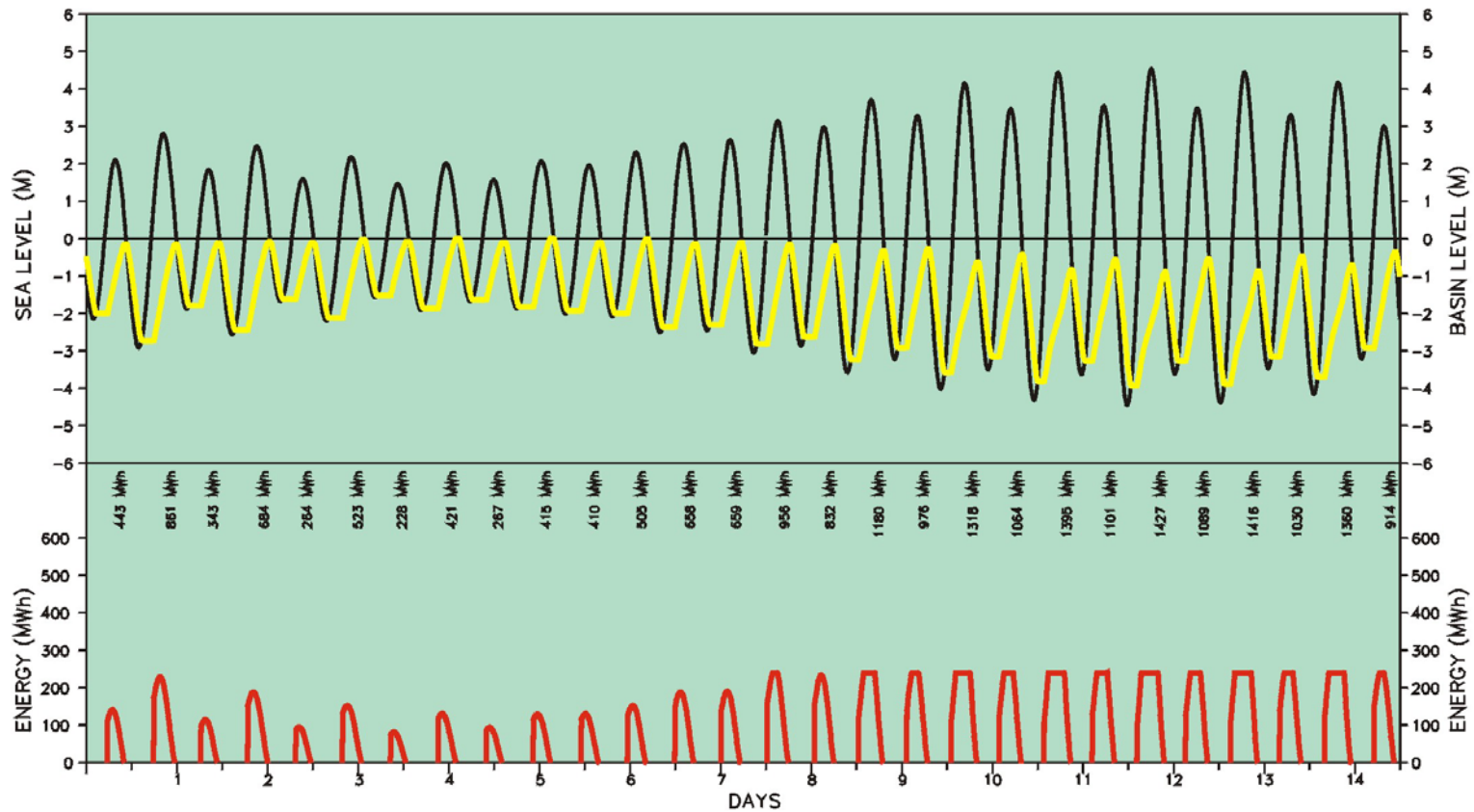


- **Purpose**
 - Power generation
 - Improve water quality inside the lake
- **Mean Tidal Range : 5.6m**
- **Spring Tidal Range : 7.8m**
- **Basin Area : 43km²**
- **Generation Method : One-way during flood tide (BWL should be under -1.0m MSL)**
- **Installed Capacity : 250MW (Horizontal Axial Bulb Unit)**
- **Estimated Annual Output : 553 GWh**
- **Construction Cost : 350M\$ (1,300\$/kW)**
- **Completion : 2009**

SITE : SHIWHA

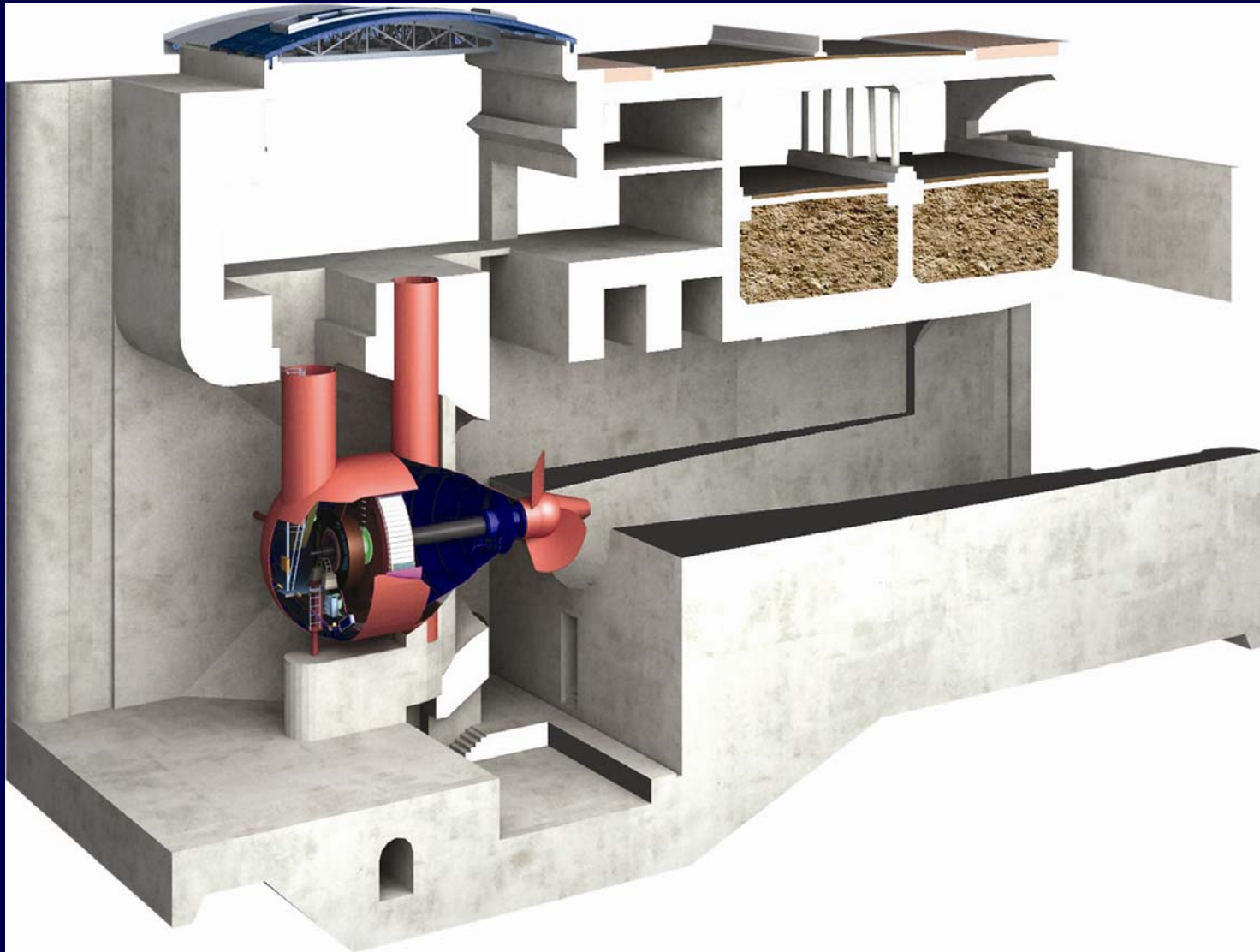
NO. OF TURBINES = 12 NO. OF SLUICES = 4

ENERGY GENERATED : 22738 MWh



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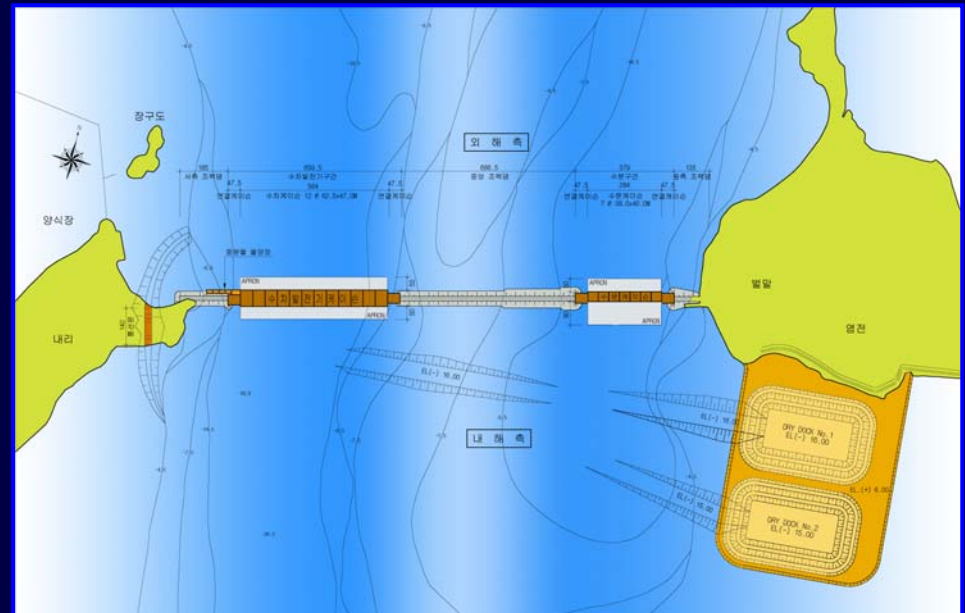


III-2. Garolim Tidal Power Project

- Korea Tidal Power Study 1978 (Shawinigan, Canada)
 - Dealing with 10 sites on the west coast
 - Garolim was proposed as the 1st place
- Feasibility Study (1980-1981 / Sogreah)
- Revisit to Garolim Bay (1985-1986 / EPD, U.K.)
- Feasibility Study (1992-1993 / CSTC, China)
- Feasibility Study (2005.12-2007. 1)



- Mean Tidal Range : 4.7m
- Spring Tidal Range : 6.6m
- Barrage Length : 2.0km
- Basin Area : 45.5km²

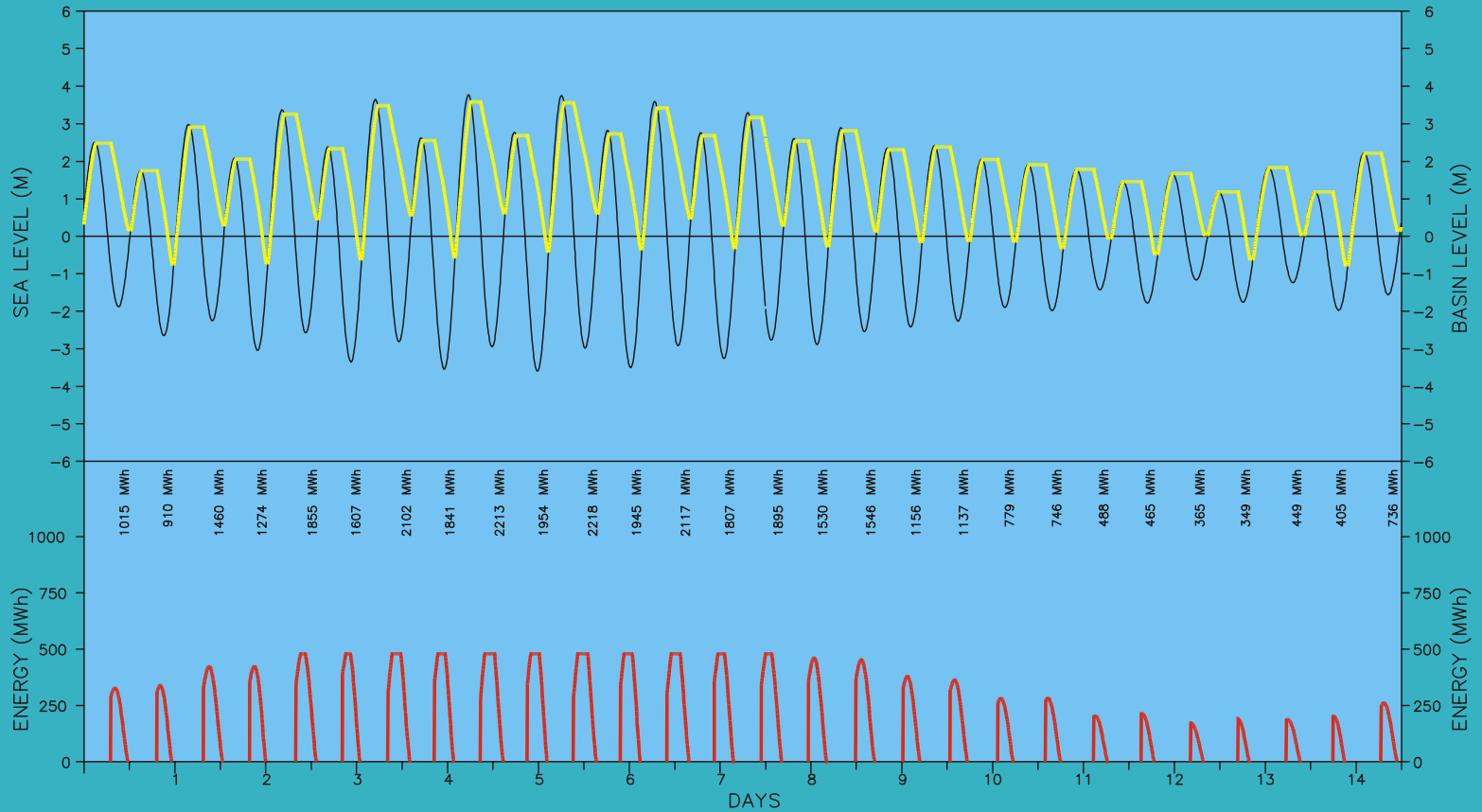


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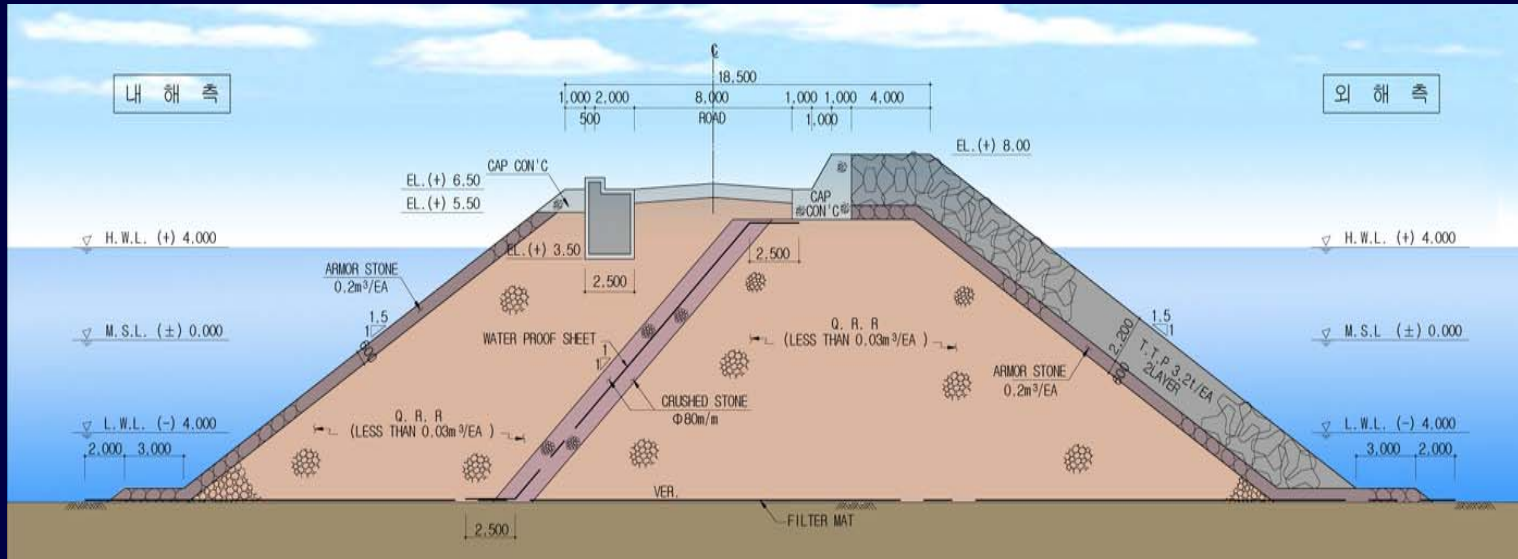
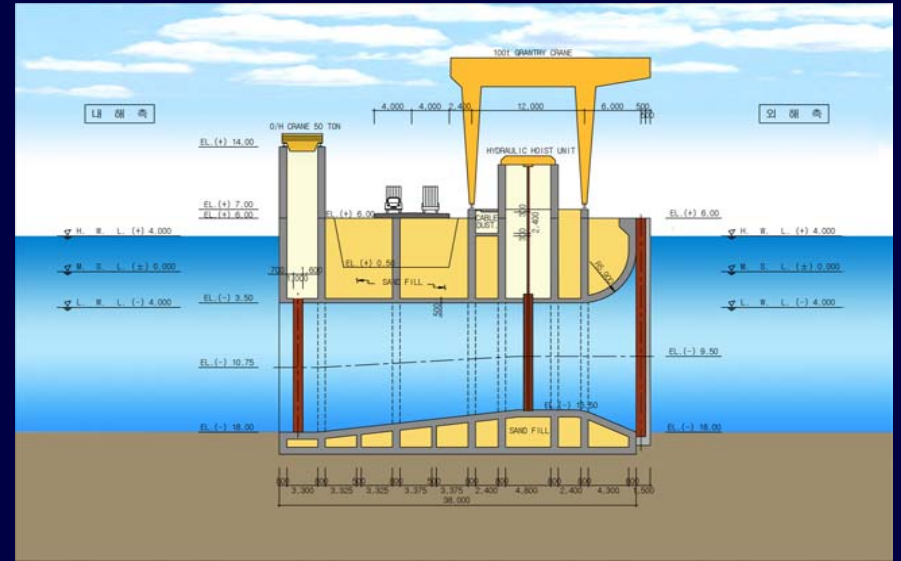
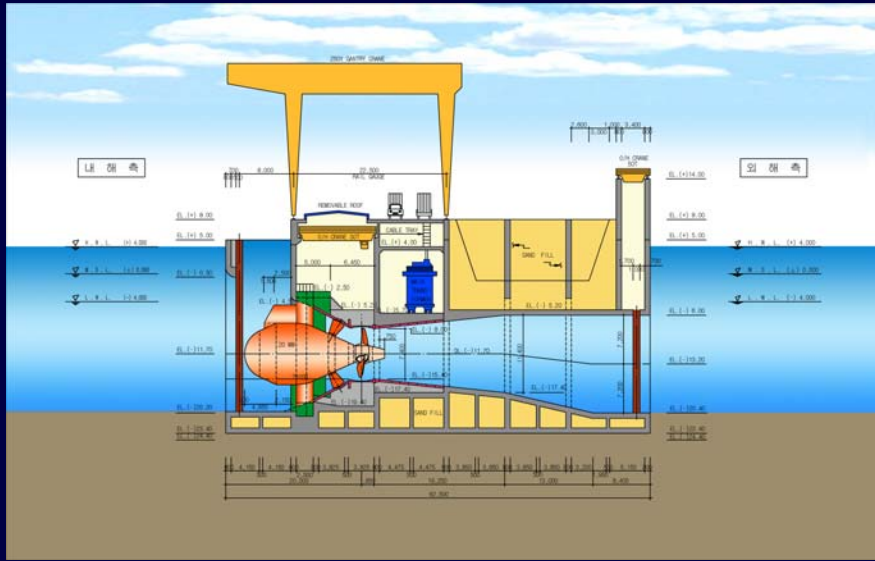
SITE : Garolim

NO. OF TURBINES = 24 NO. OF SLUICES = 14

ENERGY GENERATED : 36366 MWh



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- **Generation Method : One-way during ebb tide**
- **Installed Capacity : 480MW (Horizontal Axial Bulb / Pit Unit with step-up Gear)**
- **Estimated Annual Output : 880 GWh**
- **Construction Cost : 1,000M\$ (2,100\$/kW)**
- **Detailed Design for Construction : 2007**
- **Construction will be started at 2007**
- **Completion : 2012**

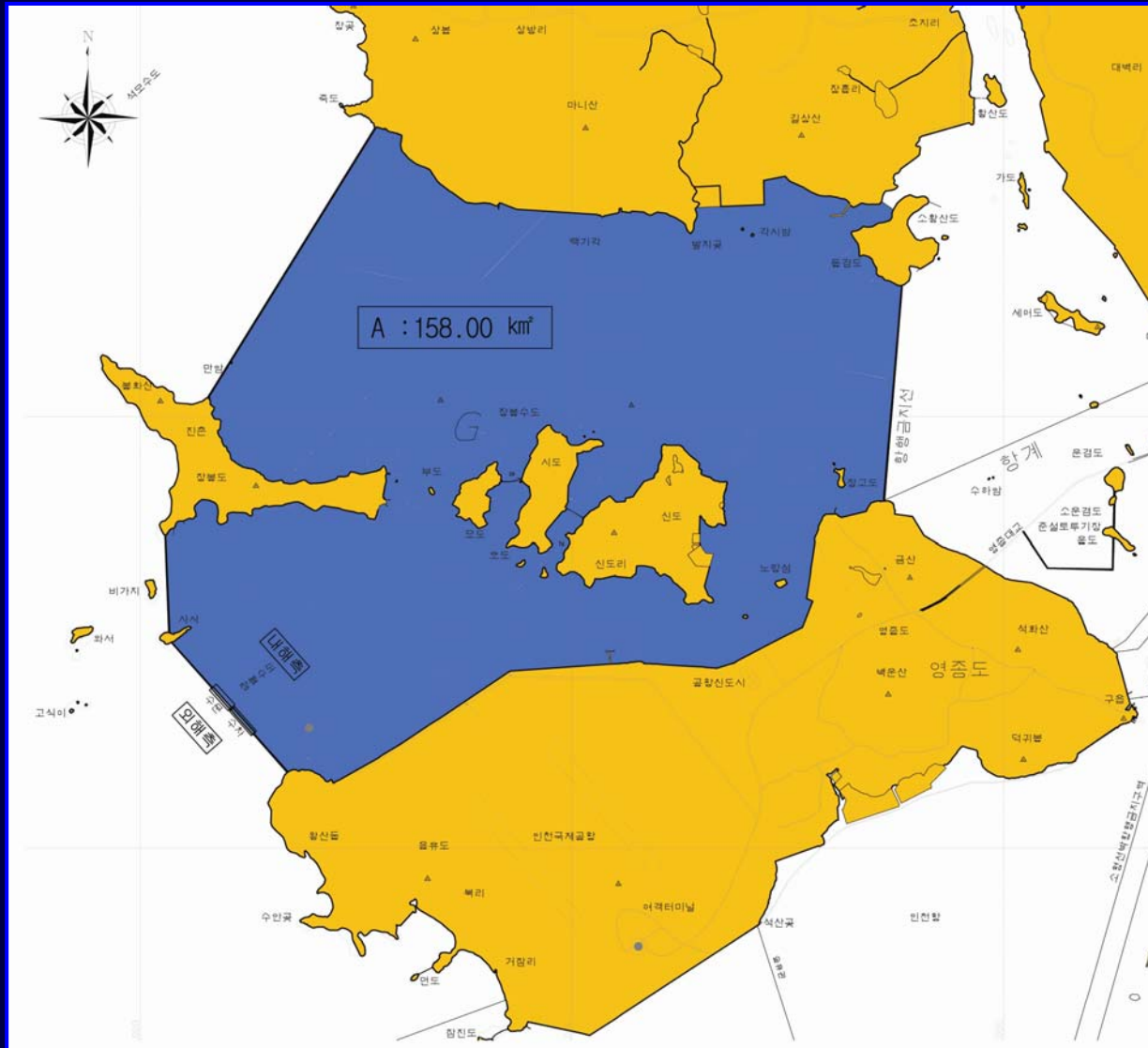


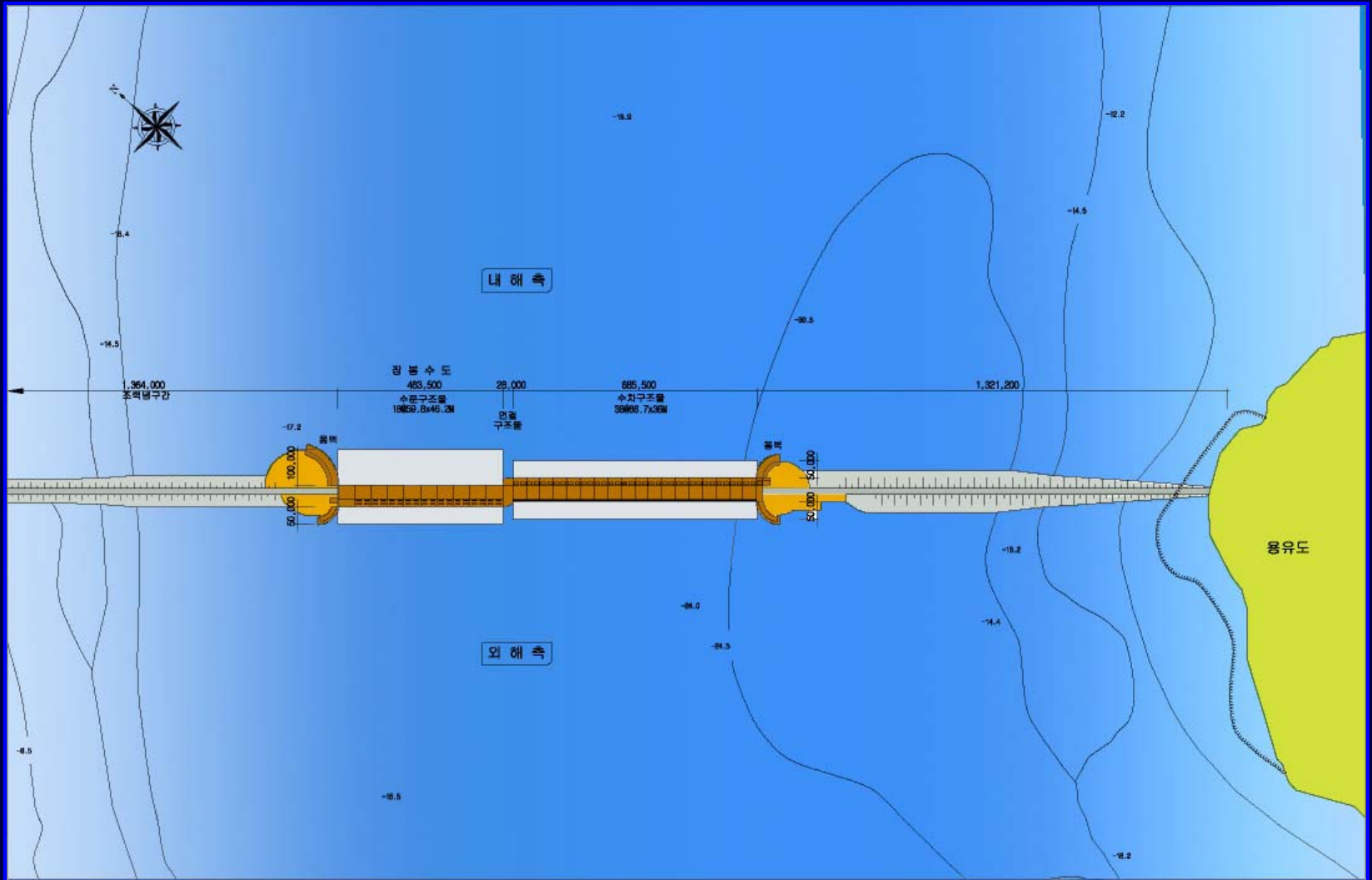
III-3. Incheon Tidal Power Project

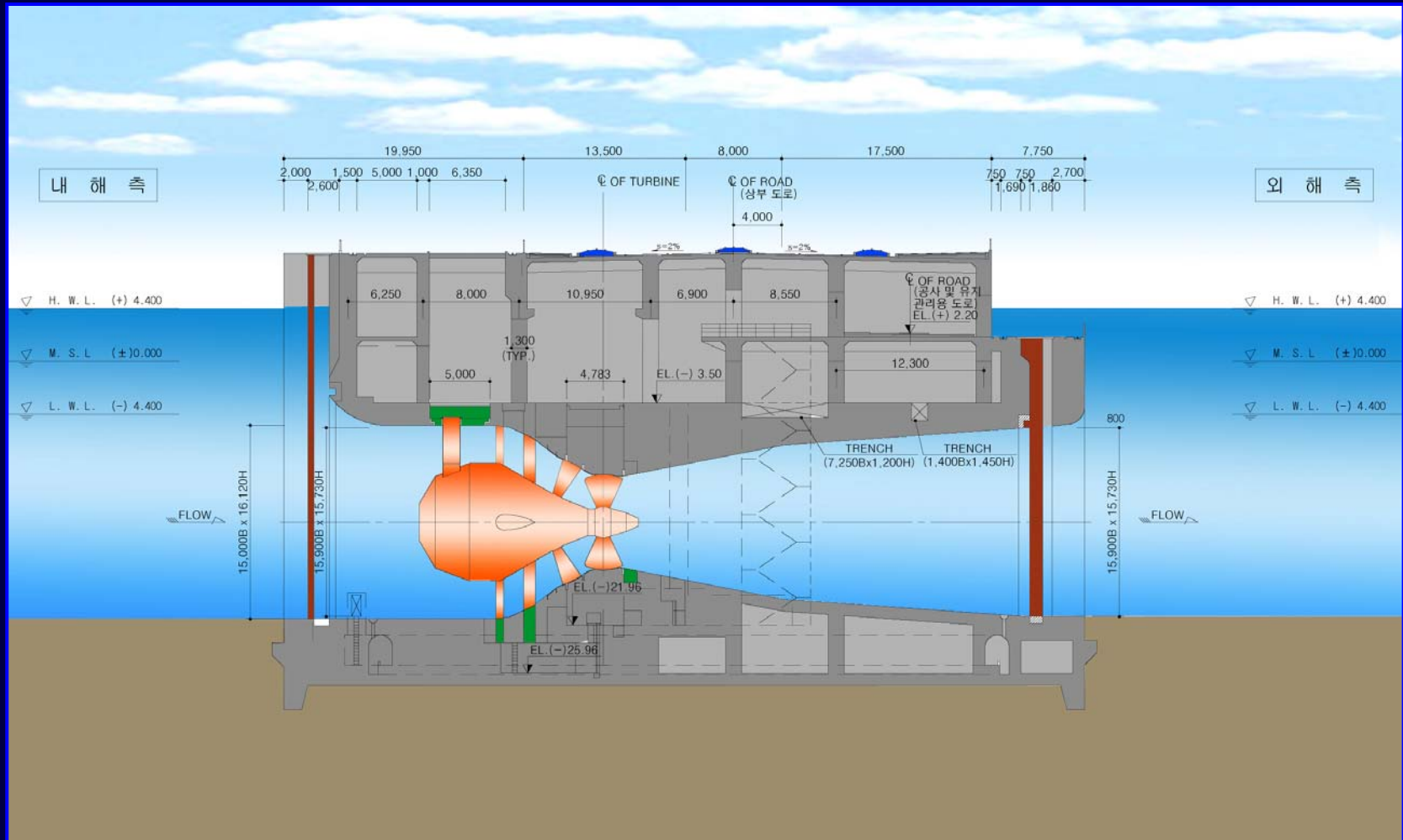


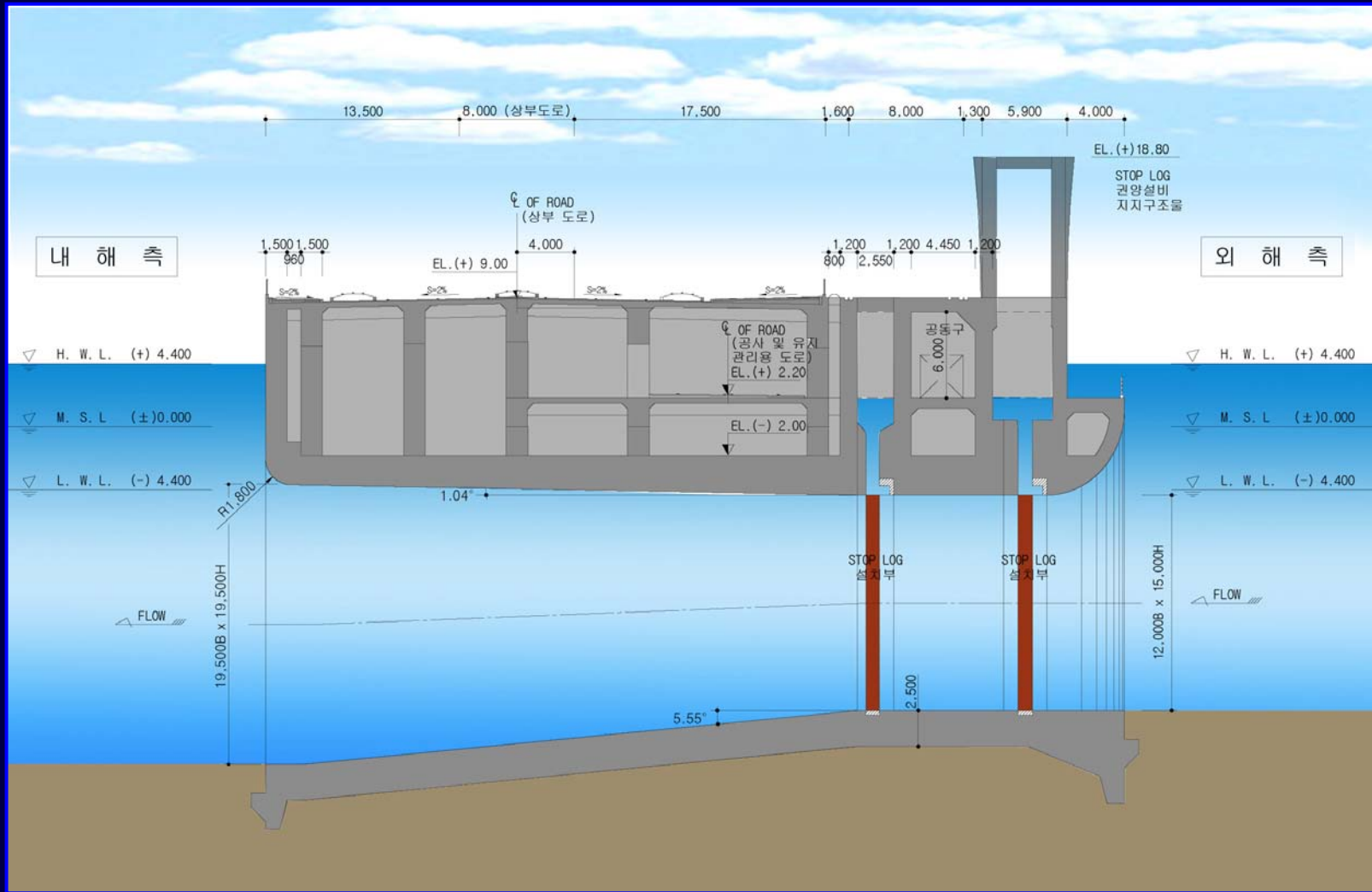
- Mean Tidal Range : 5.3m
- Spring Tidal Range : 7.3m
- Barrage Length : 20km
- Basin Area : 106km²

Landsat Satellite Image(2000.9.4)

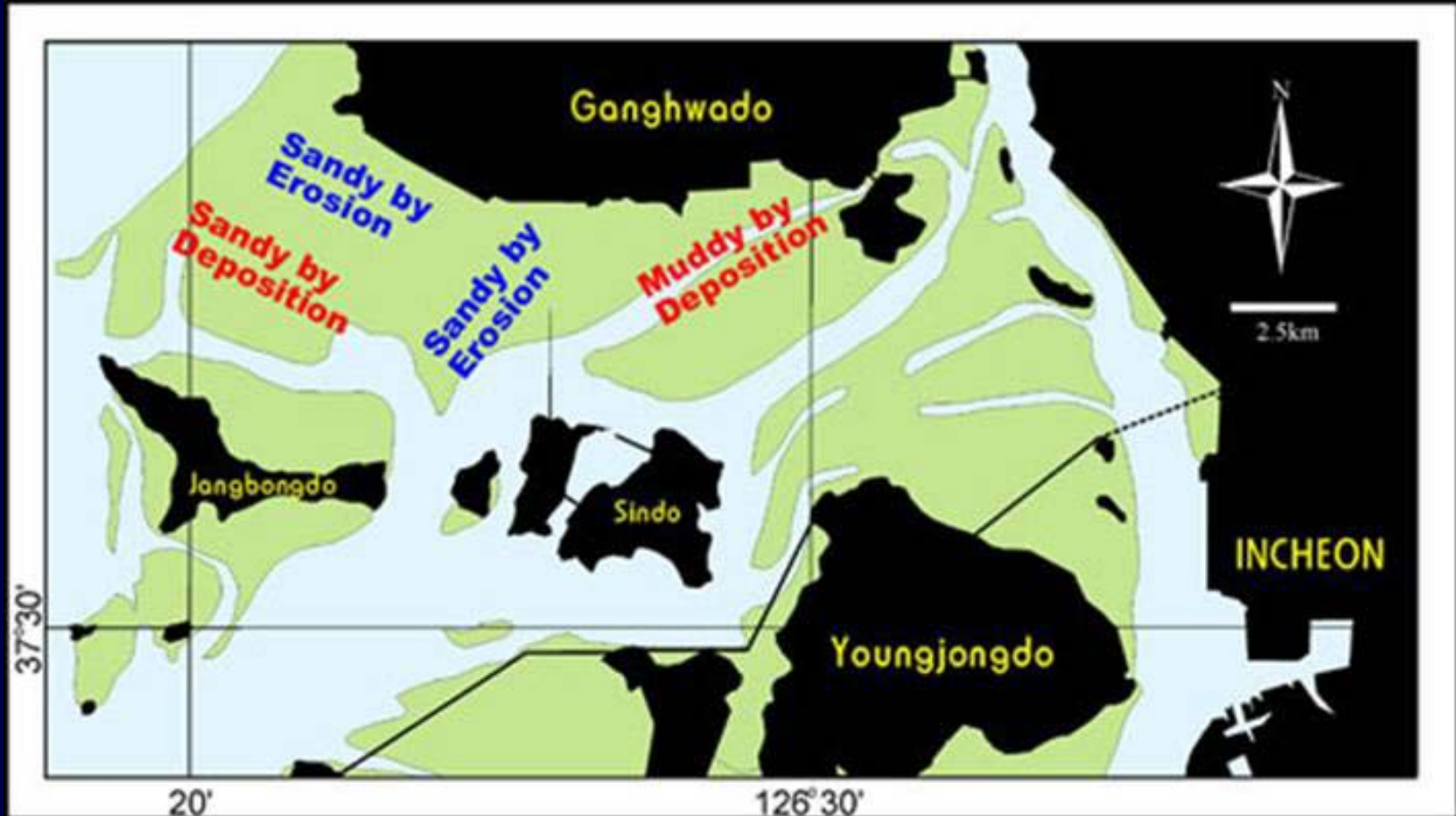






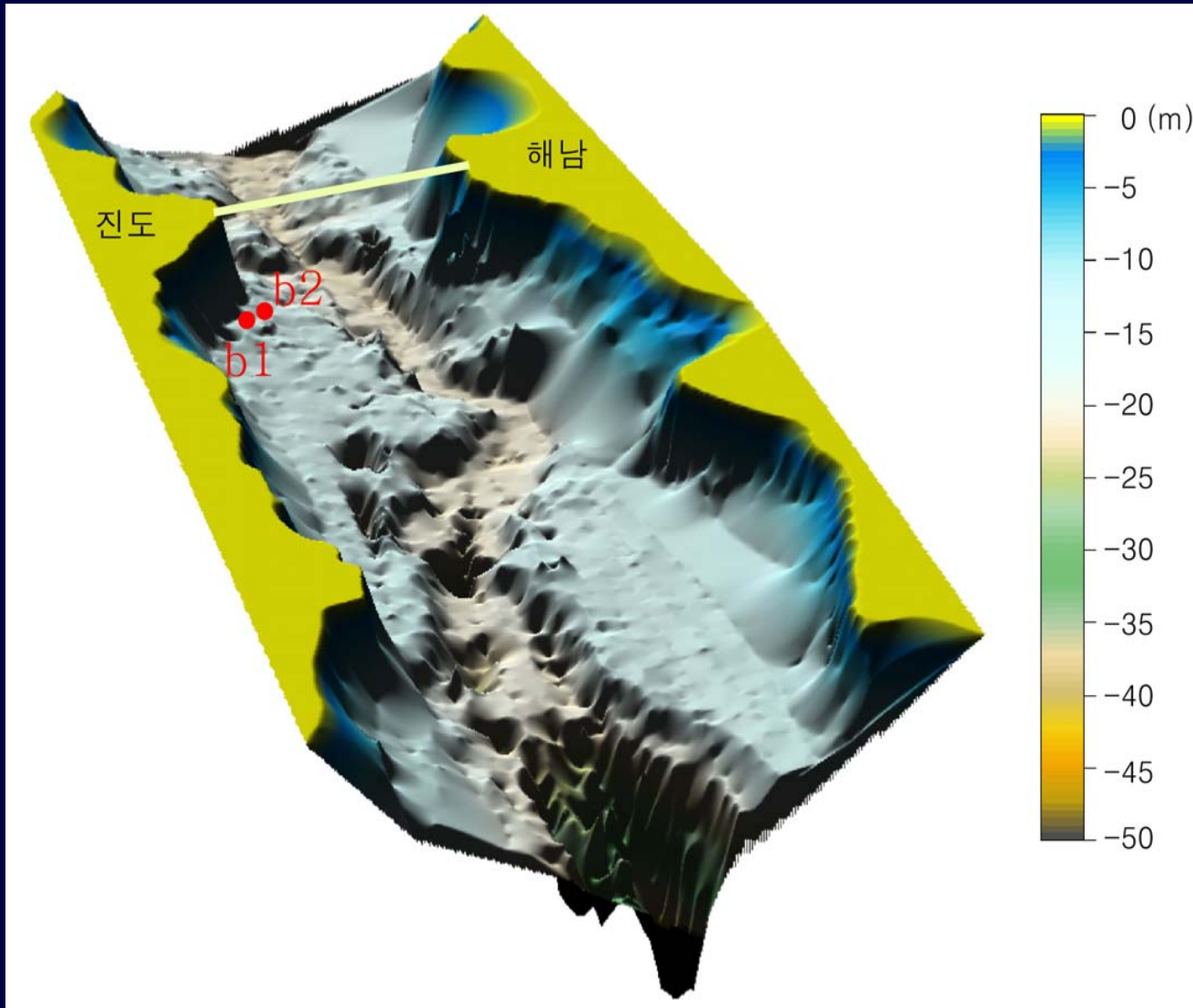


- **Generation Method : One-way during ebb tide**
- **Installed Capacity : 1,000MW (Horizontal Axial Bulb / Pit Unit with step-up Gear)**
- **Estimated Annual Output : 1,800 GWh**
- **Construction Cost : 2,500M\$ (2,500\$/kW)**
- **Detailed Design for Construction : 2008**
- **Construction will be started at 2009**
- **Completion : 2015**

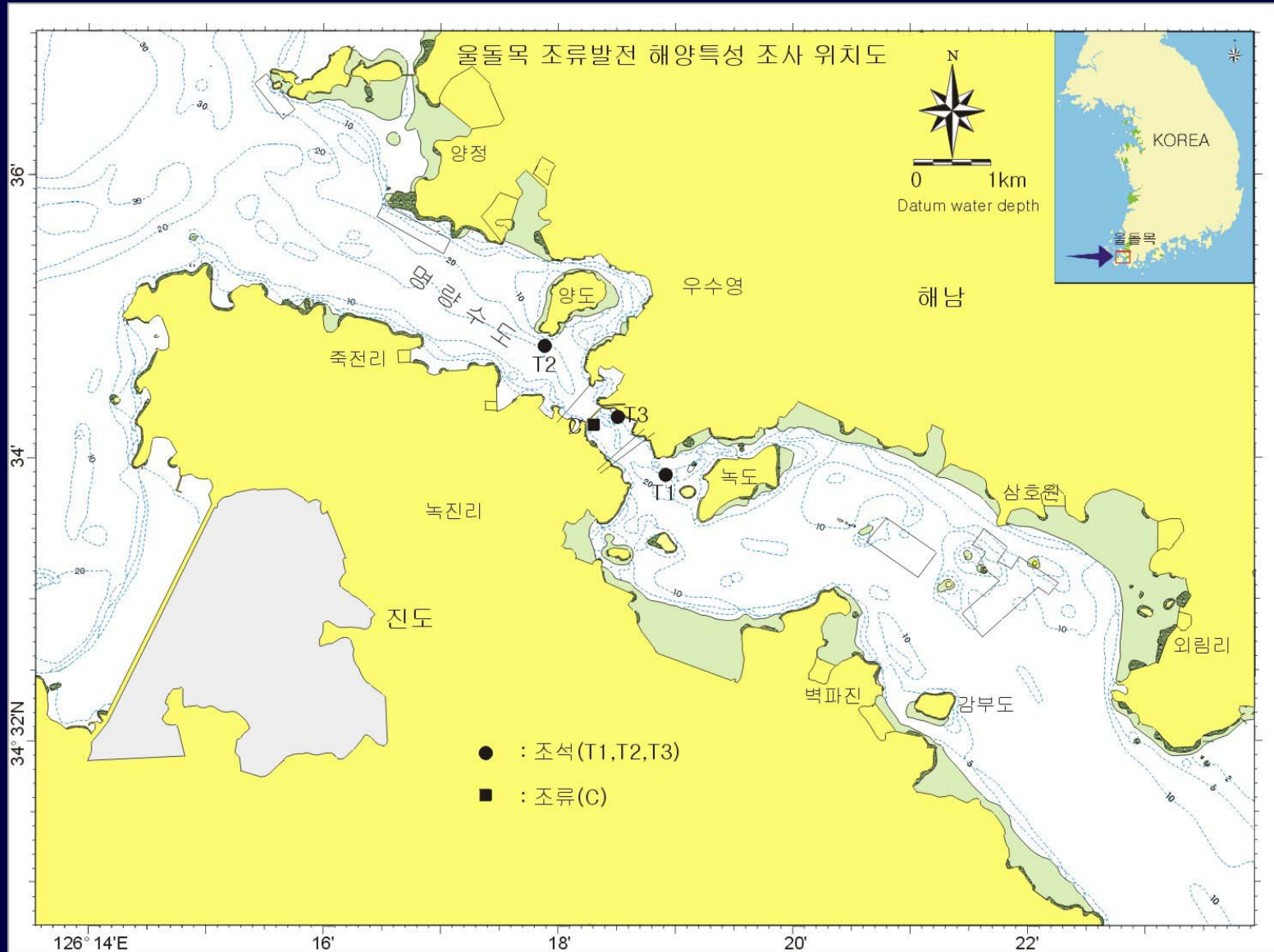


IV. Uldolmok Tidal Current Power

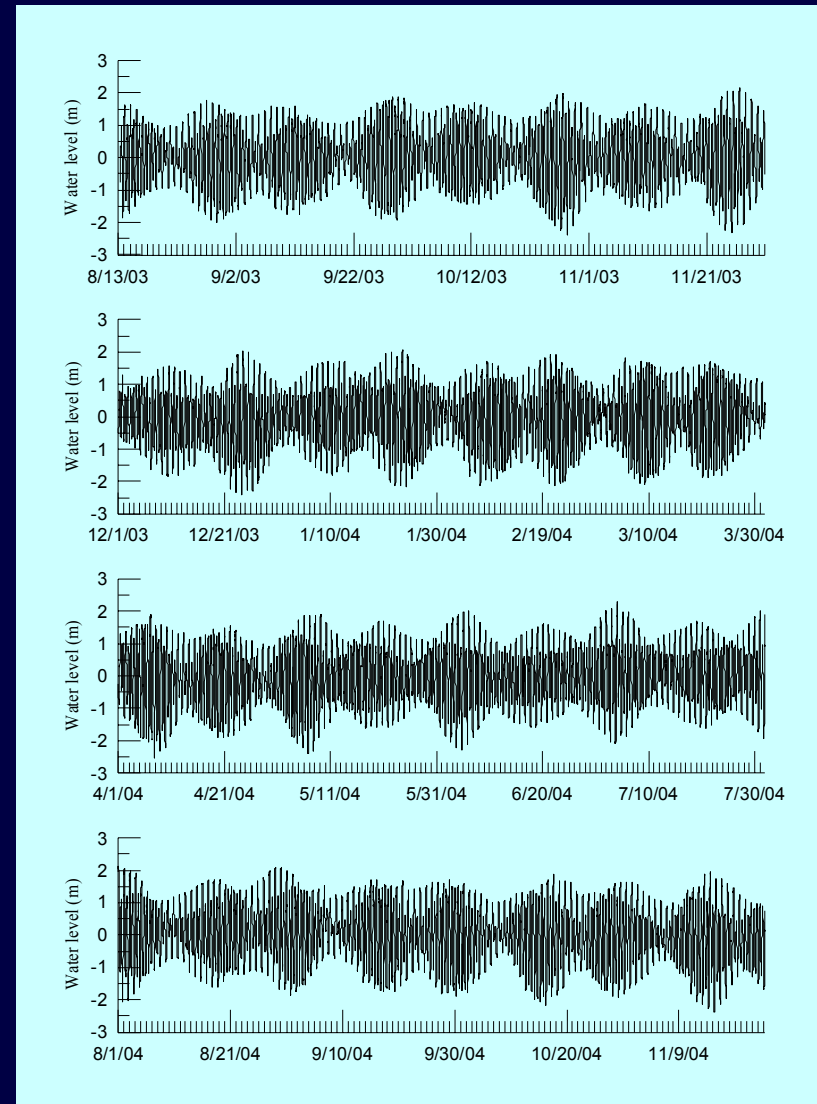


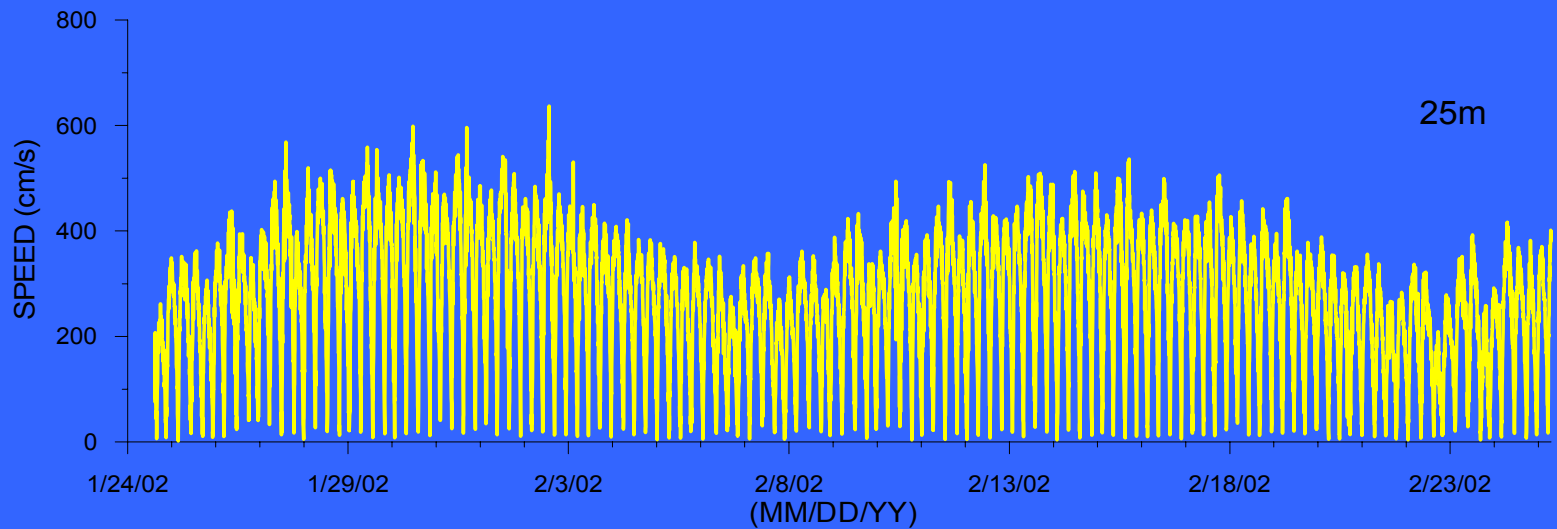
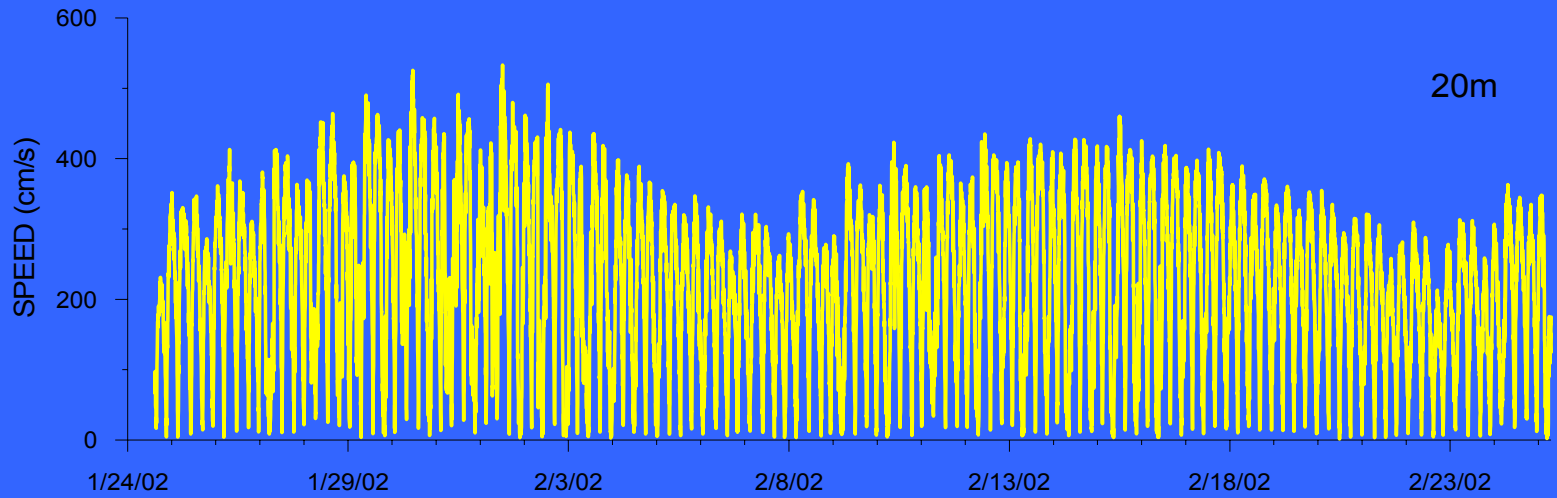


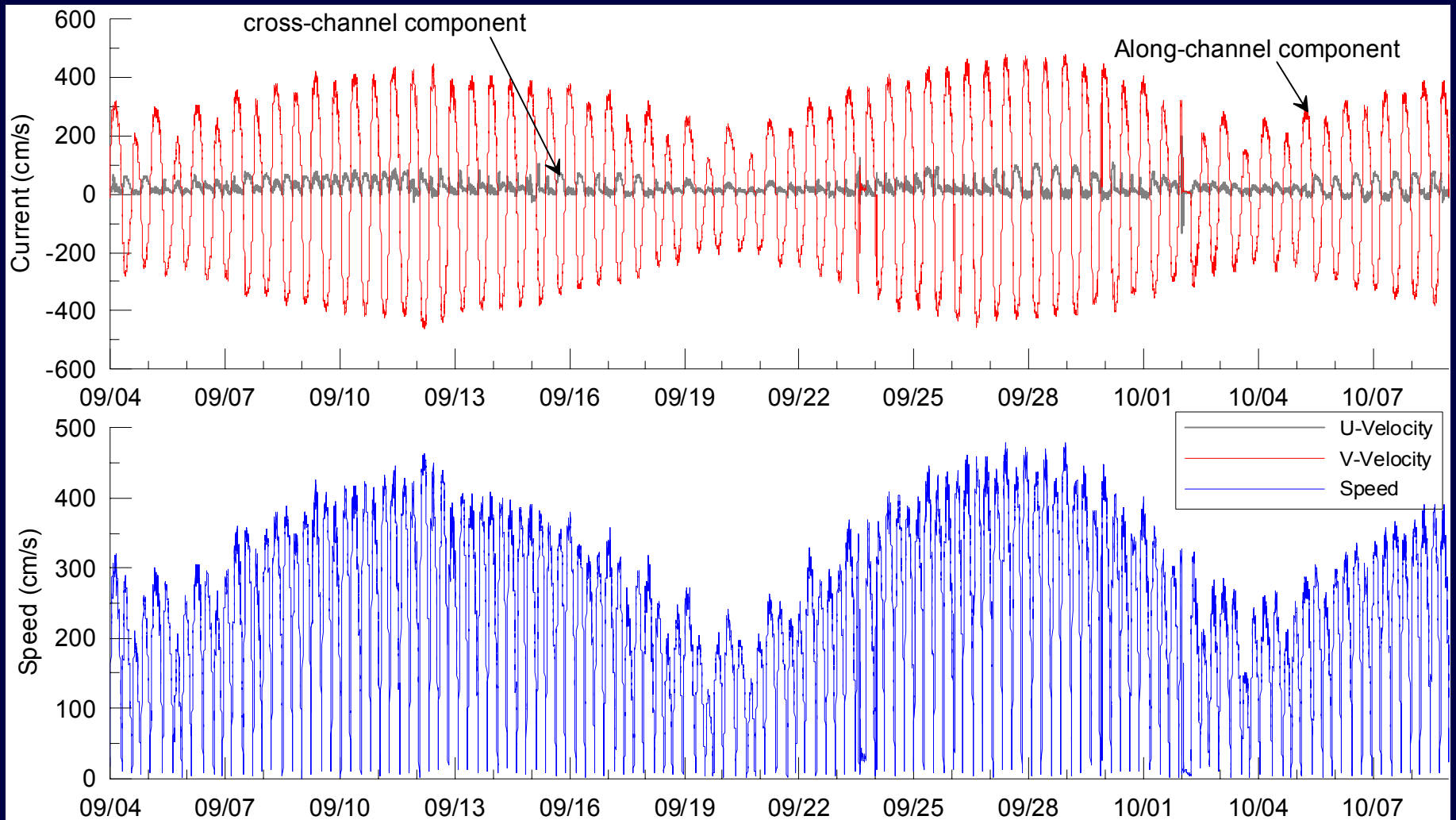
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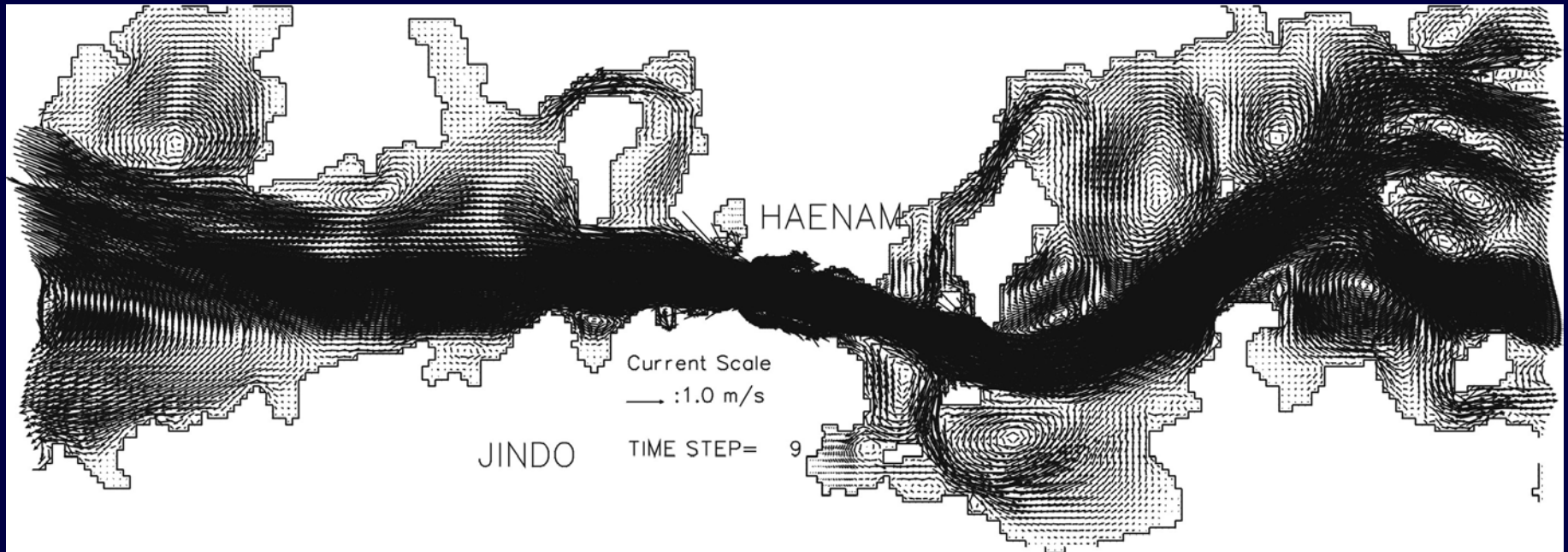
- **Why the strong current occurs ?**
 - ✓ **Tidal range over the entire channel : avg. 3m**
 - ✓ **Tidal phase difference : 100min. between both ends**
 - ✓ **Which makes 2m difference in water levels and strong current**





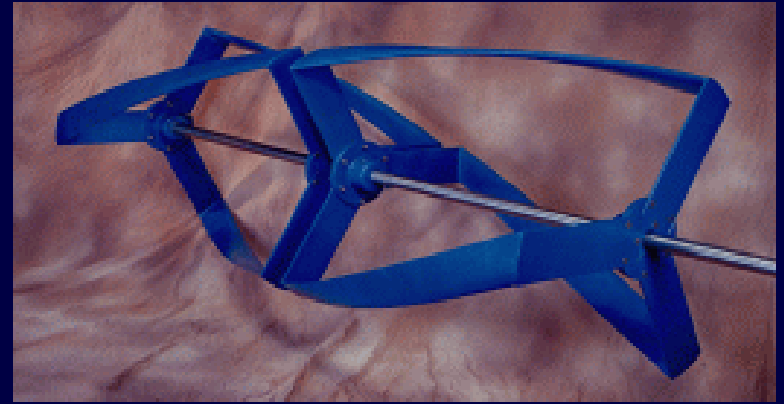
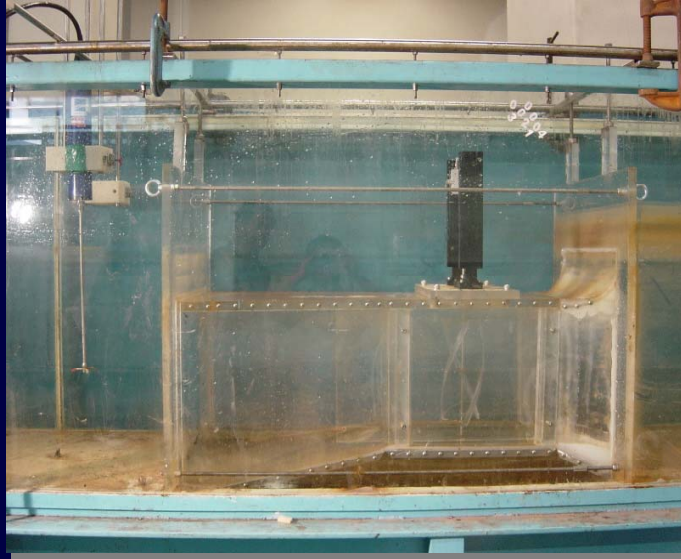


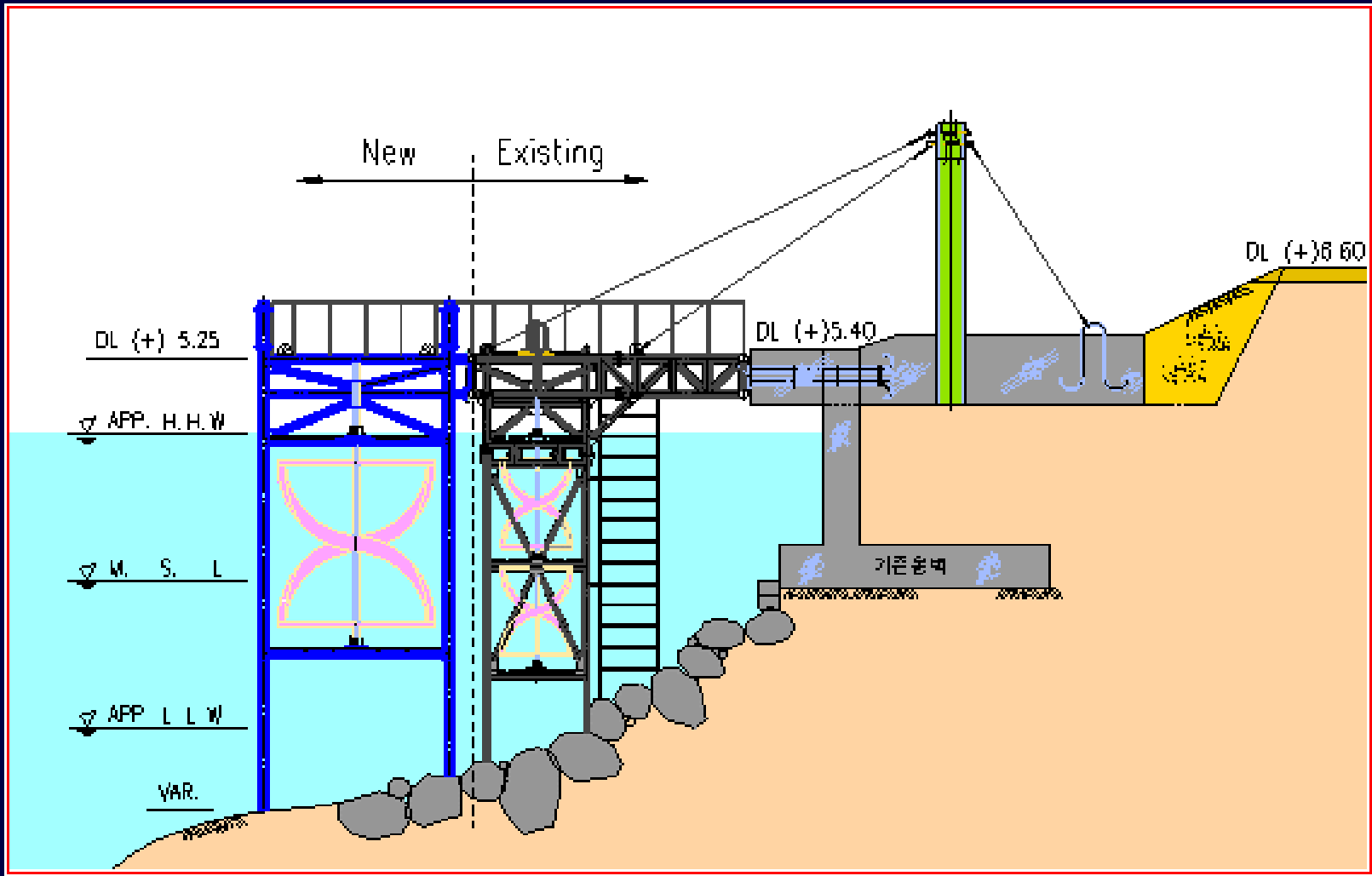
- ✓ Fine mesh modelling (min. mesh size ; 20m)



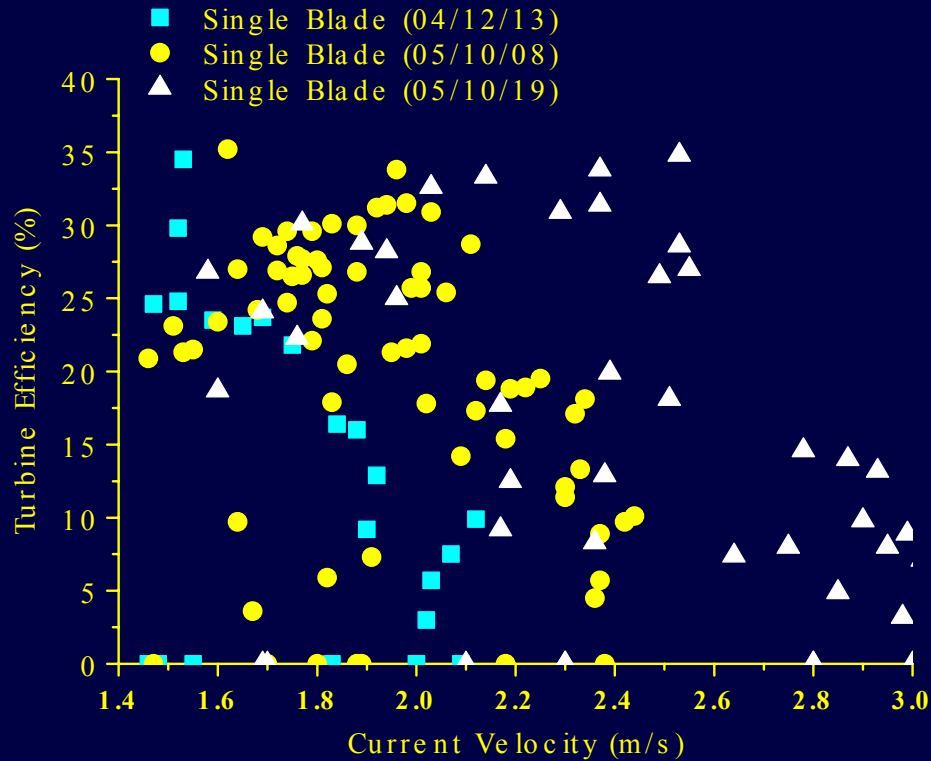
Power Generating System

➤ Triple helical turbine

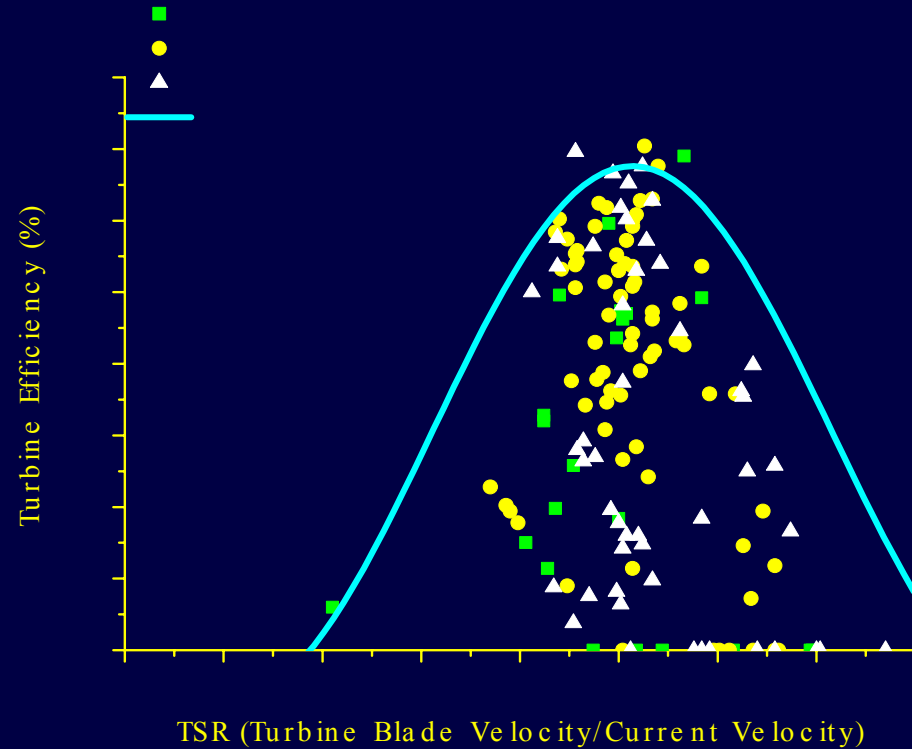




● Single Blade

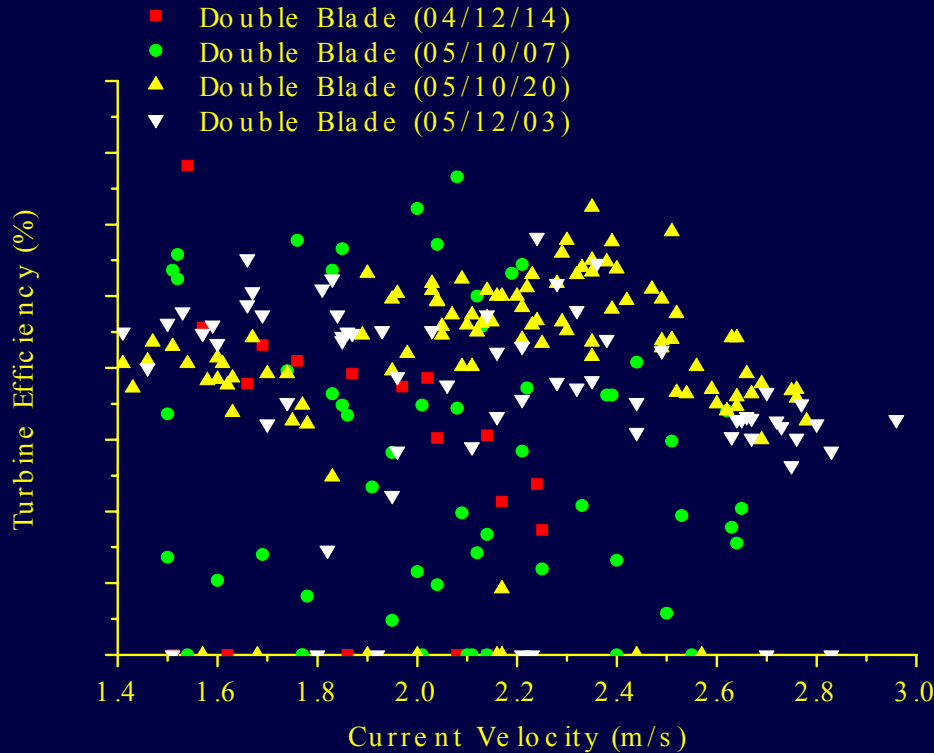


Velocity-Efficiency

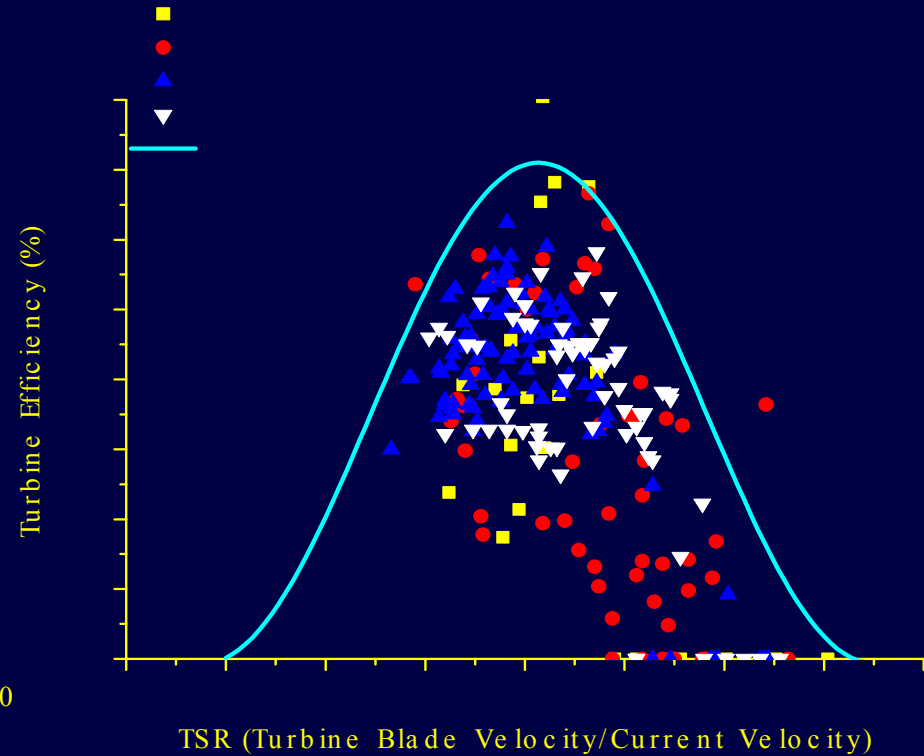


TSR-Efficiency

● Double Blade



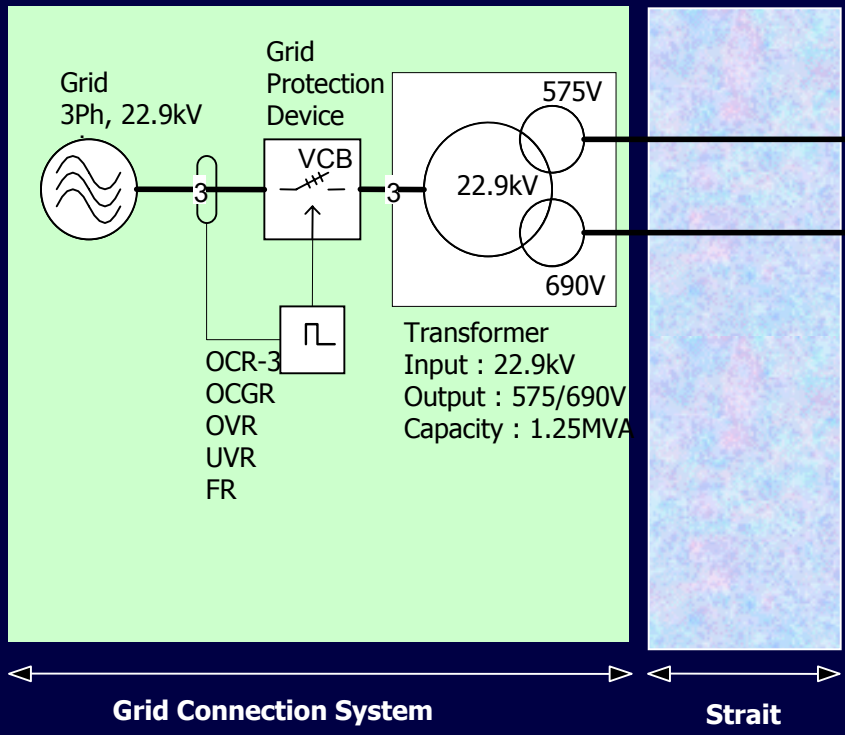
Velocity-Efficiency



TSR-Efficiency

➤ 500kW Power Converter





Electrical Power Converter for a DFIG

500kW DFIG

Helical type Turbine

Reduction Gear

Tidal current power plant with a 500kW DFIG

Electrical Power Converter for a SG

500kW SG

Helical type Turbine

Reduction Gear

Tidal current power plant with a 500kW SG

Tidal Current Power Generation System

DFIG : Doubly-fed Induction Generator, [□□□□□□□□]

SG : Synchronous Generator, [□□□□]

- **Pilot Tidal Current Power Plant is under construction**
 - ✓ **Installed capacity ; 1,000kW**
 - ✓ **Jacket type Structure**
 - ✓ **Completion in 2007**

